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Lexicon Technicum:

Or, An UNIVERSAL

English Dictionary

OF

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:

Printed for D. BROWN, J. WALTHOE, J. KNAPTON, B. and S. TOOKE, D. MIDWINTER, B. COWSE, T. WARD, E. SYMON, E. VALENTINE, and J. CLARK. MDCCXXIII.

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TO THE

RIGHT HONOURABLE

WILLIAM Lord *COWPER*,

Baron of *WINGHAM*,

AND

Lord High-Chancellor

OF

GREAT BRITAIN.

My LORD,

THE great Honour and Advantage which the former Volume of this Work receiv'd 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 the

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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.

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THE

INTRODUCTION.

THE 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 defer Printing *any thing* at all of it till the Whole was finished: 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 five Years for a *more Compleat* one. And the unprejudic'd 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 hope, the Pains I have taken, and the Time I have employed this Way, may be of some Use and Benefit 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 further 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

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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 Lymphæducts 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 shewn, that what he said in his *Preface* to his *Principia Philos. Math.* in these Words: *Multa me movent ut non nihil suspicer cætera Naturæ Phænomena, ex viribus quibusdam pendere posse, quibus Corporum particulæ, per Causas nondum cognitas, vel in se mutuo impelluntur, & secundum Figuras regulares cohærent, vel ab invicem fugantur & 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 further 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 Fluxions* 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

a short

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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, *&c.*

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 Morasses, 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 Phænomena of Prisms and the Rainbow; with a short System of Opticks from Sir *Isaac Newton*; and many Improvements in Microscopes and Telescopes; the Art of Perspective, and the Methods of Projective, Reflective and Refractive Dialling.

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

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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 fifty 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 shewn.

I have

INTRODUCTION.

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 Microſcopes, I ever ſaw.

And that I might do farther 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 Semibraccio*, 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.

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INTRODUCTION.

DE NATURA ACIDORUM.

Is. Newton. 1692.

Acidorum particulæ sunt Aqueis Crassiores, & propterea minus Volatiles, at Terrestribus multo subtiliores & propterea multo minus fixæ. Vi magna attractivâ pollent, & in hac vi consistit earum Activitas, quâ & corpora dissolvunt & Organa sensuum agitant & pungunt. Mediæ sunt Naturæ inter Aquam & Corpora, & Utraque attrahunt. Per vim suam attractivam congregantur circùm particulas corporum seu Lapideas seu Metallicas iisq; undiq; adhærent arctissimè, ut ab iisdem deinceps per Distillationem vel sublimationem vix possint separari. Attractæ vero & undique congregatæ, elevant, disjungunt & discutiunt particulas corporum ab invicem, id est corpora dissolvunt; & per vim Attractionis quâ ruunt in particulas commovent fluidum & sic calorem excitant, particulasq; nonnullas adeo discutiunt ut in Aerem convertant & sic Bullas generant. Et hæc est Ratio Dissolutionis & Fermentationis; Acidum verò attrahendo Aquam æquè ac Terram efficit ut particulæ dissolutæ promptè misceantur cum aquâ eique innatent ad modum salium. Et quem admodum Globus terræ per vim Gravitatis attrahendo aquam fortiùs quam Corpora leviora, efficit ut leviora ascendant in Aquâ, & fugiant de Terrâ. Sic particulæ Salium attrahendo Aquam fugant se mutuò & ab invicem quam maxime recedendo, per Aquam totam expanduntur.

Particulæ Salis Alkali ex Terreis & Acidis similitèr Unitis constant; sed hæ Acidæ vi maxima Attractivâ pollent ut per ignem non separentur à Sale; utq; Metalla dissoluta præcipitant attrahendo ab ipsis particulas Acidas quibus dissolvebantur.

Si particulæ Acidæ in minori proportione cum Terrestribus jungantur, hæ tam arcte retinentur à Terrestribus, ut ab iis supprimi ac occultari videantur. Neq; enim sensum jam pungunt neq; attrahunt aquam, sed corpora dulcia & quæ cum aquâ ægre miscentur, hoc est pinguia, componunt; ut fit in Mercurio dulci, Sulphure communi, Luna Cornea *& Cupro quod Mercurius Sublimatus corrosit. Ab Acidi vero sic suppressi vi attractivâ fit ut pinguia Corporibus prope Universis adhæreant & flammam facile concipiant, si modo Acidum calefactum inveniat alia Corpora in fumo accensorum quæ fortius attrahat quam propria. Sed & Acidum in Sulphureis suppressum fortius attrahendo particulas aliorum corporum (scilicet Terreas) quam proprias, Fermentationem lentam & Naturalem ciet & fovet usq; ad Putrefactionem Compositi.*

Quæ Putrefactio sita est in eo quod Acidæ Fermentationem diu foventes tandem in interstitia minima & primæ Compositionis *partes interjacentia sese insinuant, intimq; iis partibus Unitæ mixtionem 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.

Nihil est absolutè quiescens secundum partes suas & ideo frigidum, præter atomos, vacui scilicet expertes.

Terra augetur, Aquâ in eam conversâ, & omnia in aquam (vi ignis) reduci possunt.

Nitrum abit distillatione magnam partem in Spiritum Acidum, relictâ terrâ, quia Acidum Nitri attrahit Phlegma; & idcirco simul ascendunt constituuntq; 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.

Tinctura Cochinellæ cum Spiritu Vini facta in aquæ magnam molem immissa, parvâ licet dosi, totam aquam inficit: Sc. quia particulæ Cochinellæ magis attrahuntur ab aquâ quam à se mutuo.

Aqua non habet magnum vim dissolvendi quia pauco Acido gaudet. Acidum enim dicimus quod multum attrahit & attrahitur, videmus nempe ea quæ in aquâ solvuntur lente & sine Effervescentiâ solvi, at ubi est attractio fortis & particulæ menstrui undiq; attrahuntur à particulâ Metalli, vel potius particula metalli undiq; attrahitur à particulis menstrui, hæ illam arripiunt & circumsistunt, hoc est metallum corrodunt: Hæ eadem particulæ sensorio applicatæ ejus partes eodem modo divellunt doloremq; inferunt; à quo Acidæ appellantur, relictâ scilicet terrâ Subtili cui adhærebant ob majorem attractionem ad liquidum linguæ, &c.

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In omni Solutione per Menstruum particulæ solvendæ magis attrahuntur a partibus Menstrui quam à se mutuo.

In omni Fermentatione est Acidum suppressum quod coagulat præcipitando.

Oleum cum nimis magnâ mole phlegmatis intime mixtum, fit Salinum quiddam & sic Acetum constituit, hic etiam Tartari seu Terræ admistæ habenda est ratio.

Mercurius attrahitur id est corroditur ab Acidis & sicut pondere Obstructiones tollit ita vi attractrice Acida infringit.

Mercurius est Volatilis & facile elevatur calore quia ejus particulæ ultimæ Compositionis *sunt parvæ & facile separantur separatæq; sese fugant; ut fit in particulis Vaporis, fluidorumq; rarefactorum.*

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

Aurum particulas habet se mutuo trahentes; minimarum summæ vocentur primæ Compositionis, *harum summarum summæ* secundæ Compositionis, *&c.*

Potest Mercurius, potest Aqua Regia poros pervadere, qui particulas ultimæ Compositionis *interjacent at non alios.*

Si posset menstruum alios illos pervadere vel si auri partes primæ & secundæ Compositionis *possent separari fieret Aurum, vel Fluidum, vel saltem magis malleabile. Si Aurum fermentescere posset in aliud quodvis corpus posset transformari.*

Viscidítas est vel solum defectus fluiditatis, quæ sita est in partium parvitate & separabilitate (intellige partes ultimæ Compositionis) vel defectus lubricitatis seu levioris partes unius supra alias labi impediens. Hujus viscíditatis Acidum sæpe causa est; sæpe Spiritus alius lubricus terræ junctus, ut oleum Terebinthinæ capiti suo Mortuo redditum fit tenax.

Ratio cur Charta Oleo inuncta Transitum Oleo non Aquæ concedat est quia Aqua Oleo non miscetur sed fugatur ab eo.

Cum Acidæ partes, minores scilicet, aliquid dissolvunt, id faciunt, quia partem rei solvendæ includunt undiq; utpote Majorem quâlibet Acidi partium.

Some Thoughts about the NATURE *of* ACIDS; *By Sir* ISAAC NEWTON.

THE Particles of Acids are of a Size grosser 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 consists; 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 together about the Particles of Bodies, they raise, disjoin and shake them one from another; that is, they dissolve those Bodies.

By their attractive Force also, by which they rush towards the Particles of Bodies, they move the Fluid, and excite Heat; and they shake asunder some Particles, so much as to turn them into Air, and generate Bubbles: And this is the Reason of Dissolution, and all violent Fermentation; 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 dissolved Particles do readily mingle with Water, or swim or float in it, after the manner of Salts.

And as this Globe 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 consist 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 dissolv'd in *Menstrua*, by attracting from them the Acid Particles, which before had dissolved them, and kept them suspended in the *Menstruum*.

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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 Putrefaction of the Compound: Which Putrefaction 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. And if Gold could be brought once to ferment and putrify, it might be turn'd into any other Body whatsoever.

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.*

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LEXICON TECHNICUM:

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OF

Arts and Sciences.

VOL. II.

ABACUS. 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, saith 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 call'd *Mitred Abbats*; and such were exempted from the Jurisdiction of the Diocesan, having Episcopal Authority themselves within their Limits, and were also Lords of Parliament. These were sometimes call'd *Abbats Sovereign*, and *Abbats General*. The other *Abbats* were subject to the Diocesan in all Spiritual Government. There were also *Lords Priors*, which had exempt Jurisdiction, and were Lords of Parliament. Of these *Lords Abbats* and *Priors*, Sir *Edw. Coke* saith there were 29 that sat in Parliament, 27 *Abbats* and 2 *Priors*. But sometimes their Number was varied, there being but 25 *Abbats* and 2 *Priors* in a Parliament 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 such as are harsh and unpleasant, which are call'd *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, &c. as if a Man seek 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 Acquiliæ* 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 'tis objected that he is a Bastard, the Bastard must be first tried; that is call'd *Actio Prejudicalis*, because it must be first judg'd or determin'd.

ACTION

ACTION *Ancestrel*, is in opposition to Personal, being that which a Man hath by some Right descending from his Ancestors: This is either *Droiturel* or *Possessory*: See *Co.* 2 *Instit. f.* 291.

ACTOR, is sometimes used for a Proctor or Advocate in Civil Courts or Causes. *Actor dominicus* was also the Term formerly for the Lord's Bailey or Attorney. *Actor Ecclesiæ* was sometimes the Foreign Term for the Advocate or Pleading Patron of a Church. *Actor Villæ* was the Steward 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 prov'd by the *Stat.* 1 *H.* 5. *c.* 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 *Glacis* of a Place, to prevent its being surprised by the Besiegers: But of late this Work hath been disus'd, because as soon as the Enemy could drain it, it was a Trench ready made for the Advantage of the Besiegers.

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 Advocatus*, was formerly us'd for him that had Right of 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 *Advowson* or *Patronage* of it. Sometimes the Patron had the sole Nomination of the *Prelate*, *Abbot* or *Prior*, either by Investiture (or Delivery of a Pastoral Staff) or by direct Presentation to the Diocesan. And if a free Election was left to the Religious, yet a *Conge d'eslire*, or License of Election, was first to be obtain'd of the 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 such Irregularities as the Axe can't come at, and where a Plane, tho' *rank Set*, will not make riddance enough. 'Tis much us'd in taking off the Irregularities of Floors when they are pinned and framed together; and sometimes on Posts framed upright, and ranged in with other Work framed to them, where the Edge of the Axe can't come.

ÆSTUARY, is an Arm of the Sea running up a good way into the Land, like the *Bristol* Channel, *&c.*

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 Discretion*; and at 21, at full Age. At 12 Years of Age a Man may take the Oath of Allegiance at a Leet; at 14 he may consent to marry, and in *Soccage* chuse his Guardian; at 15 he is of Age for the Lord to have *Aid pur fuir fitz Chivalier*, and may be sworn to 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 *Aid 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.* 5. *c.* 22. *Lit. Lib.* 1. *c.* 5.) she is able *promereri dotem & virum sustinere*: 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 she 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 she 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 further the Design.

AIDE, in the Law, hath several Significations; sometimes 'tis the same with *Subsidy*; sometimes 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 Observations 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 Prisms 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, so 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 saith that the *Thickness* of the Air between the Glasses there, where the Rings are successively 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 $1, \frac{8}{9}, \frac{5}{6}, \frac{3}{4}, \frac{2}{3}, \frac{3}{5}, \frac{9}{16}, \frac{1}{2}$.

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 $\frac{1}{178000}$ $\frac{3}{178000}$ $\frac{5}{178000}$ $\frac{7}{178000}$ $\frac{9}{178000}$ $\frac{11}{178000}$ Parts of an Inch.

'Tis highly probable that True and Permanent Air is made by Fermentation, (saith the same 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 fix'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 rising of the Mercury in dry Weather, and by Clouds and Vapours rising into and floating in our Atmospherical 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 Cause 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 much *rarer* than in more open Spaces, and by that means not pressing so much on the Surface of the Water *within* the Tubes as *without*. And this Account Dr. *Hook* had hinted at long ago. Sir *Is*. did in his admirable *Prin. Philo. Mathem. Prop.* 23. *P.* 301. 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 solve the prodigious 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 Transf. N.* 305.) to be nearly 885 to 1.

ALARM *Post*, is the Ground appointed to each Regiment by the Quarter-Master-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 sometimes for a Spot in the Eye, and then seems to be the same with *Albugo*: But in the Plural *Albula*, signifies 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 signifies 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 insight into this wonderful and useful Art, may consult the following Authors,

Diophanti Alexandrini Arithmeticorum Lib. 6, *&c. cum Comment. C. G. Bacheti & Observationibus D. P. de Fermat. cui accessit Doctr. Analyticæ inventum novum. Tholosæ.* 1670. *Fol.*

Labyrinthus Algebræ per Joh. Jac. Ferguson. 1667, 4*to*.

Kersey's Algebra, 2 *Vol. Fol. Lond.* 1683.

Baker's Geometrical Key of Equations. *Lond.* 1681.

Tractatus de Principiis Calculi Exponentialis.

Analysis Geometrica, sive nova & vera Methodus Resolvendi tam Probl. Geometr. tam Quæst Arithmeticas pars prima, de Planis. Authore Hugo de Omerique Sanlacarense. Cadiz. 1698.

Vietæ opet Math. Lugd. Bat. 1646. *Fol.*

Jeak's Arithmetick. *Lond.* 1696.

Des Cartes Geometria cum Commentariis Schooteni. Amster. 1659.

Brancker's Algebra, by Dr. *Pell. Lond.* 1668.

Erasm. Bartholini Dioristice, seu determinatio Equationum. Haunia. 1663.

Wallisii Opera Mathematica. Oxon. 1657.
his Algebra *English. Lond.* 1685.
Comercium Epistolicum. Lond. 1653.

De Billy's Diaphantus Redivivus. Lugdu. 1670.

Wells's Arithmeticæ numerosæ & Speciosæ Elementa. Oxon. 1698.

Oughtredi Clavis Mathematica denuo Limata, Oxon. 1667.

Moor's Algebra. *Lond.* 1660.

Parsons and *Wastell's Clavis Arithmetica. Lond.* 1703.

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. Cambridge.* 1707.

ALGEBRAIC-*Curve*, in Geometry, is of such a Nature, that its *Abscissæ* or *intercepted Diameters* bear always the same Proportion to their Respective *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 Abscissa x and the Ordinate y; the Expression of the Nature of the Curve by way of Equation will be $px = yy$, where p is the *Parameter* or *Latus Rectum* of the Figure; and the Curve is the common Apollonian Parabola; and because the two *indeterminate* or *flowing* Quantities x and y, do here denote *strait Lines*; therefore the Curve is call'd an *Algebraick* or *Geometrick 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

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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 *Lancashire*; '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 Moisture cankers and corrupts the Stone, making it nitrous. In this Mine are found several Veins of Stone call'd *Doggers*, of the same Colour but not so good. Here are found those also which are commonly call'd *Snake-Stones*. For the more convenient working of the Mine which sometimes 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 save 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 Liquor will issue out of the Side of the Mine, which by the 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 ½ 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 'tis 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 last Pit being always of the fresh Mine.

This Mine thus steeped in each of the several Liquors 24 Hours, or thereabouts, is of course four Days in passing the four several Pits from 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 increaseth to five Pounds, in the third to eight Pounds, and in the last Pit which is always fresh Mine to twelve Pounds; 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 Reason.

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 poisons 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, set 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 save the Liquor which comes from the *Allum*, or wherein it shoots, which they call the *Mothers*, with this they fill ⅔ of the Boilers, and put in ⅓ 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

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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 greasy, 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 said 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 requir'd.

In the Cooler, the Liquor in temperate Weather stands 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 longer 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 Melts and Boils a little; then 'tis scooped into a great Cask, where it commonly stays 10 Days, and is then fit to take down for the Market.

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

ALMAN *Furnace* or *Almond*, as some write it, 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 six 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 forementjon'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 *Ashes*.

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 measureth 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 Assize 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, signifying 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.

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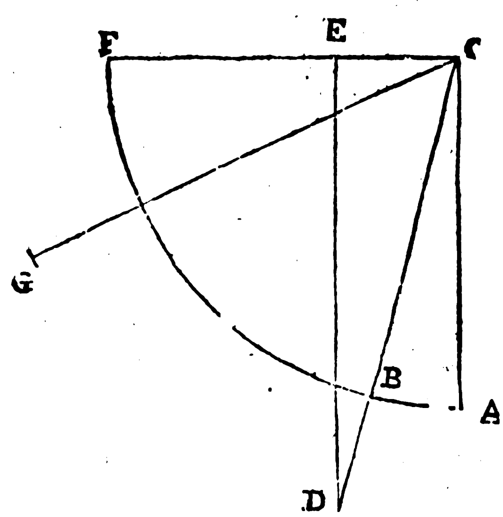
ALTITUDE of the Sun. *To find it readily at any time without a Quadrant or such like Instrument.*

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 *A F*, make *C E* equal to the Heigth of the Pin or Wire, and through *E*



draw *E D* parallel to *C A*, and make it equal to *C G* the Length of the Shadow. Then will a Ruler laid from *C* to *D*, intersect the Quadrant in *B*, and *B A* 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 *Amvabyr*, was the old Custom of the *Pretium virginitatis Domino Solvendum*. *Henry Fasted Arundel*, by Deed dated 31 *Aug.* 3, 4. of *Phil.* and *Mar.* releas'd 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*. *Bruno*.

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 *Amerciamentum* is 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 Difference between *Fines* and *Amercemenes*; *Fines* are Punishments certain and determin'd by some Statute; but *Amercements* 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 κεράμιον, 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 μετρητός. See *Weights and Measures*.

ANALEMMA, when all the whole Furniture of this kind of Projection is drawn on a large Plate of Brass or Wood; with an *Horizon* and *Cursor* 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:

I. *Having the Pole's Height and Day of the Month; to find the time of the Sun's Rising and Setting, and consequently 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 ♋ or ♑; (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 oo of ♉ and his Altitude observ'd by a Quadrant or otherwise 18 *deg.* Then since the Degrees of the Cursor denote the several Parallels of Altitude, move the Cursor till 18 *deg.* on it, will just cut the Parallel of oo ♉ 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 five in the Afternoon. 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 Ascension*, *Altitude*, *Azimuth* and *Hour*, &c. by a ready and easy Projection of part of the *Analemma*; you will find under these Words.

ANALYSIS *of Infinites*. Se *Fluxions* and *Geometry*.

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

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

Tho' the Word *Anteceffor*, whence *Anceftor* is deriv'd, is not applied to the *Anceftor* of a Family, but to the Prepoffeffor of an Eftate, or a Predeceffor in Office. *Anceftrel* Homage, is fuch Homage as hath been perform'd by our *Anceftors*.

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 *Tufcan*, *Dorick* and *Ionick Orders*; and alfo to the *Boultins* of Bed Mouldings, of the *Dorick*, *Ionick* and *Corinthian* Cornifhes. The Anchors and Eggs being placed alternately.

ANCIENT *Demefne* or *Demayn*, 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 fuch Manors were entred by the *Conqueror*, in a Book call'd *Doomfday Book*, and now remaining in the *Exchequer*; fo that fuch Lands as by that Book appear'd to have belong'd to the Crown at that Time, are call'd *Ancient Demefne*. The Tenants in *Ancient Demefne* 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 Cuftom 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 Hufbandry: Nor can they be impannell'd upon any Inqueft.

ANCONY, is the Term in the Iron Works for a *Bloom*, wrought into the Figure of a flat Iron Bar of about three Foot long, with two fquare rough Knobs, one at each End, which are afterwards to be wrought at the *Chafery*. See *Iron*.

ANGARIA, was formerly the Word for any troublefome or vexatious Duty or Service paid by the Tenant to the Lord.

ANGEL, the Name of a Gold Coin in *England*, which feems to be fo call'd from the Figure of an Angel imprefs'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. 10 *s*. and the half Angel, or as it was fometimes call'd the *Angelet*, was the Moiety of this. *Chron. Preciof.*

ANGLE *of Inclination* of the Plane of a Planet's or Comet's Orbit to that of the Eclips ick, is the Angle made by the Interfection of the Planes of thofe two Orbits. For the Orbits of the Planets are by no means all in the fame Plane, but diverfely 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 Eclip ick, 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 lefs than 2 Degrees; that of *Venus* a little more than 3°. 20'. and that of *Mercury* almoft 7°. 00'.

ANGUINEAL *Hyperbola*, is one of an Eel-like Figure, which cuts its Afymptote with contrary Flexions, and is produced both ways with contrary Legs. See *Curves*.

ANGULAR *Motion*, in Aftronomy, is the Increafe of the Diftance between any two Planets, &c. revolving round any Body as the Centre of their Motion; and is exprefs'd by two Right Lines drawn from the faid Centre to the Revolving Bodies, which will open wider, and confequently grow greater, as the Revolving Bodies part 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 Courfe of Circulation. How thefe *Secretions* are every where made in the Body, 'tis of very great Ufe to underftand; and fome of our Modern Phyficians, who have apply'd themfelves to confider the wonderful Machine of a Human Body Geometrically and Mechanically, have made great Advances this way; fuch as *Borelli*, *Bellini*, *Baglivi*, *Pitcairne*, *Cheyne*, *Wainwright*, &c. from whom you have the following Account of this important Affair.

The Nature of *Secretions* in general depends upon thefe three Things. (1.) *The different Diameter of the Orifice of the Secretory Duct*; for thereby all Particles, whofe Diameters are greater than thofe of the Ducts, muft 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 fufficiently enlarg'd, together with the Diameters of the Secretory Ducts.

(2.) *The different Angle which the Secretory Duct makes with the Trunk of the Artery*. For all Fluids prefs the Sides of the containing Veffels in a Direction perpendicular to its Sides; and this is evident in the Pulfation of the Arteries, fince 'tis to that *Preffure* that this Pulfation is owing. It is likewife evident, that the Blood is urg'd forward by the Force of the Heart; fo that this *Motion of Secretion* muft be compounded of both thefe Motions. Now this *Lateral Preffure* is greater when the Velocity of the *Longitudinal Motion* is fo too; but yet 'tis not in the Proportion of this Velocity. For the *Lateral Preffure* is confiderable, even when the Fluid is at reft; 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 Preffure* is in a Compound Proportion of both: From whence it will follow, that if two Particles of equal Diameters, but of unequal Specifick Gravity do arrive, with the fame Velocity, at an Orifice capable of admitting them, yet they will not *both* enter it and pafs, becaufe their *Motion of Direction* is different. So that this *Diverfity in the Angles*, which thefe Ducts make with the Trunk of the Artery, feems altogether neceffary to account for the poffible Diverfities of *Secerned* Fluids, even fuppofing their Diameters and Figures to be the fame: For no doubt the Blood is a *Heterogeneous* Fluid, and contains Parts of very different Specifick Gravities, Cohæfions and Denfities; whereas the feparated Fluid muft be *Homogeneous*, in order to perform the uniform Functions of Life.

(3.) *The different Velocities with which the Blood arrives at the Orifices of thefe Secretory Ducts*. For fince the Secretions are made in Form of a *Fluid*, no poffible Reafon can be affign'd, why fince Animals have a foft loofe Texture and Union of the Solid Parts, and why one Part of the Body is of a tender, loofe, eafily feparable Texture, and others of an harder, firmer, and more clofe Cohæfion; but this different *Velocity* of the Blood, at the Orifices of the *Secretory Ducts*. 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 so *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 Ducts*, 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 *stagnates*, 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 *stagnate*, 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 *slower* the Blood's Motion is, the more *Serum* will be separated from it, *cæteris 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 forc'd thro' a Concave Cylinder (and much more so thro' a Concave Cone) moves with greater Celerity at the *Axis* than at the Sides. This *Baglivi* saith, 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 separating 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 Plications in the complicated Artery.* VII. When the Motion of the Blood is too slow, the most *Serous* Part is thrown on those Arteries which are the smallest, most complicated, or at the greatest Distance from the Heart. VIII. The *Intestines* in an Animal are a *Gland*, and the *Lacteals* 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 Degrees of Cohesion and Fluidity.* X. *The Relaxed Coat of any Gland increases the Viscidity of the Secerned Matter*, vice versâ. 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 increas'd Quantity of Blood 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 Viscid*, & vice versâ. XV. *An Universal Enlargement of the Orifices of all the Glands increases the Fluid Secretions*, &c. & vice versâ. XVI. An increas'd Viscidity *of the Blood decreaseth the Fluid Secretions more than the Viscid*: *& vice versâ*, 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, *Philos. 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 Benefactors.

ANNUALIA. The Learned Author of the *Chron. Preciosum* 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 Annuity* against the *Grantor*, his Heir, or Successors.

ANNULETS in Architecture, this signifies a 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 *Cointure*, a *Supercilium*, *Liste*, *Tince*, *Square*, and *Rabit*.

ANTÆ, the same with *Antes*.

ANTIPÆGMENTS, in Architecture, are the Ornaments or Garnishings 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

 Aver-

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Averſion 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 aſcribed to an *Incongruity*: See *Congruity*.

ANTIQUE, is a Word much uſed by Architects, 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, &c.

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, 'Tis attended with a Lienteria uſually, or ſome ſuch Cœliacal Flux, by which it is diſtinguiſh'd from βυλιμία: 'Tis called ſometimes *Phagedæna*.

APPROPRIATION, is the granting a Parochial Church, or the great Tithes and better Profits, *ad Proprios 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, &c. 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 & di quarto acuto*, as the *Italians* 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 about 12 Inches. The Workmen call 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 Arches 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 *Deanery*, and exempt from the Authority of the Biſhop of *London*, and belonging to the Archbiſhop of *Canterbury*: Of 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, ſends 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. &c.

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 Act of Uniformity he is now obliged to be in Prieſt's Orders.

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 Architecture, laſt Edit. 1706. *Lond. Fol.*

Adami Boetleri Architectura curioſa nova cum multis Figuris. Norimberg.

Albert Dureri, *Architectura & Geometria*, *Paris*, 1535.

Potſi's Architecture in 2 *Vol. Fol.* in *Latin* and *Italian*, and lately done into *Engliſh*.

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

L' Architettura d' Andria Palladio. Venet. 1642. *con Fig.* This is tranſlated into *Engliſh*.

Vitruvius and *Vignola*, abridged by Mr. *Perault*.

Palladio's Architecture.

Scamozzi's, *Wotton*'s } Architecture.

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

ARCH-PRESBYTER, the ſame with *Rural Deans*.

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

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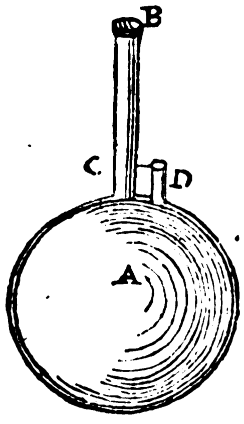
AREOMETER, besides that mention'd in *Vol.* I. Mr. *Homberg* of *Paris* hath invented a new Instrument of this Kind, which is describ'd in *Phil. Transf. N.* 262. Thus, *A* is a Glass-Bottle or Matrass with so slender a Neck, that a Drop of Water takes up in it about five or six Lines, or $\frac{6}{11}$ of 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 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* thinks. 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, *& de Numeris Multangulis lib. unus cum Commentariis G. Bocheti, & Observationibus P. P. de Fermat. cui accessit Doctrina Analytica inventum Novum. Tolosæ* 1670. *Folio.*

Moor's Arithmetick.

Parson's *and Wastall*'s Arithmetick and Algebra.

Jeak's Arithmetick in Folio.

Wel's Arithmetick in *Latin. Oxon.*

Sir *Isaac Newton*'s *Arithmetica Universalis. Cambridge.* 1607.

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

ARMINGS, in a Ship, are the same with *Wast-cloaths*, which are Red-cloaths hung about the out-sides of the Ship's upper Works fore and aft, and before the *Cubbridge* Heads; and there are some also hung round the Tops, and these are call'd *Top Armings*.

ARQUEBUSS *a Croc*, is a Sort of small Fort Arms, carries a Ball of about 3½ 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.

THESE * Figures are closely drawn after the Original Schemes, and I am apt to flatter my self 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 *Fœtus* injected 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 *Vesalius*. But first of the *Arteries*.

* *Fig.* 1*st*, 6*th*, *and* 8*th*.

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 *Fœtus* 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, as in the *Adult*.

The

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The Trunk of the *Splenick Artery* has a straight Progress in the *Fœtus* 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 *Quadrupeds* as well as *Men*, shew a constant 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. Besides 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 *Trifles*.

The principal Inducement of Nature in making use of these different Contrivances in the *Spermatick 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* descend into the *Scrotum*; which we know neverthelss 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 Bodies is *Horizontal*, and their Intestines therefore cannot press on the Processes of the *Peritonæum*, 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 inquisitive: In the mean time, I shall, at present, pursue the Thread, and describe the Extremities of the *Arteries*, with their *Communications* with the *Veins*, and afterwards produce some Instances of the Art of Nature in conveying the refluent Blood to the *Heart*.

After the *Circulation of the Blood* through the Heart, Lungs, and large Blood Vessels, was demonstrated by Dr. *Harvey*, it was only guess'd how the Extremities of the *Arteries* transmitted the Blood to the *Veins*, till Mr. *Lewenhoeck*'s *Microscopes* had discovered the Continuation of the Extremities of those Vessels in *Fish*, *Frogs*, &c. which is now commonly shewn by *Microscopes* made by other *Hands*: Yet there are not wanting *those*, who doubt of the like Continuations of the Extremities of *Arteries* and *Veins* in *human Bodies* and *Quadrupeds*; since those *Animals* it has hitherto been seen in (to any Satisfaction, as Mr. *Lewenhoeck* confesses) have been either such *Fish*, or of the *Amphibious Kind*, that have but *one Ventricle* 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 Course.

This Difference in the principal Organs of the *Circulation 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 intimate 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 soon 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. After 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 Dog, that was not large; in whose *Omentum* we saw it very well; but by the Assistance 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* so small, as that but one Globule could pass, and that very slowly before the other. In young *Fish*, particularly in Grigs, I have frequently observ'd a *Communicant Branch*, so very small as that one Globule of Blood only has pass'd it in two or three Seconds of a Minute: At other times I have found considerable Intervals in passing

ſing 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 freely as in the *Spleen*.

On viewing the Extremities of the *Pulmonick* Blood-Veſſels in a living Frog with my *Microſcope*, 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 beſides, 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 aſſures us, that in Bruiſes when the Blood is extravaſated, 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 *Meſentery* of a Dog when living, in which I had before ſeen the Blood paſſing 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*, cut 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 ſee the ſtagnant Blood diffuſed in the Interſtices of the Blood Veſſels, and between the Membranes of the *Meſentery*: Hence it's evident, 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, ſo 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 aſſiſt 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 *Bulbous* 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 contriv'd 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 refluent Blood from the *Teſtes* is a *Pondus* to the influent Blood from the *Arteries*, and ſtill leſſens its current in the *Teſtes*, theſe Spermatick Veins, like *thoſe* of other Parts, might have diſcharged their Blood into the next adjacent Trunk.

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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 Body 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 sent 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 *sine pari*, is contriv'd to convey the Blood sent to the Muscles of the Back and *Thorax* 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.

FIG. 1.

Represents the Trunks and large Branches of the *Arteries*, dissected from an *Adult Human Body*, when displayed and dried; as they are now to be seen in the *Repository* of the *Royal Society*.

1. The Trunk of the *Aorta* cut from the *Basis* of the Heart.

2. That Part of it, whence the Coronary Artery of the Heart does arise.

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

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

5. The left *Carotid Artery* (in this Subject it seems) arising from a common Trunk with the right *Carotid* 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 *Acta 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 adjacent.

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 prick'd in letting Blood, and makes an *Aneurisma*, 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 *Aneurisma* 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 sufficient, 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, receiv'd a Wound near the middle of the *Cubit* in which the *Trunk* of the *Artery* (mark'd in the Fig. †) was divided. The *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 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 elapsed 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 Effusion 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 expeditiously 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 flow'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 Arteries 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 *Pulsation* continued, tho' much abated. I then discovered another Trunk of the *Artery*, arising from the lower Part of the *Tumour*, on which also I made another Ligature, and the Pulsation was then taken off. However, on cutting off the Surface of the *Cystis* or dilated *Artery*, and clearing it of the coagulated Blood, which was soon 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 *Carpus*.

17. The Arteries of the Hand and Fingers.

18. The Mammary Artery.

19. 19. The descending Trunk of the *Arteria magna*.

20. 20. The Intercostal Arteries.

21. The *Arteria Cœliaca*.

22. The *Arteria Hepatica*.

23. The Trunk of the *Arteria Splenica*.

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*.

34. The internal Iliack Branch.

35. The external———

36. The Epigastrick Artery.

37. Branches of the external Iliack Artery, passing to the oblique Muscles of the *Abdomen*.

38. 38. The Arteries that pass to the Muscles of the Thigh and *Tibia*.

39. 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 Leg.

43. The Arteries of the Foot and Toes.

FIG. 2.

THE Trunks and some of the Ramications of the Arteries of an adult human Body fill'd with Wax, to shew the Variety in Nature, 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 Magna*.

D. D. The internal Mammary Arteries.

2. The Trunk of the Coronary, cut off.

3. The *Ligamentum Arteriosum*. Which in the *Fœtus* is the *Canalis Arteriosus*, and conveys Blood from the Pulmonick 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

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Parts of the Face, Tongue, adjacent Muscles and Glands.

8. 8. 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*, &c.

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 *Sinus'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 Quadrupeds than in human Bodies.

15. 15. The Contortions of the Vertebral Arteries, where we find their Trunks considerably 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 Arteries of the Brain displayed.

FIG. 3.

I 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 *Distich*, which I find written on the *Original Table* of this Scheme of the *Arteries*.

Pulsificus Sanguis de Cordis Ventre sinistro.
Funditur ut Corpus nutriat hisce 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 sixty 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 Convulsions 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 stronger and quicker: That Part of the Foot next the Toes became tumid and inflam'd, the Tumour extending it self above the *Maleoli*: a sinuous Ulcer passed by the Side of one of the *Metatarsal* *Bones*; the Extremity of which Bone (whence the Toe was taken off) lying bare. In this Condition I found the left Foot and Leg of this *Gentleman*, when I had the Honour to wait on him, by Command 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. *Coldwyer* 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 six 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 pursued 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* did 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 *Bore* was *contracted* 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 *Vein* for the *Artery*, and that the Valves opposed the passing of the Probe that Way: but on further Dissection 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 *Salisbury*, 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 shew its Canal.

C. That Part of the Trunk of the Artery which was so contracted by the Putrefaction or Ossification, 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 Ossifications 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, &c. The Branches arising from the Trunk of the Artery.

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

H. The Sides 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 *Ossifications* in the Coats of *Arteries* have been frequently observ'd, especially in their large Trunks within the Cavities of the *Thorax* and *Abdomen*; but I don't remember the like has been ta-

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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 fatal. 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 six Weeks after the Amputation, as did the Parts about the Hips, which were compress'd in lying or sitting before he expired.

FIG. 4.

REpresents 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 associate, C C their lesser Branches where they pass from each other, and are united at their Extremities.

FIG. 5.

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

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

FIG. 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 appears 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 Duct* enters it, and discharges it self of its *Chyle* and *Lympha*.

b, 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 *Mediastinum*.

g, g, The Veins of the Thyroid Glands.

h, The *Vena Sacra*.

i, The internal Iliack Branch.

k, The external———

K, K, The occiputal Veins.

L, 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.

R, The right Phrenick Vein.

r, A large Vein from the left *Glandula Renalis* and Parts adjacent.

S, The left emulgent Vein.

T, The right emulgent, in this Subject very much lower than the left, which is not usual.

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 descending 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 Vein.

y, A Vein which brings Blood from the Muscles 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 dissected 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*.

FIG. 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 *Falx*, &c.

A, The Extremity of the *Falx* cut from the *Crista Galli*.

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

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the Brain from the left; where the fifth *Sinus* 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 *Cerebellum* from being press'd by those Parts of the *Cerebrum*.

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 *Sinus*.

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 Jaw and Parts adjacent.

FIG. 8.

THE 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.

a, 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 Stomach of the right Side, and

F, The same Coronary Vein of the left 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*.

d, The *Vena duodeni*.

H, The *Vena Hæmorrhoidalis* arising from the *Rectum* and *Anus*, 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 *Hæmorrhoid* Veins ending in the *Ramus Splenicus*.

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 *Intestinum Rectum* and *Anus*, become distended with Blood, and cause the *Hæmorrhoides Cæca* and *Aperta*; *which* are frequently attended with *Apostumations* in the *Anus* and Parts adjacent; which Disorders are the more incident, not only because these Hæmorrhoid Veins (like the rest of the Branches 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 exposed 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 afflicted with the *Hæmorrhoids* at that *time*, than at any other. Nor are the *Iliack* 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 Abdominal Teguments were vastly 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) *Synarthrosis* or Co-articulation, which is a much closer Juncture, and where there is no such natural apparent Motion of one Joint on the other. (3) *Ginglymus*, where each Bone receives into its *Sinus* the *Processus* of the other; as in the Articulation of the *Ulna*, *Tibia*, *Humerus*, &c. *Ossa Femorum*.

ARYTÆNOIDÆUS *Minor*, is a Muscle which runs on the Surface of the *Arytænoidus Major*, arising from that Part of one of the *Cartilagines Arytænidei*, next the *Cricoides* on one Side, and terminating in that Part of the other *Arytænoideal 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 Quarry.

ASPECT *Double*, is a Term in painting, us'd for a single Figure representing two or more different Objects; which is caused either by a Change of the Position of the Eye, or by angular Glasses, &c.

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 solemn Trial by a Jury of 12 or more Knights, to give their Verdict in a Cause prosecuted *per Breve de Recto*; i. e. where the Dispute lies not about the bare Possession, but of the *Right* and *Property*; in this distinguished from the *Assisa 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 or 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

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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 Frisius*; which supposes the Eye in the Point of the Interjection of the Equator and Horizon, projecting the Sphere on the Plane of the opposite Meridian.

ASTRONOMICAL *Hours*, are such as are accounted from the Noon of one natural Day, or as some will have it from Midnight, to the Noon or Midnight of the next natural Day.

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1

The former Equation of apparent Time.

Substract from the apparent Time, if it be the Sun's mean Anamoly.

Sign.	0 '	0 "	1 '	1 "	2 '	2 "	3 '	3 "	4 '	4 "	5 '	5 "	
0	0	00	3	46	6	34	7	43	6	42	3	54	30
1	0	08	3	53	6	38	7	40	6	38	3	47	29
2	0	16	3	59	6	42	7	40	6	34	3	40	28
3	0	23	4	06	6	46	7	40	6	30	3	33	27
4	0	31	4	13	6	49	7	39	6	26	3	25	26
5	0	39	4	19	6	53	7	39	6	21	3	18	25
6	0	47	4	26	6	57	7	38	6	17	3	11	24
7	0	55	4	32	7	00	7	38	6	12	3	03	23
8	1	03	4	38	7	03	7	37	6	07	2	56	22
9	1	10	4	45	7	06	7	36	6	02	2	48	21
10	1	18	4	51	7	09	7	34	5	57	2	40	20
11	1	26	4	57	7	12	7	33	5	52	2	33	19
12	1	34	5	03	7	1	7	32	5	46	2	25	18
13	1	41	5	09	7	1	7	30	5	41	2	17	17
14	1	49	5	15	7	19	7	28	5	36	2	09	16
15	1	57	5	20	7	22	7	26	5	30	2	01	15
16	2	04	5	26	7	24	7	24	5	24	1	53	14
17	2	12	5	32	7	26	7	22	5	18	1	45	13
18	2	19	5	37	7	28	7	20	5	12	1	37	12
19	2	27	5	42	7	30	7	18	5	06	1	29	11
20	2	34	5	48	7	31	7	15	5	00	1	21	10
21	2	42	5	53	7	33	7	12	4	54	1	13	9
22	2	49	5	58	7	34	7	10	4	48	1	05	8
23	2	56	6	03	7	35	7	07	4	41	0	57	7
24	3	03	6	07	7	36	7	04	4	35	0	49	6
25	3	11	6	12	7	37	7	00	4	28	0	41	5
26	3	18	6	17	7	38	6	57	4	22	0	33	4
27	3	25	6	21	7	39	6	54	4	15	0	24	3
28	3	32	6	26	7	40	6	50	4	08	0	16	2
29	3	39	6	30	7	40	6	46	4	01	0	08	1
30	3	46	6	34	7	40	6	42	3	54	0	00	0
	11		10		9		8		7		6		

Add to the apparent Time, if it be the Sun's mean Anamoly.

2

The latter Equation of the apparent Time.

Substract from the apparent Time, if it be the Sun's Place.

	♈ ♎ '	♈ ♎ "	♉ ♏ '	♉ ♏ "	♊ ♐ '	♊ ♐ "	
0	0	00	8	24	8	46	30
1	0	20	8	35	8	36	29
2	0	40	8	45	8	25	28
3	1	00	8	54	8	14	27
4	1	19	9	03	8	01	26
5	1	39	9	11	7	49	25
6	1	59	9	18	7	35	24
7	2	18	9	25	7	21	23
8	2	37	9	31	7	05	22
9	2	57	9	36	6	51	21
10	3	16	9	41	6	35	20
11	3	34	9	45	6	19	19
12	3	53	9	49	6	02	18
13	4	11	9	51	5	45	17
14	4	29	9	53	5	27	16
15	4	47	9	55	5	09	15
16	5	04	9	55	4	50	14
17	5	21	9	55	4	31	13
18	5	38	9	54	4	12	12
19	5	54	9	52	3	52	11
20	6	10	9	50	3	32	10
21	6	26	9	47	3	12	9
22	6	41	9	43	2	51	8
23	6	55	9	38	2	30	7
24	7	10	9	33	2	09	6
25	7	23	9	27	1	48	5
26	7	36	9	20	1	27	4
27	7	49	9	13	1	05	3
28	8	01	9	05	0	43	2
29	8	13	8	56	0	22	1
30	8	24	8	46	0	00	0
	♓	♍	♎	♌	♑	♋	

Add to the apparent Time, if it be the Sun's Place.

A Table

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A Table of the Equation of Days made from the two preceding ones.

G.	♈ S ′	″	♉ A ′	″	♊ A ′	″	♋ S ′	″	♌ S ′	″	♍ S ′	″
0	7	45	1	11	4	3	0	59	5	43	2	8
1	7	26	1	24	4	0	1	15	5	45	1	53
2	7	7	1	37	3	56	1	29	5	46	1	37
3	6	48	1	49	3	51	1	42	5	47	1	21
4	6	29	2	1	3	45	1	54	5	48	1	5
5	6	10	2	12	3	39	2	6	5	48	0	48
6	5	51	2	23	3	32	2	19	5	48	0	30
7	5	31	2	33	3	25	2	32	5	46	0	12
8	5	11	2	43	3	17	2	44	5	44	0 A	7
9	4	51	2	53	3	9	2	56	5	40	0	26
10	4	31	3	3	3	0	3	8	5	36	0	45
11	4	11	3	13	2	51	3	20	5	31	1	3
12	3	52	3	22	2	41	3	32	5	25	1	21
13	3	33	3	30	2	31	3	43	5	19	1	40
14	3	14	3	37	2	21	3	54	5	13	1	59
15	2	55	3	43	2	10	4	4	5	6	2	19
16	2	37	3	48	2	0	4	14	4	58	2	40
17	2	19	3	53	1	49	4	24	4	49	3	1
18	2	1	3	57	1	37	4	34	4	39	3	22
19	1	43	4	1	1	25	4	43	4	30	3	44
20	1	26	4	5	1	13	4	51	4	20	4	6
21	1	9	4	8	1	1	4	59	4	9	4	29
22	0	52	4	10	0	49	5	6	3	57	4	51
23	0	35	4	12	0	37	5	13	3	45	5	13
24	0	19	4	13	0	24	5	19	3	32	5	35
25	0	3	4	11	0	10	5	24	3	19	5	57
26	0 A	12	4	9	0 S	3	5	29	3	5	6	19
27	0	27	4	8	0	16	5	33	2	51	6	41
28	0	42	4	6	0	29	5	37	2	37	7	2
29	0	57	4	5	0	44	5	40	2	23	7	23
30	1	11	4	3	0	59	5	43	2	8	7	44

A Table of the Equation of Days made from the two preceding ones.

G.	♎ A ′	″	♏ A ′	″	♐ A ′	″	♑ A ′	″	♒ S ′	″	♓ S ′	″
0	7	44	15	34	13	25	0	59	11	48	14	36
1	8	5	15	42	13	7	0	27	12	4	14	29
2	8	25	15	48	12	48	0 S	5	12	19	14	21
3	8	45	15	53	12	29	0	35	12	35	14	13
4	9	5	15	57	12	10	1	4	12	50	14	4
5	9	25	16	1	11	50	1	33	13	5	13	55
6	9	44	16	5	11	30	2	3	13	19	13	46
7	10	3	16	7	11	10	2	32	13	32	13	37
8	10	22	16	8	10	49	3	1	13	44	13	27
9	10	41	16	9	10	28	3	29	13	55	13	17
10	11	0	16	9	10	6	3	57	14	5	13	7
11	11	19	16	9	9	42	4	25	14	14	12	56
12	11	38	16	8	9	17	4	53	14	22	12	44
13	11	57	16	7	8	51	5	20	14	29	12	32
14	12	15	16	5	8	25	5	48	14	35	12	19
15	12	33	16	1	7	58	6	15	14	40	12	6
16	12	50	15	56	7	31	6	42	14	45	11	52
17	13	7	15	50	7	5	7	9	14	50	11	37
18	13	22	15	44	6	38	7	34	14	54	11	21
19	13	36	15	37	6	12	7	58	14	56	11	4
20	13	49	15	30	5	45	8	21	14	58	10	46
21	14	2	15	22	5	19	8	45	14	59	10	28
22	14	14	15	13	4	52	9	8	15	0	10	10
23	14	26	15	3	4	26	9	31	15	0	9	52
24	14	37	14	52	3	58	9	53	15	0	9	34
25	14	47	14	40	3	30	10	13	14	58	9	16
26	14	57	14	27	3	1	10	32	14	55	8	58
27	15	7	14	13	2	31	10	51	14	51	8	40
28	15	16	13	58	2	1	11	10	14	47	8	22
29	15	25	13	42	1	30	11	29	14	42	8	4
30	15	34	13	25	0	59	11	48	14	36	7	45

A Table

4

A Table of the Earth's mean Motions; of the Place of its Perihelion, and of the Preceſſion of the Equinoxes from the firſt Star in *Aries*.

Years from Chriſt	*The Earth's mean Motion from the Vernal Equinox.*				*The Motion of the Earth's Perihelion from the Vernal Equinox.*			
	s	°	′	″	s	°	′	″
1	9	07	53	3	2	14	3	30
1501	9	19	13	9	3	4	53	30
1581	9	19	49	26	3	6	0	10
1601	9	19	58	30	3	6	16	50
1621	9	20	07	34	3	6	33	30
1641	9	20	16	38	3	6	50	10
1661	9	20	25	42	3	7	6	50
1681	9	20	34	46	3	7	23	30
1701	9	20	43	50	3	7	40	10
1721	9	20	52	54	3	7	56	50
1741	9	21	01	58	3	8	13	30
1761	9	21	11	2	3	8	30	10
1781	9	21	20	6	3	8	46	50
1801	9	21	29	11	3	9	3	30

A Table of the Earth's mean Motion, and of the Motion of its Perihelion, and of the Fix'd Stars for the intermediate Years not mention'd in the preceding Table.

Years.	*The mean Motions for the intermediate Years.*				*The Motions of the Perihelii, and of the fix'd Stars for intermed. Years.*			
	s	°	′	″	s	°	′	″
1	11	29	45	40	0	00	00	50
2	11	29	31	20	0	00	01	40
3	11	29	17	00	0	00	02	30
4	00	00	01	48	0	00	03	20
5	11	29	47	28	0	00	04	10
6	11	29	33	08	0	00	05	00
7	11	29	18	48	0	00	05	50
8	00	00	03	36	0	00	06	40
9	11	29	49	16	0	00	07	30
10	11	29	34	57	0	00	08	20
11	11	29	20	37	0	00	09	10
12	00	00	05	26	0	00	10	00
13	11	29	51	6	0	00	10	50
14	11	29	36	46	0	00	11	40
15	11	29	22	26	0	00	12	30
16	00	00	07	14	0	00	13	20
17	11	29	52	54	0	00	14	10
18	11	29	38	34	0	00	15	00
19	11	29	24	14	0	00	15	50
20	00	00	09	4	0	00	16	40
40	00	00	18	8	0	00	33	20
60	00	00	27	12	0	00	50	00
80	00	00	36	16	0	01	06	40
100	00	00	45	20	0	01	23	20
200	00	01	30	41	0	02	46	40
300	00	02	16	1	0	04	10	00
400	00	03	1	22	0	05	33	20
500	00	03	46	42	0	06	56	40
600	00	04	32	3	0	08	20	00
700	00	05	17	23	0	09	43	20
800	00	06	2	44	0	11	06	40
900	00	06	48	4	0	12	29	00
1000	00	07	33	25	0	13	53	20
2000	00	15	6	50	0	27	46	40
3000	00	22	40	15	1	11	40	40
4000	01	00	13	41	1	25	33	20
5000	01	07	47	6	1	09	26	40

A Table of the Earth's mean Motion for every Day in the Year.

Days	Jan. The Earth's mean Motion. s ° ' "	M. P. "	Feb. The Earth's mean Motion. s ° ' "	M. P. "	March. The Earth's mean Motion. s ° ' "	M. P. "
1	0 00 59 08	00	1 01 32 27	04	1 29 08 20	08
2	0 01 58 17	00	1 02 31 25	05	2 00 07 28	08
3	0 02 57 25	00	1 03 30 43	05	2 01 06 36	08
4	0 03 56 33	01	1 04 29 52	05	2 02 05 45	09
5	0 04 55 42	01	1 05 29 00	05	2 03 04 53	09
6	0 05 54 50	01	1 06 28 08	05	2 04 04 01	09
7	0 06 53 58	01	1 07 27 16	05	2 05 03 10	09
8	0 07 53 07	01	1 08 26 25	05	2 06 02 18	09
9	0 08 52 15	01	1 09 25 33	06	2 07 01 26	09
10	0 09 51 23	01	1 10 24 41	06	2 08 00 35	09
11	0 10 50 32	02	1 11 23 50	06	2 08 59 43	10
12	0 11 49 40	02	1 12 22 58	06	2 09 58 51	10
13	0 12 48 48	02	1 13 22 06	06	2 10 58 00	10
14	0 13 47 57	02	1 14 21 15	06	2 11 57 08	10
15	0 14 47 05	02	1 15 20 23	06	2 12 56 16	10
16	0 15 46 13	02	1 16 19 31	06	2 13 55 25	10
17	0 16 45 22	02	1 17 18 40	07	2 14 54 33	10
18	0 17 44 30	02	1 18 17 48	07	2 15 53 41	11
19	0 18 43 38	03	1 19 16 56	07	2 16 52 50	11
20	0 19 42 47	03	1 20 16 04	07	2 17 51 58	11
21	0 20 41 55	03	1 21 15 13	07	2 18 51 06	11
22	0 21 41 03	03	1 22 14 21	07	2 19 50 15	11
23	0 22 40 12	03	1 23 13 30	07	2 20 49 23	11
24	0 23 39 20	03	1 24 12 38	08	2 21 48 31	11
25	0 24 38 28	03	1 25 11 46	08	2 22 47 40	11
26	0 25 37 37	04	1 26 10 55	08	2 23 46 48	12
27	0 26 36 45	04	1 27 10 03	08	2 24 45 56	12
28	0 27 35 53	04	1 28 09 11	08	2 25 45 05	12
29	0 28 35 02	04			2 26 44 13	12
30	0 29 34 10	04			2 27 43 21	12
31	1 00 33 18	04			2 28 42 30	12

A Table of the Earth's mean Motion for every Day in the Year.

Days	April. The Earth's mean Motion. s ° ' "	M. P. "	May. The Earth's mean Motion. s ° ' "	M. P. "	June. The Earth's mean Motion. s ° ' "	M. P. "
1	2 29 41 38	12	3 29 15 48	17	4 29 49 05	21
2	3 00 40 46	13	4 00 14 56	17	5 00 48 14	21
3	3 01 39 55	13	4 01 14 04	17	5 01 47 23	21
4	3 02 39 03	13	4 02 13 13	17	5 02 46 31	21
5	3 03 38 11	13	4 03 12 21	17	5 03 45 39	21
6	3 04 37 20	13	4 04 11 29	17	5 04 44 48	21
7	3 05 36 27	13	4 05 10 38	17	5 05 43 56	22
8	3 06 35 36	13	4 06 09 46	17	5 06 43 04	22
9	3 07 34 45	13	4 07 08 54	18	5 07 42 13	22
10	3 08 33 53	14	4 08 08 03	18	5 08 41 21	22
11	3 09 33 01	14	4 09 07 11	18	5 09 40 29	22
12	3 10 32 10	14	4 10 06 19	18	5 10 39 38	22
13	3 11 31 18	14	4 11 05 28	18	5 11 38 46	22
14	3 12 30 26	14	4 12 04 36	18	5 12 37 54	23
15	3 13 29 34	14	4 13 03 44	18	5 13 37 03	23
16	3 14 28 43	14	4 14 02 53	19	5 14 36 11	23
17	3 15 27 51	15	4 15 02 01	19	5 15 35 19	23
18	3 16 27 00	15	4 16 01 09	19	5 16 34 28	23
19	3 17 26 08	15	4 17 00 18	19	5 17 33 36	23
20	3 18 25 16	15	4 17 59 26	19	5 18 32 44	23
21	3 19 24 24	15	4 18 58 34	19	5 19 31 53	24
22	3 20 23 33	15	4 19 57 42	19	5 20 31 01	24
23	3 21 22 41	15	4 20 56 51	20	5 21 30 09	24
24	3 22 21 49	16	4 21 55 59	20	5 22 29 18	24
25	3 23 20 58	16	4 22 55 08	20	5 23 28 26	24
26	3 24 20 06	16	4 23 54 16	20	5 24 27 34	24
27	3 25 19 14	16	4 24 53 24	20	5 25 26 43	24
28	3 26 18 23	16	4 25 52 33	20	5 26 25 51	24
29	3 27 17 31	16	4 26 51 41	20	5 27 24 59	25
30	3 28 16 39	16	4 27 50 49	21	5 28 24 08	25
31			4 28 49 58	21		

A Table

A Table of the Earth's mean Motion for every Day in the Year.

Days	July. The Earth's mean Motion.				M. P.	Aug. The Earth's mean Motion.				M. P.	Septemb. The Earth's mean Motion.				M. P.
″	s	°	′	″	″	s	°	′	″	″	s	°	′	″	″
1	5	29	23	16	25	6	29	56	34	29	8	00	29	52	33
2	6	00	22	24	25	7	00	55	42	29	8	01	29	01	34
3	6	01	21	32	25	7	01	54	51	29	8	02	28	09	34
4	6	02	20	40	25	7	02	33	59	30	8	03	27	17	34
5	6	03	19	49	25	7	03	53	07	30	8	04	26	36	34
6	6	04	18	57	26	7	04	52	16	30	8	05	25	34	34
7	6	05	18	06	26	7	05	51	24	30	8	06	24	42	34
8	6	06	17	14	26	7	06	50	32	30	8	07	23	51	34
9	6	07	16	22	26	7	07	49	41	30	8	08	22	59	35
10	6	08	15	31	26	7	08	48	49	30	8	09	22	07	35
11	6	09	14	39	26	7	09	47	57	31	8	10	21	16	35
12	6	10	13	47	26	7	10	47	06	31	8	11	20	24	35
13	6	11	12	56	27	7	11	46	14	31	8	12	19	32	35
14	6	12	12	04	27	7	12	45	22	31	8	13	18	41	35
15	6	13	11	12	27	7	13	44	31	31	8	14	17	49	35
16	6	14	10	21	27	7	14	43	39	31	8	15	16	57	36
17	6	15	09	29	27	7	15	42	47	31	8	16	16	05	36
18	6	16	08	37	27	7	16	41	56	31	8	17	15	14	36
19	6	17	07	46	27	7	17	41	04	32	8	18	14	22	36
20	6	18	06	54	28	7	18	40	12	32	8	19	13	30	36
21	6	19	06	02	28	7	19	39	21	32	8	20	12	39	36
22	6	20	05	11	28	7	20	38	25	32	8	21	11	47	36
23	6	21	04	19	28	7	21	37	37	32	8	22	10	55	36
24	6	22	03	27	28	7	22	36	46	32	8	23	10	04	37
25	6	23	02	36	28	7	23	35	54	32	8	24	09	12	37
26	6	24	01	44	28	7	24	35	02	33	8	25	08	20	37
27	6	25	00	52	28	7	25	34	11	33	8	26	07	29	37
28	6	26	00	01	29	7	26	33	19	33	8	27	06	37	37
29	6	26	59	09	29	7	27	32	27	33	8	28	05	45	37
30	6	27	58	17	29	7	28	31	36	33	8	29	04	54	37
31	6	28	57	26	29	7	29	30	44	33					

A Table of the Earth's mean Motion for every Day in the Year.

Days	Octob. The Earth's mean Motion.				M. P.	Novemb. The Earth's mean Motion.				M. P.	Decemb. The Earth's mean Motion.				M. P.
″	s	°	′	″	″	s	°	′	″	″	s	°	′	″	″
1	9	00	04	02	38	10	00	37	20	42	11	00	11	30	46
2	9	01	03	10	38	10	01	36	29	42	11	01	10	38	46
3	9	02	02	19	38	10	02	35	37	42	11	02	09	47	46
4	9	03	01	27	38	10	03	34	45	42	11	03	08	55	46
5	9	04	00	35	38	10	04	33	54	42	11	04	08	03	46
6	9	04	59	44	38	10	05	33	02	42	11	05	07	12	47
7	9	05	58	52	38	10	06	32	10	43	11	06	06	20	47
8	9	06	58	00	38	10	07	31	19	43	11	07	05	28	47
9	9	07	57	08	39	10	08	30	27	43	11	08	04	37	47
10	9	08	56	17	39	10	09	29	35	43	11	09	03	45	47
11	9	09	55	25	39	10	10	28	44	43	11	10	02	53	47
12	9	10	54	34	39	10	11	27	52	43	11	11	02	02	47
13	9	11	53	42	39	10	12	27	00	43	11	12	01	10	48
14	9	12	52	50	39	10	13	26	09	44	11	13	00	18	48
15	9	13	51	59	39	10	14	25	17	44	11	13	59	27	48
16	9	14	51	07	40	10	15	24	25	44	11	14	58	35	48
17	9	15	50	15	40	10	16	23	34	44	11	15	57	43	48
18	9	16	49	24	40	10	17	22	42	44	11	16	56	52	48
19	9	17	48	32	40	10	18	21	50	44	11	17	56	00	48
20	9	18	47	40	40	10	19	20	59	44	11	18	55	08	48
21	9	19	46	49	40	10	20	20	07	44	11	19	54	17	49
22	9	20	45	57	40	10	21	19	15	45	11	20	53	25	49
23	9	21	45	05	41	10	22	18	24	45	11	21	52	33	49
24	9	22	44	14	41	10	23	17	32	45	11	22	51	42	49
25	9	23	43	22	41	10	24	16	40	45	11	23	50	50	49
26	9	24	42	30	41	10	25	15	49	45	11	24	49	58	49
27	9	25	41	39	41	10	26	14	57	45	11	25	49	07	49
28	9	26	40	47	41	10	27	14	05	45	11	26	48	15	49
29	9	27	39	55	41	10	28	13	13	46	11	27	47	23	50
30	9	28	39	04	41	10	29	12	22	46	11	28	46	32	50
31	9	29	38	12	42						11	29	45	40	50

A Table of the Horary mean Motion of the Earth.

In Leap Years after *February*, add a Day and the Motion of one Day to the Time.

H. ′ ″	° ′ ″	′ ″ ‴	″ ‴ ⁗	H. ′ ″	° ′ ″	′ ″ ‴	″ ‴ ⁗
0	0	00	00	30	1	13	55
1	0	02	28	31	1	16	23
2	0	04	56	32	1	18	51
3	0	07	24	33	1	21	19
4	0	09	51	34	1	23	47
5	0	12	19	35	1	26	14
6	0	14	47	36	1	28	42
7	0	17	15	37	1	31	10
8	0	19	43	38	1	33	38
9	0	22	11	39	1	36	06
10	0	24	38	40	1	38	34
11	0	27	06	41	1	41	02
12	0	29	34	42	1	43	29
13	0	32	02	43	1	45	57
14	0	34	30	44	1	48	25
15	0	36	58	45	1	50	53
16	0	39	25	46	1	53	21
17	0	41	53	47	1	55	49
18	0	44	21	48	1	58	16
19	0	46	49	49	2	00	44
20	0	49	17	50	2	03	12
21	0	51	45	51	2	05	40
22	0	54	13	52	2	08	08
23	0	56	40	53	2	10	36
24	0	59	08	54	2	13	03
25	1	01	36	55	2	15	31
26	1	04	04	56	2	17	59
27	1	06	32	57	2	20	27
28	1	09	00	58	2	25	55
29	1	11	27	59	2	22	23
30	1	13	55	60	2	25	50

A Table of the Equation of the Earth's Orbit.

Substract.

	Sign. 0			1			2			3			4			5			
	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	
0	0	00	00	0	56	56	1	39.	28	1	56	20	1	41	34	0	59	2	30
1	0	01	58	0	58	39	1	40	28	1	56	20	1	40	33	0	57	14	29
2	0	03	57	1	0	21	1	41	27	1	56	20	1	39	30	0	55	26	28
3	0	05	56	1	2	3	1	42	24	1	56	17	1	38	26	0	53	37	27
4	0	07	55	1	03	43	1	43	21	1	56	13	1	37	20	0	51	47	26
5	0	09	54	1	5	22	1	44	15	1	56	4	1	36	11	0	49	55	25
6	0	11	53	1	7	0	1	45	8	1	55	54	1	35	1	0	48	3	24
7	0	13	51	1	08	37	1	45	58	1	55	42	1	33	49	0	46	10	23
8	0	15	48	1	10	13	1	46	47	1	55	28	1	32	36	0	44	16	22
9	0	17	46	1	11	48	1	47	33	1	55	12	1	31	20	0	42	21	21
10	0	19	44	1	13	22	1	48	19	1	55	53	1	30	3	0	40	26	20
11	0	21	40	1	14	53	1	49	1	1	54	32	1	28	45	0	38	30	19
12	0	23	36	1	16	24	1	49	42	1	54	10	1	27	25	0	36	32	18
13	0	25	33	1	17	53	1	50	21	1	53	46	1	26	3	0	34	34	17
14	0	27	29	1	19	22	1	50	59	1	53	19	1	24	39	0	32	36	16
15	0	29	24	1	20	49	1	51	34	1	52	50	1	23	14	0	30	36	15
16	0	31	19	1	22	14	1	52	7	1	52	19	1	21	47	0	28	37	14
17	0	33	13	1	23	38	1	52	38	1	51	46	1	20	19	0	26	37	13
18	0	35	7	1	25	0	1	53	8	1	51	11	1	18	48	0	24	36	12
19	0	37	1	1	26	22	1	53	35	1	50	35	1	17	17	0	22	34	11
20	0	38	54	1	27	42	1	54	0	1	49	56	1	15	44	0	20	32	10
21	0	40	44	1	28	58	1	54	23	1	49	14	1	14	10	0	18	30	9
22	0	42	35	1	30	4	1	54	44	1	48	32	1	12.	34	0	16	28	8
23	0	44	26	1	31	29	1	55	3	1	47	47	1	10	57	0	14	26	7
24	0	46	16	1	32	42	1	55	21	1	46	59	1	9	19	0	12	22	6
25	0	48	5	1	33	54	1	55	35	1	46	10	1	07	39	0	10	19	5
26	0	49	52	1	35	03	1	55	48	1	45	20	1	05	58	0	08	16	4
27	0	51	40	1	36	12	1	55	59	1	44	26	1	04	16	0	06	12	3
28	0	53	26	1	37	19	1	56	9	1	43	31	1	2	32	0	04	8	2
29	0	55	11	1	38	24	1	56	15	1	42	34	1	00	48	0	02	4	1
30	0	56	56	1	39	28	1	56	20	1	41	35	0	59	3	0	00	00	0
	Sign 11			10			9			8			7			6			

A Table

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A Table of the Moon's mean Motion, and of her Apogæum and Node.

Years from Christ	The Moon's Motion from the Vernal Equinox.				The Apogæum's Motion from the Vernal Equinox.				The Motion of the Node from the Vernal Equinox.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	4	2	2	45	9	12	7	5	08	28	36	04
1501	1	29	39	8	3	29	55	50	01	25	46	43
1581	7	23	55	20	4	15	16	50	10	08	25	47
1601	0	7	29	25	7	19	7	5	09	11	35	31
21	4	21	03	30	10	22	57	20	08	14	45	19
41	9	4	37	35	1	26	47	35	07	17	55	03
61	1	18	11	40	5	0	37	50	06	21	04	47
81	6	1	45	45	8	4	28	5	05	24	14	35
1701	10	15	19	50	11	8	18	20	04	27	24	20
1721	02	28	53	55	02	12	8	6	04	00	34	6
1741	7	12	28	0	05	15	59	21	03	03	43	51
1761	11	26	02	05	08	19	42	36	02	06	53	35
1781	04	09	36	10	11	23	39	51	01	10	03	20
1801	08	23	10	15	02	27	30	6	00	13	13	4

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A Table of the Moon's mean Motion, of her Apogæum and Node for the intermediate Years, not mentioned in the preceding Table.

Years	The Moon's mean Motion.				The Apogæ's mean Motion.				The Node's mean Motion.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	04	09	23	4	01	10	39	51	00	19	59	43
2	08	18	46	7	02	21	19	41	01	08	39	26
3	00	28	09	10	04	01	59	32	01	27	59	09
4	05	20	42	49	05	12	46	4	02	17	22	03
5	10	00	05	52	06	23	25	54	03	06	41	46
6	02	09	28	55	08	04	05	44	03	26	01	29
7	06	18	51	59	09	14	45	35	04	15	21	12
8	11	11	25	37	10	25	32	7	05	04	44	05
9	03	20	46	41	00	06	11	57	05	24	03	49
10	08	00	11	44	01	16	51	47	06	13	23	33
11	00	09	34	48	02	27	31	38	07	02	43	16
12	05	02	18	27	04	08	18	10	07	22	06	9
13	09	11	31	30	05	18	58	0	08	11	25	52
14	01	20	54	34	06	29	37	50	09	00	45	35
15	06	00	17	37	08	10	17	41	09	20	05	18
16	10	22	51	16	09	21	04	13	10	09	28	12
17	03	02	14	19	11	01	44	3	10	28	47	56
18	07	11	37	22	00	12	23	53	11	18	07	39
19	11	21	00	25	01	23	03	44	00	07	27	22
20	4	13	34	5	03	3	50	15	00	26	50	15
40	08	27	8	10	06	07	40	30	01	23	40	31
60	01	10	42	15	09	11	30	45	02	20	30	46
80	05	24	16	20	00	15	21	0	03	17	21	2
100	10	07	50	25	03	19	11	15	04	14	11	17
200	08	15	40	50	07	08	22	30	08	28	22	33
300	06	23	31	15	10	27	33	45	01	12	33	50
400	05	01	21	40	02	16	45	00	05	26	45	7
500	03	09	12	5	06	05	56	15	10	10	56	23
600	01	17	2	30	09	25	7	30	02	25	7	40
700	11	24	52	55	01	14	18	45	07	09	18	57
800	10	02	43	20	05	03	30	0	11	23	30	13
900	08	10	33	45	08	22	41	15	04	07	41	30
1000	06	18	24	10	00	11	52	30	08	21	52	47
2000	01	06	48	20	00	23	45	0	05	13	45	44
3000	7	25	12	30	01	05	37	30	02	05	38	30
4000	2	13	35	40	01	17	30	0	10	27	31	27
5000	09	2	00	50	01	29	22	30	07	20	24	14

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A Table of the mean Motion of the Moon, of her Apogæum, and the Retrogradation of her Nodes, for every Day in the Year.

January.

Days	The Moon's mean Motion.				Apog.			Nod. Retrog.		
	s	°	′	″	°	′	″	°	′	″
1	00	3	10	35	0	06	41	0	03	11
2	00	26	21	10	0	13	22	0	06	21
3	01	09	31	45	0	20	03	0	09	32
4	01	22	42	20	0	26	44	0	12	43
5	02	05	52	55	0	33	25	0	15	53
6	02	19	03	30	0	40	06	0	19	04
7	03	02	14	05	0	46	48	0	22	14
8	03	15	24	40	0	53	29	0	25	25
9	03	28	35	15	1	00	10	0	28	36
10	04	11	45	50	1	06	51	0	31	46
11	04	24	56	25	1	13	32	0	34	57
12	05	08	07	00	1	20	13	0	38	08
13	05	21	17	35	1	26	54	0	41	18
14	06	04	28	10	1	33	35	0	44	29
15	06	17	38	45	1	40	16	0	47	40
16	07	00	49	20	1	46	57	0	50	50
17	07	13	59	55	1	53	38	0	54	01
18	07	27	10	30	2	00	19	0	57	11
19	08	10	21	05	2	07	00	1	00	22
20	08	23	31	40	2	13	41	1	03	33
21	09	06	42	15	2	20	23	1	06	43
22	09	19	52	50	2	27	04	1	09	54
23	10	03	03	25	2	33	45	1	13	05
24	10	16	14	00	2	40	26	1	16	15
25	10	29	24	35	2	47	07	1	19	26
26	11	12	35	10	2	53	48	1	22	37
27	11	25	45	45	3	00	29	1	25	47
28	00	08	56	20	3	07	10	1	28	58
29	00	22	06	55	3	13	51	1	32	09
30	01	05	17	31	3	20	32	1	35	19
31	01	18	28	06	3	27	13	1	38	30

A Table of the mean Motion of the Moon, of her Apogæum, and the Retrogradation of her Nodes, for every Day in the Year.

February.

Days	The Moon's mean Motion.				Apog.			Nod. Retrog.		
	s	°	′	″	s	°	′	°	′	″
1	02	01	38	41	3	33	54	1	41	40
2	02	14	49	16	3	40	35	1	44	50
3	02	27	59	51	3	47	16	1	48	01
4	03	11	10	26	3	53	57	1	51	12
5	03	24	21	01	4	00	38	1	54	23
6	04	07	31	36	4	07	19	1	57	33
7	04	20	42	11	4	14	00	2	00	44
8	05	03	52	46	4	20	41	2	03	54
9	05	17	03	21	4	27	22	2	07	06
10	06	00	13	56	4	34	04	2	10	16
11	06	13	24	31	4	40	45	2	13	27
12	06	26	35	06	4	47	26	2	16	37
13	07	09	45	41	4	54	07	2	19	48
14	07	22	56	15	5	00	48	2	22	59
15	08	06	06	50	5	07	29	2	26	09
16	08	19	17	26	5	14	10	2	29	20
17	09	02	28	01	5	20	51	2	32	30
18	09	15	38	36	5	27	32	2	35	41
19	09	28	49	11	5	34	13	2	38	52
20	10	11	59	46	5	40	54	2	42	02
21	10	25	10	21	5	47	36	2	45	13
22	11	08	20	56	5	54	17	2	48	23
23	11	21	31	31	6	00	58	2	51	34
24	00	04	42	06	6	07	39	2	54	45
25	00	17	52	41	6	14	20	2	57	55
26	01	01	03	16	6	21	01	3	01	06
27	01	14	13	51	6	27	42	3	04	16
28	01	27	24	26	6	34	23	3	07	27

A Table

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A Table of the mean Motion of the Moon, &c.

March.

Days	The Moon's mean Motion. s	°	′	″	Apog. °	′	″	Nod. Retrog. °	′	″
1	02	10	35	01	06	41	04	03	10	38
2	02	23	45	36	06	47	45	03	13	49
3	03	06	56	11	06	54	26	03	16	59
4	03	20	06	46	07	01	07	03	20	10
5	04	03	17	21	07	07	48	03	23	20
6	04	16	27	56	07	14	29	03	26	31
7	04	29	38	31	07	21	11	03	29	42
8	05	12	49	06	07	27	52	03	32	52
9	05	25	59	41	07	34	33	03	36	03
10	06	09	10	16	07	41	14	03	39	14
11	06	22	20	51	07	47	55	03	42	25
12	07	05	31	26	07	54	36	03	45	36
13	07	18	42	01	08	01	17	03	48	46
14	08	01	52	36	08	07	58	03	51	56
15	08	15	03	11	08	14	39	03	55	07
16	08	28	13	46	08	21	20	03	58	18
17	09	11	24	21	08	28	01	04	01	28
18	09	24	34	56	08	34	42	04	04	39
19	10	07	45	31	08	41	23	04	07	[illegible]
20	10	20	56	07	08	48	04	04	11	00
21	11	04	06	42	08	54	45	04	14	11
22	11	17	17	17	09	01	27	04	17	22
23	00	00	27	52	09	08	08	04	20	32
24	00	13	38	27	09	14	49	04	23	43
25	00	26	49	02	09	21	30	04	26	53
26	01	09	59	37	09	28	11	04	30	04
27	01	23	10	12	09	34	52	04	33	15
28	02	06	20	47	09	41	33	04	36	25
29	02	19	31	22	09	48	14	04	39	36
30	03	02	41	57	09	54	55	04	42	47
31	03	15	52	32	10	01	36	04	45	58

A Table of the mean Motion of the Moon, &c.

April.

Days	The Moon's mean Motion. s	°	′	″	Apog. °	′	″	Nod. Retrog. °	′	″
1	03	29	03	07	10	08	17	04	49	08
2	04	12	13	42	10	14	58	04	52	19
3	04	25	24	17	10	21	39	04	55	29
4	05	08	34	52	10	28	20	04	58	40
5	05	21	45	27	10	35	02	05	01	51
6	06	04	56	02	10	41	43	05	05	01
7	06	18	06	38	10	48	24	05	08	12
8	07	01	17	12	10	55	05	05	11	22
9	07	14	27	47	11	01	46	05	14	33
10	07	27	38	22	11	08	27	05	17	44
11	08	10	48	57	11	15	08	05	20	54
12	08	23	59	32	11	21	49	05	24	05
13	09	07	10	07	11	28	30	05	27	16
14	09	20	20	42	11	35	11	05	30	26
15	10	03	31	17	11	41	52	05	33	37
16	10	16	41	52	11	48	33	05	36	48
17	10	29	52	27	11	55	14	05	39	58
18	11	13	03	02	12	01	55	05	43	09
19	11	26	13	37	12	08	36	05	46	19
20	00	09	24	12	12	15	18	05	49	31
21	00	22	34	47	12	21	59	05	52	41
22	01	05	45	22	12	28	40	05	55	52
23	01	18	55	57	12	35	21	05	59	02
24	02	02	06	37	12	42	02	06	02	13
25	02	15	17	07	12	48	43	06	05	24
26	02	28	27	42	12	55	24	06	08	34
27	03	11	38	17	13	02	05	06	11	45
28	03	24	48	52	13	08	46	06	14	55
29	04	07	59	27	13	15	27	06	18	05
30	04	21	10	02	13	22	08	06	21	17

A Table

A Table of the mean Motion of the Moon, &c.

May.

Days	The Moon's mean Motion.				Apog.			Nod. Retrog.		
	s	°	′	″	°	′	″	°	′	″
1	05	04	20	37	13	28	49	06	24	27
2	05	17	31	12	13	35	30	06	27	38
3	06	00	41	47	13	42	11	06	30	48
4	06	13	52	22	13	48	52	06	33	59
5	06	27	02	57	13	55	34	06	37	10
6	07	10	13	32	14	02	15	06	40	20
7	07	23	24	07	14	08	56	06	43	31
8	08	06	34	42	14	15	37	06	46	41
9	08	19	45	17	14	22	18	06	49	52
10	09	02	55	53	14	28	59	06	53	03
11	09	16	06	27	14	35	40	06	56	14
12	09	29	17	03	14	42	21	06	59	24
13	10	12	27	38	14	49	02	07	02	34
14	10	25	38	13	14	55	43	07	05	45
15	11	08	48	48	15	02	24	07	08	56
16	11	21	59	23	15	09	05	07	12	06
17	00	05	09	58	15	15	46	07	15	17
18	00	18	20	33	15	22	28	07	18	27
19	01	01	31	08	15	29	09	07	21	38
20	01	14	41	43	15	35	50	07	24	49
21	01	27	52	18	15	42	31	07	28	00
22	02	11	02	53	15	49	12	07	31	10
23	02	24	13	28	15	55	53	07	34	21
24	03	07	24	03	16	02	34	07	37	32
25	03	20	34	38	16	09	15	07	40	43
26	04	03	45	13	16	15	56	07	43	53
27	04	16	55	48	16	22	37	07	47	04
28	05	00	06	23	16	29	18	07	50	14
29	05	13	16	58	16	35	59	07	53	25
30	05	26	27	33	16	42	40	07	56	36
31	06	09	38	08	16	49	21	07	59	46

A Table of the mean Motion of the Moon, &c.

June.

Days	The Moon's mean Motion.				Apog.			Nod. Retrog.		
	s	°	′	″	s	°	′	°	′	″
1	06	22	48	43	16	56	03	08	02	56
2	07	05	59	18	17	02	44	08	06	07
3	07	19	09	53	17	09	25	08	09	18
4	08	02	20	28	17	16	06	08	12	29
5	08	15	31	03	17	22	47	08	15	39
6	08	28	41	38	17	29	28	08	18	50
7	09	11	52	13	17	36	09	08	22	00
8	09	25	02	48	17	42	50	08	25	11
9	10	08	13	23	17	49	31	08	28	22
10	10	21	23	58	17	56	12	08	31	32
11	11	04	34	33	18	02	53	08	34	43
12	11	17	45	08	18	09	34	08	37	54
13	00	00	55	43	18	16	15	08	41	05
14	00	14	06	18	18	22	56	08	44	16
15	00	27	16	53	18	29	37	08	47	26
16	01	10	27	28	18	36	19	08	50	37
17	01	23	38	03	18	43	00	08	53	47
18	02	06	48	38	18	49	41	08	56	58
19	02	19	59	13	18	56	22	09	00	09
20	03	03	09	48	19	03	03	09	03	19
21	03	16	20	23	19	09	44	09	06	30
22	03	29	30	58	19	16	25	09	09	40
23	04	12	41	33	19	23	06	09	12	51
24	04	25	52	08	19	29	47	09	16	02
25	05	09	02	43	19	36	28	09	19	12
26	05	22	13	18	19	43	09	09	22	23
27	06	05	23	53	19	49	50	09	25	34
28	06	18	34	28	19	56	31	09	28	45
29	07	01	45	04	20	03	12	09	31	55
30	07	14	55	39	20	09	54	09	35	06

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A Table of the mean Motion of the Moon, &c.

July.

Days	The Moon's mean Motion. s	°	'	"	Apog. °	'	"	Nod. Retrog. °	'	"
1	07	28	06	14	20	16	35	09	38	16
2	08	11	16	49	20	23	16	09	41	27
3	08	24	27	24	20	29	57	09	44	37
4	09	07	37	59	20	36	38	09	47	48
5	09	20	48	34	20	43	19	09	50	59
6	10	03	59	09	20	50	00	09	54	09
7	10	17	09	44	20	56	41	09	57	20
8	11	00	20	19	21	03	22	10	00	30
9	11	13	30	54	21	10	03	10	03	41
10	11	26	41	29	21	16	44	10	06	51
11	00	09	52	04	21	23	25	10	10	02
12	00	23	02	39	21	30	06	10	13	13
13	01	06	13	14	21	36	47	10	16	24
14	01	19	22	49	21	43	28	10	19	35
15	02	02	34	24	21	50	09	10	22	45
16	02	15	44	59	21	56	52	10	25	56
17	02	28	55	34	22	03	32	10	29	06
18	03	12	06	09	22	10	13	10	32	17
19	03	25	16	44	22	16	54	10	35	28
20	04	08	27	19	22	23	35	10	38	39
21	04	21	37	54	22	30	15	10	41	49
22	05	04	48	29	22	36	56	10	45	00
23	05	17	59	04	22	43	37	10	48	11
24	06	01	09	39	22	50	19	10	51	21
25	06	14	20	14	22	57	00	10	54	32
26	06	27	30	49	23	03	41	10	57	42
27	07	10	41	20	23	10	22	11	00	53
28	07	23	15	59	23	17	03	11	04	03
29	08	07	02	34	23	23	44	11	07	14
30	08	20	13	09	23	30	25	11	10	25
31	09	03	23	44	23	37	06	11	13	36

A Table of the mean Motion of the Moon, &c.

August.

Days	The Moon's mean Motion. s	°	'	"	Apog. °	'	"	Nod. Retrog. °	'	"
1	09	16	34	19	23	43	47	11	16	47
2	09	29	44	54	23	50	28	11	19	58
3	10	12	55	29	23	57	09	11	23	08
4	10	26	06	04	24	03	51	11	26	19
5	11	09	16	39	24	10	32	11	29	29
6	11	22	27	14	24	17	13	11	32	40
7	00	05	37	49	24	23	54	11	35	51
8	00	18	48	24	24	30	35	11	39	02
9	01	01	58	59	24	37	16	11	42	12
10	01	15	09	34	24	43	57	11	45	23
11	01	28	20	09	24	50	38	11	58	33
12	02	11	30	44	24	57	19	11	51	44
13	02	24	41	19	25	04	00	11	54	54
14	03	07	51	54	25	10	42	11	58	05
15	03	21	02	29	25	17	23	12	01	15
16	04	04	13	04	25	24	04	12	04	26
17	04	17	23	40	25	30	45	12	07	36
18	05	00	34	15	25	37	26	12	10	47
19	05	13	44	50	25	44	07	12	13	58
20	05	26	55	25	25	50	48	12	17	08
21	06	10	06	00	25	57	29	12	20	19
22	06	23	16	35	26	04	10	12	23	29
23	07	06	27	10	26	10	51	12	26	40
24	07	19	37	45	26	17	32	12	29	51
25	08	02	48	20	26	24	13	12	33	01
26	08	15	58	55	26	30	55	12	36	12
27	08	29	09	30	26	37	36	12	39	23
28	09	12	20	05	26	44	17	12	42	34
29	09	25	30	40	26	50	58	12	45	44
30	10	08	14	15	26	57	39	12	48	55
31	10	21	51	50	27	04	20	12	52	05

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A Table of the mean Motion of the Moon, &c.

September.

Days	The Moon's mean Motion s	°	′	″	Apog. s	°	′	″	Nod. Retrog. °	′	″
1	11	05	02	25	0	27	11	01	12	55	16
2	11	18	13	00	0	27	17	42	12	58	27
3	00	01	23	35	0	27	24	23	13	01	37
4	00	14	34	10	0	27	31	04	13	04	48
5	00	27	44	45	0	27	37	45	13	07	58
6	01	10	55	20	0	27	44	26	13	11	09
7	01	24	05	55	0	27	51	07	13	14	20
8	02	07	16	30	0	27	57	48	13	17	31
9	02	20	27	05	0	28	04	29	13	20	41
10	03	03	37	40	0	28	11	11	13	23	52
11	03	16	48	15	0	28	17	52	13	27	03
12	03	29	58	50	0	28	24	33	13	30	14
13	04	13	09	25	0	28	31	14	13	33	24
14	04	26	20	00	0	28	37	55	13	36	35
15	05	09	30	35	0	28	44	36	13	39	45
16	05	22	41	10	0	28	51	17	13	42	56
17	06	05	51	45	0	28	57	58	13	46	07
18	06	19	02	20	0	29	04	39	13	49	17
19	07	02	12	55	0	29	11	20	13	52	28
20	07	15	23	30	0	29	18	01	13	55	38
21	07	28	34	05	0	29	24	42	13	58	49
22	08	11	44	40	0	29	31	23	14	02	00
23	08	24	55	15	0	29	38	04	14	05	10
24	09	08	05	50	0	29	44	45	14	08	21
25	09	21	16	25	0	29	51	27	14	11	31
26	10	04	27	00	0	29	50	08	14	14	42
27	10	17	37	35	1	00	04	49	14	17	53
28	11	00	48	10	1	00	11	30	14	21	03
29	11	13	58	45	1	00	18	11	14	24	14
30	11	27	09	20	1	00	24	52	14	27	24

A Table of the mean Motion of the Moon, &c.

October.

Days	The Moon's mean Motion s	°	′	″	Apog. s	°	′	″	Nod. Retrog. °	′	″
1	00	10	19	55	1	00	31	33	14	30	35
2	00	23	30	30	1	00	38	14	14	33	46
3	01	06	41	05	1	00	44	55	14	36	56
4	01	19	51	40	1	00	51	36	14	40	07
5	02	03	02	15	1	00	58	17	14	43	17
6	02	16	12	50	1	01	04	58	14	46	28
7	02	29	23	26	1	01	11	39	14	49	39
8	03	12	34	01	1	01	18	20	14	52	50
9	03	25	44	36	1	01	25	02	14	56	00
10	04	08	55	11	1	01	31	43	14	59	11
11	04	22	05	46	1	01	38	24	15	02	21
12	05	05	16	21	1	01	45	05	15	05	32
13	05	18	26	56	1	01	51	46	15	08	43
14	06	01	37	31	1	01	58	27	15	11	53
15	06	14	48	06	1	02	05	08	15	15	04
16	06	27	58	41	1	02	11	49	15	18	15
17	07	11	09	16	1	02	18	30	15	21	26
18	07	24	19	51	1	02	25	11	15	24	36
19	08	07	30	26	1	02	31	52	15	27	47
20	08	20	41	01	1	02	38	33	15	30	57
21	09	03	51	36	1	02	45	14	15	34	08
22	09	17	02	11	1	02	51	55	15	37	19
23	10	00	12	46	1	02	58	36	15	40	29
24	10	13	23	21	1	03	05	17	15	43	40
25	10	26	33	56	1	03	11	58	15	46	50
26	11	09	44	31	1	03	18	39	15	50	01
27	11	22	55	06	1	03	25	21	15	53	12
28	00	06	05	41	1	03	32	02	15	56	22
29	00	19	16	16	1	03	38	43	15	59	33
30	01	02	26	51	1	03	45	24	16	02	43
31	01	15	37	26	1	03	52	05	16	05	54

A Table

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A Table of the mean Motion of the Moon, &c.

November.

Days	The Moon's mean Motion s	°	′	″	Apog. s	°	′	″	Nod. Retrog. °	′	″
1	01	28	48	01	1	03	58	46	16	09	05
2	02	11	58	36	1	04	05	27	16	12	16
3	02	25	09	11	1	04	12	08	16	15	26
4	03	08	19	46	1	04	18	49	16	18	37
5	03	21	30	21	1	04	25	30	16	21	48
6	04	04	40	56	1	04	32	11	16	24	59
7	04	17	51	31	1	04	38	53	16	28	09
8	05	01	02	06	1	04	45	34	16	31	20
9	05	14	12	41	1	04	52	15	16	34	30
10	05	27	23	16	1	04	58	56	16	37	41
11	06	10	33	51	1	05	05	37	16	40	52
12	06	23	44	26	1	05	12	10	16	44	02
13	07	06	55	01	1	05	18	59	16	47	13
14	07	20	05	36	1	05	25	40	16	50	23
15	08	03	16	11	1	05	32	21	16	53	34
16	08	16	26	46	1	05	39	02	16	56	45
17	08	29	37	21	1	05	45	43	16	59	55
18	09	12	47	56	1	05	52	24	17	03	06
19	09	25	58	31	1	05	59	05	17	06	16
20	10	09	09	06	1	06	05	46	17	09	27
21	10	22	19	41	1	06	12	27	17	12	38
22	11	05	30	16	1	06	19	09	17	15	49
23	11	18	40	51	1	06	25	50	17	18	59
24	00	01	51	26	1	06	32	31	17	22	10
25	00	15	02	02	1	06	39	12	17	25	21
26	00	28	12	37	1	06	45	53	17	28	32
27	01	11	23	12	1	06	52	34	17	31	42
28	01	24	33	47	1	06	59	15	17	34	53
29	02	07	44	22	1	07	05	56	17	38	03
30	02	20	54	57	1	07	12	37	17	41	14

A Table of the mean Motion of the Moon, &c.

December.

Days	The Moon's mean Motion s	°	′	″	Apog. s	°	′	″	Nod. Retrog. °	′	″
1	03	04	05	32	1	07	19	18	17	44	25
2	03	17	16	07	1	07	25	59	17	47	35
3	04	00	26	42	1	07	32	40	17	50	46
4	04	13	37	17	1	07	39	21	17	53	56
5	04	26	47	52	1	07	46	02	17	57	07
6	05	09	58	27	1	07	52	43	18	00	18
7	05	23	09	02	1	07	59	24	18	03	28
8	06	06	19	37	1	08	06	06	18	06	39
9	06	19	30	12	1	08	12	47	18	09	49
10	07	02	40	47	1	08	19	28	18	13	00
11	07	15	51	22	1	08	26	09	18	16	11
12	07	29	01	57	1	08	32	50	18	19	21
13	08	12	12	32	1	08	39	31	18	22	32
14	08	25	23	07	1	08	46	12	18	25	42
15	09	08	33	42	1	08	52	53	18	28	53
16	09	21	44	17	1	08	59	34	18	32	04
17	10	04	54	52	1	09	06	15	18	35	15
18	10	18	05	27	1	09	12	56	18	38	25
19	11	01	16	02	1	09	19	38	18	41	36
20	11	14	26	37	1	09	26	19	18	44	47
21	11	27	37	12	1	09	33	00	18	47	58
22	00	10	47	47	1	09	39	41	18	51	09
23	00	23	58	22	1	09	46	22	18	54	19
24	01	07	08	57	1	09	53	03	18	57	30
25	01	20	19	32	1	09	59	44	19	00	41
26	02	03	30	07	1	10	06	25	19	03	51
27	02	16	40	42	1	10	13	06	19	07	02
28	02	29	51	17	1	10	19	47	19	10	12
29	03	13	01	52	1	10	26	28	19	13	23
30	03	26	12	27	1	10	33	09	19	16	34
31	04	09	23	02	1	10	39	50	19	19	45

A Table of the Moon's mean Motion in Hours and Parts of an Hour.

H. ′ ″	° ′ ″ / ′ ″ ‴ / ″ ‴ ⁗	′ ″ / ″ ‴ / ‴ ⁗	′ ″ / ″ ‴ / ‴ ⁗	H. ′ ″	° ′ ″ / ′ ″ ‴ / ″ ‴ ⁗	° ′ / ′ ″ / ″ ‴	′ ″ / ″ ‴ / ‴ ⁗
0	0 00 00	0 00	0 00	30	16 28 14	8 21	3 58
1	0 32 56	0 17	0 08	31	17 01 10	8 38	4 06
2	1 05 53	0 33	0 16	32	17 34 07	8 54	4 14
3	1 38 49	0 50	0 24	33	18 07 03	9 11	4 22
4	2 11 46	1 07	0 32	34	18 39 59	9 28	4 30
5	2 44 42	1 24	0 40	35	19 12 55	9 45	4 38
6	3 17 39	1 40	0 48	36	19 45 52	10 02	4 46
7	3 50 35	1 57	0 56	37	20 18 48	10 19	4 54
8	4 23 32	2 14	1 04	38	20 51 45	10 36	5 02
9	4 56 28	2 30	1 12	39	21 24 41	10 52	5 10
10	5 29 25	2 47	1 19	40	21 57 38	11 08	5 18
11	6 02 21	3 04	1 27	41	22 30 34	11 25	5 26
12	6 35 18	3 21	1 35	42	23 03 31	11 42	5 34
13	7 08 14	3 37	1 43	43	23 36 27	11 59	5 42
14	7 41 10	3 54	1 51	44	24 09 24	12 16	5 50
15	8 14 07	4 11	1 59	45	24 42 20	12 32	5 58
16	8 47 03	4 27	2 07	46	25 15 17	12 41	6 06
17	9 20 00	4 44	2 15	47	25 48 13	13 05	6 14
18	9 52 56	5 01	2 23	48	26 21 10	13 22	6 22
19	10 25 53	5 18	2 31	49	26 54 06	13 39	6 30
20	10 58 49	5 34	2 39	50	27 27 03	13 56	6 38
21	11 31 46	5 51	2 47	51	27 59 59	14 13	6 46
22	12 04 42	6 08	2 55	52	28 32 56	14 30	6 54
23	12 37 39	6 24	3 03	53	29 05 52	14 46	7 01
24	13 10 35	6 41	3 11	54	29 38 49	15 02	7 08
25	13 43 32	6 58	3 19	55	30 11 45	15 19	7 16
26	14 16 28	7 15	3 27	56	30 44 42	15 36	7 24
27	14 49 24	7 31	3 34	57	31 17 38	15 53	7 32
28	15 22 21	7 48	3 42	58	31 50 34	16 10	7 40
29	15 55 17	8 05	3 50	59	32 23 31	16 26	7 48
30	16 28 14	8 21	3 58	60	32 55 27	16 43	7 56

If it be Leap-Year, after *February*, you must to the Time given, add a Day, and to the collected Sums of her Motion.

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

Anomal. Sol. med.	Add. 0 ′ ″	1 ′ ″	2 ′ ″	3 ′ ″	4 ′ ″	5 ′ ″	
0	0 00	5 36	9 51	11 30	10 04	5 51	30
1	0 12	5 47	9 57	11 30	9 58	5 40	29
2	0 23	5 58	10 03	11 30	9 51	5 30	28
3	0 35	6 09	10 09	11 30	9 45	5 19	27
4	0 47	6 19	10 14	11 29	9 39	5 08	26
5	0 59	6 29	10 19	11 28	9 32	4 57	25
6	1 10	6 39	10 25	11 27	9 25	4 46	24
7	1 22	6 48	10 30	11 26	9 18	4 35	23
8	1 33	6 58	10 34	11 25	9 11	4 23	22
9	1 45	7 07	10 39	11 24	9 03	4 12	21
10	1 56	7 16	10 43	11 22	8 53	4 00	20
11	2 08	7 25	10 48	11 20	8 48	3 49	19
12	2 19	7 34	10 52	11 18	8 40	3 37	18
13	2 31	7 43	10 56	11 15	8 32	3 25	17
14	2 42	7 52	10 59	11 13	8 23	3 14	16
15	2 54	8 01	11 02	11 10	8 15	3 02	15
16	3 05	8 09	11 06	11 07	8 06	2 50	14
17	3 16	8 17	11 09	11 04	7 58	2 38	13
18	3 27	8 25	11 12	11 00	7 49	2 26	12
19	3 39	8 33	11 14	10 57	7 40	2 14	11
20	3 50	8 41	11 17	10 53	7 30	2 02	10
21	4 01	8 49	11 19	10 50	7 21	1 50	9
22	4 12	8 57	11 21	10 45	7 12	1 38	8
23	4 22	9 04	11 23	10 40	7 02	1 26	7
24	4 33	9 11	11 24	10 35	6 52	1 13	6
25	4 44	9 18	11 26	10 31	6 42	1 01	5
26	4 55	9 25	11 27	10 26	6 32	0 49	4
27	5 05	9 32	11 28	10 20	6 22	0 37	3
28	5 16	9 38	11 29	10 15	6 12	0 24	2
29	5 26	9 45	11 29	10 09	6 02	0 12	1
30	5 36	9 51	11 30	10 04	5 51	0 00	0
	11	10	9	8	7	6	
	Subtr.						

A Table

A Table of the Equations of the Moon's Apogæum; with the Eccentricities of her Orbit in such Parts, as the Radius contains 1000000.

Add the Equation to the Apogæum.

Argum. Ann.	Sign. 0, 6 ° ′ ″	Eccentricity. Parts.	Sign. 1, 7. ° ′ ″	Eccentricity. Parts.	Sign. 2, 8. ° ′ ″	Eccentricity. Parts.	Argum. An.
0	0 00 00	66854	09 07 14	61045	11 08 55	49429	30
1	0 20 21	66847	09 20 52	60691	10 59 45	49082	29
2	0 40 42	66826	09 34 01	60330	10 49 35	48741	28
3	1 01 01	66791	09 46 40	59962	10 38 22	48408	27
4	1 21 17	66741	09 58 49	59589	10 26 07	48085	26
5	1 41 30	66678	10 10 24	59210	10 12 50	47769	25
6	2 01 40	66600	10 21 29	58827	09 58 45	47653	24
7	2 21 44	66509	10 31 58	58439	09 43 35	47167	23
8	2 41 42	66404	10 41 50	58047	09 26 22	46880	22
9	3 01 34	66286	10 51 08	57652	09 09 07	46604	21
10	3 21 18	66154	10 59 48	57254	09 51 50	46337	20
11	3 40 54	66008	11 07 47	56854	08 41 36	46082	19
12	4 00 12	65850	11 15 07	56451	08 11 14	45838	18
13	4 19 38	65679	11 21 45	56047	07 49 55	45606	17
14	4 38 44	65495	11 27 40	55642	07 27 40	45385	16
15	4 57 38	65298	11 32 51	55237	07 04 31	45176	15
16	5 16 20	65089	11 37 17	54832	06 40 30	44979	14
17	5 34 49	64868	11 30 55	54427	06 15 40	44794	13
18	5 53 02	64636	11 43 47	54023	05 50 02	44623	12
19	6 11 01	64392	11 45 49	53920	05 23 39	44466	11
20	6 28 43	64137	11 47 01	53220	04 56 34	44320	10
21	6 46 08	63870	11 47 22	52822	04 28 51	44188	9
22	7 03 15	63594	11 46 50	52427	04 00 32	44070	8
23	7 20 03	63307	11 45 24	52035	03 31 40	43965	7
24	7 36 30	63011	11 43 04	51647	03 02 20	43874	6
25	7 52 36	62705	11 39 47	51264	02 03 26	43796	5
26	8 08 20	62389	11 35 34	50885	02 02 30	43733	4
27	8 23 41	62066	11 30 23	50512	01 32 08	43683	3
28	8 38 38	61733	11 24 14	50144	01 01 30	43648	2
29	8 53 08	61392	11 17 05	49783	00 30 45	43627	1
30	9 07 14	61045	11 08 55	49429	00 00 00	43619	0
	Sign. 5, 11		Sign. 4, 10.		Sign. 3, 9.		

Subtract the Equations of the Apogæum.

A Table of the Equations of the Centre of the Moon.

Subtract.

Anom. Med.	Sign. 0. Ecc. least. 43610 ° ′ ″	Sign. 0. Mid. 55237 ° ′ ″	Sign. 0. Great. 66854 ° ′ ″	Sign. 1. Ecc. least 43619 ° ′ ″	Sign. 1. Mid. 55237 ° ′ ″	Sign. 1. Great. 66854 ° ′ ″	Anom. Med.
0	0 00 00	0 00 00	0 00 00	2 23 08	2 59 04	3 34 08	30
1	0 04 58	0 06 12	0 07 24	2 27 32	3 04 33	3 40 43	29
2	0 09 56	0 12 24	0 14 48	2 31 50	3 10 02	3 47 15	28
3	0 14 53	0 18 35	0 22 12	2 36 07	3 15 23	3 53 43	27
4	0 19 50	0 24 47	0 29 36	2 40 22	3 20 44	4 00 08	26
5	0 24 48	0 30 58	0 36 58	2 44 35	3 26 01	4 06 30	25
6	0 29 44	0 37 09	0 44 20	2 48 48	3 31 16	4 12 47	24
7	0 34 39	0 43 19	0 51 42	2 52 53	3 36 27	4 19 01	23
8	0 39 34	0 49 27	0 59 04	2 56 54	3 41 35	4 25 12	22
9	0 44 30	0 55 36	1 06 25	3 00 58	3 46 39	4 31 18	21
10	0 49 25	1 01 43	1 13 45	3 04 55	3 51 39	4 37 20	20
11	0 54 19	1 07 51	1 21 02	3 08 53	3 56 36	4 43 18	19
12	0 59 13	1 13 57	1 28 18	3 12 46	4 01 30	4 49 12	18
13	1 04 04	1 20 02	1 35 34	3 16 35	4 06 20	4 55 01	17
14	1 08 56	1 26 05	1 42 49	3 20 22	4 11 06	5 00 46	16
15	1 13 45	1 32 07	1 50 02	3 24 05	4 15 47	5 06 26	15
16	1 18 33	1 38 08	1 57 13	3 27 44	4 20 24	5 12 01	14
17	1 23 20	1 44 08	2 04 23	3 31 20	4 24 58	5 17 32	13
18	1 28 06	1 50 06	2 11 31	3 34 53	4 29 28	5 22 59	12
19	1 32 50	1 56 02	2 18 37	3 38 22	4 33 53	5 28 20	11
20	1 37 32	2 01 56	2 25 41	3 41 47	4 38 14	5 33 36	10
21	1 42 13	2 07 49	2 32 43	3 45 09	4 42 31	5 38 47	9
22	1 46 53	2 13 39	2 39 43	3 48 28	4 46 43	5 43 53	8
23	1 51 33	2 19 27	2 46 40	3 51 43	4 50 50	5 48 53	7
24	1 56 09	2 25 14	2 53 35	3 54 55	4 54 53	5 53 48	6
25	2 00 45	2 30 58	3 00 28	3 58 03	4 58 55	5 58 38	5
26	2 05 18	2 36 41	3 07 18	4 01 06	5 02 43	6 03 21	4
27	2 09 49	2 42 21	3 14 05	4 04 05	5 06 32	6 07 59	3
28	2 14 18	2 47 58	3 20 49	4 07 00	5 10 15	6 12 31	2
29	2 18 44	2 53 32	3 27 30	4 09 51	5 13 54	6 16 58	1
30	2 23 08	2 59 04	3 34 08	4 12 40	5 17 27	6 21 18	0
		Sign. 11.			Sign. 10.		

Add.

A Table of the Equations of the Centre of the Moon.

Anom. Med.	Subtract. Sign. 2. Ecc. least 43619 ° ′ ″	Sign. 2. Mid. 55237 ° ′ ″	Sign. 2. Great. 66854 ° ′ ″	Sign. 3. Ecc. least 43619 ° ′ ″	Sign. 3. Mid. 55237 ° ′ ″	Sign. 3. Great. 66854 ° ′ ″	Anom. Med.
0	4 12 40	5 17 27	6 21 18	4 59 30	6 18 59	7 38 17	30
1	4 15 18	5 20 54	6 25 32	4 59 48	6 19 23	7 38 52	29
2	4 17 56	5 24 17	6 29 39	4 59 56	6 19 40	7 39 20	28
3	4 20 28	5 27 35	6 33 40	4 59 59	6 19 50	7 39 40	27
4	4 23 00	5 30 47	6 37 36	4 59 58	6 19 54	7 39 51	26
5	4 25 24	5 33 53	6 41 25	4 59 49	6 19 51	7 39 53	25
6	4 27 44	5 36 54	6 45 08	4 59 36	6 19 40	7 39 47	24
7	4 30 00	5 39 49	6 48 44	4 59 20	6 19 23	7 39 33	23
8	4 32 12	5 42 39	6 52 14	4 58 53	6 18 57	7 39 09	22
9	4 34 19	5 45 24	6 55 36	4 58 24	6 18 25	7 38 37	21
10	4 36 21	5 48 02	6 58 52	4 57 48	6 17 46	7 37 58	20
11	4 38 18	5 50 35	7 02 01	4 57 06	6 17 00	7 37 09	19
12	4 40 12	5 53 02	7 05 03	4 56 19	6 16 08	7 36 12	18
13	4 41 58	5 55 22	7 07 57	4 55 27	6 15 08	7 35 06	17
14	4 43 41	5 57 36	7 10 45	4 54 30	6 14 00	7 33 52	16
15	4 45 19	5 59 44	7 13 25	4 53 27	6 12 46	7 32 29	15
16	4 46 53	6 01 46	7 15 58	4 52 19	6 11 25	7 30 57	14
17	4 48 22	6 03 42	7 18 24	4 51 03	6 09 56	7 29 17	13
18	4 49 44	6 05 31	7 20 42	4 49 45	6 08 20	7 27 28	12
19	4 51 02	6 07 15	7 22 53	4 48 21	6 06 37	7 25 30	11
20	4 52 15	6 08 52	7 24 56	4 46 51	6 04 48	7 23 23	10
21	4 53 22	6 10 23	7 26 52	4 45 16	6 02 51	7 21 08	9
22	4 54 23	6 11 46	7 28 39	4 43 34	6 00 48	7 18 44	8
23	4 55 20	6 13 03	7 30 20	4 41 44	5 58 37	7 16 12	7
24	4 56 12	6 14 14	7 31 52	4 39 56	5 56 19	7 13 30	6
25	4 56 59	6 15 19	7 33 16	4 37 58	5 53 54	7 10 40	5
26	4 57 38	6 16 17	7 34 32	4 35 56	5 51 23	7 07 42	4
27	4 58 14	6 17 08	7 35 40	4 33 47	5 48 43	7 04 35	3
28	4 58 45	6 17 52	7 36 41	4 31 33	5 45 57	7 01 19	2
29	4 59 10	6 18 29	7 37 34	4 29 13	5 43 04	6 57 55	1
30	4 59 30	6 18 59	7 38 17	4 26 49	5 40 05	6 54 23	0
	Sign. 9.			Sign. 8.			
	Add.						

A Table of the Equations of the Centre of the Moon.

Anom. Med.	Subtract. Sign. 4. Ecc. least 43619 ° ′ ″	Sign. 4. Mid. 55237 ° ′ ″	Sign. 4. Great. 66854 ° ′ ″	Sign. 5. Ecc. least 45619 ° ′ ″	Sign. 5. Mid. 55237 ° ′ ″	Sign. 5. Great. 66854 ° ′ ″	Anom. Med.
0	4 26 49	5 40 05	6 54 23	2 37 10	3 21 48	4 07 29	30
1	4 24 19	5 37 00	6 50 42	2 32 27	3 15 48	4 00 10	29
2	4 21 43	5 33 46	6 46 52	2 27 42	3 09 44	3 52 45	28
3	4 19 01	5 30 25	6 42 54	2 12 54	3 03 36	3 45 14	27
4	4 16 14	5 26 57	6 38 48	2 18 03	2 57 24	3 37 39	26
5	4 13 22	5 23 24	6 34 34	2 13 09	2 51 06	3 29 59	25
6	4 10 25	5 19 43	6 30 11	2 08 13	2 44 45	3 22 14	24
7	4 07 24	5 15 58	6 25 40	2 03 14	2 38 22	3 14 24	23
8	4 04 18	5 12 06	6 21 01	1 58 12	2 31 55	3 06 30	22
9	4 01 08	5 08 07	6 16 14	1 53 07	2 25 24	2 58 31	21
10	3 57 53	5 04 00	6 11 20	1 48 01	2 18 50	2 50 29	20
11	3 54 32	4 59 48	6 06 16	1 42 52	2 12 13	2 42 23	19
12	3 51 07	4 55 30	6 01 06	1 37 41	2 05 32	2 34 12	18
13	3 47 38	4 51 06	5 55 49	1 32 27	1 58 49	2 25 58	17
14	3 44 04	4 46 36	5 50 21	1 27 11	1 52 05	2 17 41	16
15	3 40 27	4 42 00	5 44 48	1 21 54	1 45 17	2 09 21	15
16	3 36 43	4 37 17	5 39 06	1 16 35	1 38 26	2 00 58	14
17	3 32 55	4 32 27	5 33 17	1 11 14	1 31 33	1 52 31	13
18	3 29 02	4 27 32	5 27 22	1 05 55	1 24 38	1 44 01	12
19	3 25 05	4 22 33	5 21 19	1 00 27	1 17 42	1 35 29	11
20	3 21 04	4 17 28	5 15 09	0 55 02	1 10 44	1 26 55	10
21	3 16 59	4 12 17	5 08 52	0 49 34	1 03 43	1 18 19	9
22	3 12 48	4 07 01	5 02 28	0 44 07	0 56 42	1 09 42	8
23	3 08 34	4 01 40	4 55 58	0 38 37	0 49 40	1 01 03	7
24	3 04 16	3 56 13	4 49 21	0 33 08	0 42 36	0 52 22	6
25	2 59 53	3 50 40	4 42 38	0 27 38	0 35 30	0 43 40	5
26	2 55 27	3 45 03	4 35 48	0 22 08	0 28 25	0 34 57	4
27	2 50 58	3 39 21	4 28 52	0 16 37	0 21 19	0 26 13	3
28	2 46 26	3 33 34	4 21 49	0 11 04	0 14 13	0 17 29	2
29	2 41 50	3 27 43	4 14 41	0 05 32	0 07 07	0 08 45	1
30	2 37 10	3 21 48	4 07 29	0 00 00	0 00 00	0 00 00	0
	Sign. 7.			Sign. 6.			
	Add						

A Table of the Variation of the Moon.

	Add.						
	Sign. 0, 6.		Sign. 1, 7.		Sign. 2, 8.		
	'	"	'	"	'	"	
0	00	00	32	54	32	54	30
1	01	20	33	33	32	13	29
2	02	39	34	09	31	30	28
3	03	59	34	42	30	45	27
4	05	18	35	13	29	57	26
5	06	36	35	42	29	07	25
6	07	54	36	09	28	14	24
7	09	11	36	32	27	20	23
8	10	28	36	52	26	24	22
9	11	44	37	10	25	26	21
10	13	00	37	25	24	25	20
11	14	14	37	38	23	23	19
12	15	27	37	48	22	20	18
13	16	40	37	55	21	15	17
14	17	51	37	59	20	08	16
15	19	00	38	00	19	00	15
16	20	08	37	59	17	51	14
17	21	15	37	55	16	40	13
18	22	20	37	48	15	27	12
19	23	23	37	38	14	14	11
20	24	25	37	25	13	00	10
21	25	26	37	10	11	44	9
22	26	24	36	52	10	28	8
23	27	20	36	32	09	11	7
24	28	14	36	09	07	54	6
25	29	07	35	42	06	36	5
26	29	57	35	13	05	18	4
27	30	45	34	42	03	59	3
28	31	30	34	09	02	39	2
29	32	13	33	33	01	20	1
30	32	54	32	54	00	00	0
	Sign. 11, 5.		Sign. 10, 4.		Sign. 9, 3.		
	Subtract.						

A Table of the Equation of the Moon's Node, and of the Inclination of her Limit above five Degrees.

	Add the Equations of the Node.						
	Sign. 0, 6.		Sign. 1, 7.		Sign. 2, 8.		
☊ à ☊ dist.	Equat. ☊	Inclin Lim.	Equat. ☊	Inclin Lim.	Equat. ☊	Inclin. Lim.	☊ à ☋ dist.
	° ' "	' "	° ' "	' "	° ' "	' "	
0	0 00 00	18 00	1 25 12	13 30	1 26 50	04 30	30
1	0 03 28	18 00	1 27 00	13 14	1 25 01	04 14	29
2	0 06 56	17 59	1 28 37	12 57	1 23 06	03 59	28
3	0 10 23	17 59	1 30 04	12 40	1 21 06	03 43	27
4	0 13 49	17 55	1 31 22	12 23	1 19 03	03 28	26
5	0 17 11	17 52	1 32 30	12 05	1 46 56	03 13	25
6	0 20 31	17 48	1 33 34	11 47	1 14 44	02 59	24
7	0 23 48	17 43	1 34 34	11 29	1 12 26	02 45	23
8	0 27 02	17 38	1 35 31	11 11	1 10 02	02 32	22
9	0 30 13	17 34	1 36 25	10 53	1 07 31	02 19	21
10	0 33 22	17 28	1 37 15	10 34	1 04 53	02 06	20
11	0 36 29	17 21	1 37 59	10 14	1 02 09	01 54	19
12	0 39 34	17 13	1 38 37	09 55	0 59 19	01 43	18
13	0 42 37	17 05	1 39 09	09 37	0 56 23	01 32	17
14	0 45 38	16 57	1 39 33	09 18	0 53 21	01 22	16
15	0 48 37	16 48	1 39 46	09 00	0 50 15	01 12	15
16	0 51 33	16 38	1 39 34	08 42	0 47 06	01 03	14
17	0 54 27	16 28	1 39 11	08 23	0 43 56	00 55	13
18	0 57 17	16 17	1 38 41	08 05	0 40 44	00 47	12
19	1 00 06	16 06	1 38 05	07 46	0 37 29	00 39	11
20	1 02 51	15 54	1 37 23	07 26	0 44 12	00 32	10
21	1 05 31	15 41	1 36 34	07 07	0 30 53	00 26	9
22	1 08 04	15 28	1 35 46	06 49	0 27 32	00 22	8
23	1 10 29	15 15	1 34 56	06 31	0 24 09	00 17	7
24	1 12 48	15 01	1 34 03	06 13	0 20 44	00 12	6
25	1 15 01	14 47	1 33 06	05 55	0 17 18	00 08	5
26	1 17 08	14 32	1 32 05	05 37	0 13 51	00 05	4
27	1 19 12	14 17	1 31 00	05 20	0 10 24	00 03	3
28	1 21 14	14 01	1 29 47	05 03	0 06 57	00 01	2
29	1 23 14	13 46	1 28 24	04 46	0 03 29	00 00	1
30	1 25 12	13 30	1 26 50	04 30	0 00 00	00 00	0
	Sign. 5, 11.		Sign. 4, 10.		Sign. 3, 9.		
	Subtract the Equations of the Node.						

A Table

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A Table of the Moon's simple Latitude, fitted to the least Inclination of the Orbit, five Degrees, with the proper Increment of the greatest Inclination, 5°. 18'.

Argum. Lat.	North Sign. 0,6. South Lat. Lun ° ' "	Increm. or Parts added ' "	North Sign. 1,7. South Lat. Lun ° ' "	Increm. or Parts added ' "	North Sig. 2,8. South Lat. Lun ° ' "	Increm. or Parts added ' "	Argum. Lat.
0	0 00 00	0 00	2 29 51	9 00	4 19 44	15 36	30
1	0 05 14	0 19	2 34 22	9 16	4 22 18	15 45	29
2	0 10 28	0 37	2 38 50	9 32	4 24 49	15 54	28
3	0 15 42	0 56	2 43 15	9 48	4 27 14	16 02	27
4	0 20 55	1 15	2 47 37	10 03	4 29 34	16 11	26
5	0 26 08	1 34	2 51 56	10 19	4 31 50	16 19	25
6	0 31 20	1 53	2 56 11	10 34	4 34 00	16 27	24
7	0 36 32	2 11	3 00 24	10 49	4 36 06	16 34	23
8	0 41 43	2 30	3 04 33	11 04	4 38 06	16 42	22
9	0 46 53	2 49	3 08 39	11 19	4 40 02	16 49	21
10	0 52 02	3 08	3 12 42	11 34	4 41 52	16 55	20
11	0 57 10	3 26	3 16 41	11 48	4 43 37	17 01	19
12	1 02 18	3 45	3 20 36	12 02	4 45 17	17 07	18
13	1 07 24	4 03	3 24 38	12 16	4 46 52	17 12	17
14	1 12 29	4 21	3 28 16	12 30	4 48 21	17 18	16
15	1 17 33	4 39	3 32 00	12 44	4 49 45	17 23	15
16	1 22 36	4 57	3 35 40	12 56	4 51 04	17 28	14
17	1 27 37	5 15	3 39 17	13 09	4 52 18	17 33	13
18	1 32 36	5 33	3 42 49	13 22	4 53 26	17 37	12
19	1 37 34	5 51	3 46 17	13 35	4 54 28	17 40	11
20	1 42 29	6 09	3 49 42	13 47	4 55 26	17 44	10
21	1 47 23	6 27	3 53 02	13 59	4 56 18	17 47	9
22	1 52 16	6 45	3 56 17	14 11	4 57 04	17 50	8
23	1 57 06	7 02	3 59 29	14 23	4 57 45	17 52	7
24	2 01 54	7 19	4 02 35	14 34	4 58 21	17 54	6
25	2 06 39	7 36	4 05 39	14 45	4 58 51	17 56	5
26	2 11 23	7 53	4 08 37	14 56	4 59 16	17 58	4
27	2 16 04	8 09	4 11 30	15 06	4 59 35	17 59	3
28	2 20 42	8 26	4 14 19	15 17	4 59 49	17 59	2
29	2 25 18	8 43	4 17 04	15 26	4 59 57	18 00	1
30	2 29 51	9 00	4 19 44	15 36	5 00 00	18 00	0
	North Sig. 5,11. South		North Sig. 4,10. South		North Sig. 3,9. South		

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'.

Argum. Lat.	Sig. 0,6. subt. Reduct. ' "	Excess. "	Sig. 1,7. subt. Reduct. ' "	Excess. "	Sig. 2,8. subt. Reduct. ' "	Excess. "	Argum. Lat.
0	0 00	00	5 40	42	5 41	42	30
1	0 14	02	5 47	43	5 34	41	29
2	0 27	04	5 53	44	5 26	40	28
3	0 41	06	5 59	45	5 18	39	27
4	0 55	08	6 04	46	5 10	38	26
5	1 08	09	6 09	46	5 02	37	25
6	1 22	11	6 14	46	4 53	36	24
7	1 35	12	6 18	47	4 43	35	23
8	1 48	13	6 21	47	4 34	34	22
9	2 01	15	6 24	47	4 23	33	21
10	2 14	17	6 27	48	4 13	30	20
11	2 27	19	6 29	48	4 02	30	19
12	2 40	20	6 31	48	3 51	29	18
13	2 52	22	6 32	48	3 40	28	17
14	3 04	23	6 33	49	3 29	26	16
15	3 16	24	6 33	49	3 17	24	15
16	3 28	26	6 33	49	3 05	23	14
17	3 40	28	6 32	49	2 53	22	13
18	3 51	29	6 31	49	2 40	20	12
19	4 02	30	6 29	48	2 28	19	11
20	4 12	31	6 27	48	2 15	17	10
21	4 23	33	6 25	47	2 02	15	9
22	4 33	34	6 22	47	1 49	13	8
23	4 44	35	6 18	47	1 35	12	7
24	4 52	36	6 14	46	1 22	11	6
25	5 01	37	6 10	46	1 08	9	5
26	5 09	38	6 05	46	0 55	8	4
27	5 18	39	6 00	45	0 41	6	3
28	5 26	40	5 54	44	0 27	4	2
29	5 33	41	5 47	43	0 14	2	1
30	5 40	42	5 41	42	0 00	0	0
	Sig 5,11		Sig 4,10		Sig. 3,9		
	Add						

A Table

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

Mid. Anom	The true Horary Mot. of the Earth.	Semidiameter of the Sun.	The true Horary Mot. of the Moon. Eccentricity. 4362	The true Horary Mot. of the Moon. Eccentricity. 6685	Mid. Anom
s °	′ ″	′ ″	′ ″	′ ″	s °
0 00	2 23	15 50	30 51	29 30	12 00
06	2 23	15 50	30 52	29 31	24
12	2 23	15 50	30 55	29 33	18
18	2 23	15 50	30 59	29 39	12
24	2 23	15 51	31 03	29 47	06
1 00	2 23	15 52	31 10	29 57	11 00
06	2 24	15 53	31 19	30 09	24
12	2 24	15 54	31 29	30 22	18
18	2 24	15 55	31 40	30 37	12
24	2 25	15 56	31 52	30 55	06
2 00	2 25	15 58	32 06	31 15	10 00
06	2 26	15 59	32 21	31 36	24
12	2 26	16 01	32 36	31 59	18
18	2 27	16 02	32 54	32 24	12
24	2 27	16 04	33 11	32 50	06
3 00	2 28	16 06	33 29	33 18	9 00
06	2 28	16 08	33 47	33 47	24
12	2 29	16 09	34 07	34 15	18
18	2 29	16 11	34 26	34 43	12
24	2 30	16 13	34 45	34 12	06
4 00	2 30	16 14	35 03	35 42	8 00
06	2 31	16 15	35 20	36 10	24
12	2 31	16 17	35 36	36 36	18
18	2 32	16 19	35 51	37 01	12
24	2 32	16 20	36 05	37 24	06
5 00	2 32	16 21	36 17	37 45	7 00
06	2 33	16 21	36 27	38 02	24
12	2 33	16 22	36 34	38 15	18
18	2 33	16 22	36 39	38 25	12
24	2 33	16 23	36 43	38 31	06
6 00	2 33	16 23½	36 44	38 32	6 00

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

Mid. Anom	The Moon's Horizontal Parallax. Eccentricity. 4362	The Moon's Horizontal Parallax. Eccentricity. 6685	The Horizontal Semidiam. of the ☾. Eccentricity. 4362	The Horizontal Semidiam. of the ☾. Eccentricity. 6685	Mid. Anom
s °	′ ″	′ ″	′ ″	′ ″	s °
12 00	55 35	54 23	15 04	14 45	0 00
24	55 35	54 23	15 05	14 45	06
18	55 38	54 26	15 05	14 46	12
12	55 43	54 31	15 06	14 47	18
06	55 48	54 38	15 08	14 49	24
11 00	55 54	54 47	15 10	14 52	1 00
24	56 01	54 58	15 12	14 55	06
18	56 09	55 11	15 14	14 58	12
12	56 19	55 25	15 16	15 02	18
06	56 30	55 41	15 19	15 06	24
10 00	56 42	55 58	15 23	15 11	2 00
24	56 56	56 17	15 27	15 16	06
18	57 10	56 37	15 30	15 21	12
12	57 25	56 59	15 34	15 27	18
06	57 39	57 22	15 38	15 34	24
9 00	57 54	57 45	15 42	15 40	3 00
24	58 10	58 10	15 47	15 46	06
18	58 27	58 35	15 51	15 53	12
12	58 43	59 01	15 55	16 01	18
06	58 58	59 25	16 00	16 07	24
8 00	59 13	59 48	16 04	16 14	4 00
24	59 28	60 12	16 08	16 20	06
18	59 43	60 35	16 12	16 26	12
12	59 56	60 56	16 16	16 32	18
06	60 07	61 14	16 19	16 37	24
7 00	60 16	61 30	16 21	16 41	5 00
24	60 24	61 44	16 23	16 45	06
18	60 30	61 55	16 25	16 48	12
12	60 35	62 03	16 26	16 50	18
06	60 38	62 08	16 27	16 51	24
6 00	60 39	62 10	16 27	16 52	6 00

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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 true Horary Motion of the Moon from the Sun.										Argum. Latitud.
Sig. 0	27′	28′	29′	30′	31′	32′	33′	34′	35′	36′	Sig. 5
Sig. 6	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	Sig. 11
gr. 0	5 46	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	gr. 30
1	5 46	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	29
2	5 46	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	28
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
10	5 41	5 40	5 39	5 38	5 37	5 36	5 35	5 34	5 33	5 32	20
11	5 40	5 39	5 38	5 37	5 36	5 35	5 34	5 33	5 32	5 31	19
12	5 39	5 38	5 37	5 36	5 35	5 34	5 33	5 32	5 31	5 30	18

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

Argum. Latitud.	Subtract from the time of the true Syzygy in the Orbit. The true Horary Motion of the Moon from the Sun.										Argum. Latitud.
Sig. 0	27′	28′	29′	30′	31′	32′	33′	34′	35′	36′	Sig. 5
Sig. 6	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Sig. 11
gr. 0	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	0 00	gr. 30
1	0 35	0 34	0 33	0 31	0 30	0 29	0 28	0 27	0 26	0 26	29
2	1 10	1 07	1 05	1 05	1 00	0 58	0 56	0 55	0 53	0 51	28
3	2 45	1 41	1 37	1 34	1 30	1 27	1 25	1 22	1 19	1 17	27
4	2 20	2 15	2 10	2 05	2 00	1 56	1 53	1 49	1 45	1 42	26
5	2 55	2 48	2 41	2 36	2 30	2 25	2 21	2 16	2 12	2 08	25
6	3 29	3 21	3 14	3 07	3 00	2 54	2 48	2 43	3 38	2 33	24
7	4 04	3 54	3 46	3 38	3 30	3 23	3 16	3 10	3 04	2 58	23
8	4 38	4 27	4 17	4 08	3 59	3 51	3 43	3 36	3 09	3 23	22
9	5 11	4 59	4 48	4 38	4 28	4 19	4 10	4 02	3 54	3 47	21
10	5 44	5 31	5 19	5 07	4 56	4 46	4 37	4 28	4 19	4 21	20
11	6 17	6 03	5 49	5 37	5 25	5 14	5 03	4 53	4 44	4 35	19
12	6 50	6 34	6 19	6 06	5 53	5 41	5 29	5 19	5 09	4 59	18
	Add to the time of the true Syzygy in the Orbit.										

A Table

A Table of the mean Motions of the Moon from the Sun.

An. Æræ Christ Cu	Moon's mean Motion from the Sun. s	°	'	"	An. Jul. Expansi	Moon's mean Motion from the Sun. s	°	'	"
1	6	24	9	42	1	4	9	37	25
1501	4	10	25	59	2	8	19	14	48
1581	10	4	5	54	3	0	28	52	11
1601	2	17	30	55	4	5	20	41	3
1621	7	0	55	56	5	10	0	18	27
1641	11	14	20	57	6	2	9	55	50
1661	3	27	45	58	7	6	19	33	14
1681	8	11	10	59	8	11	11	22	5
1701	0	24	56	0	9	3	20	59	30
1721	5	8	1	1	10	8	0	36	53
1741	9	21	26	2	11	0	10	14	17
1761	2	4	51	3	12	5	2	3	7
1781	6	18	16	4	13	9	11	40	32
1801	11	1	41	4	14	1	21	17	55
An. Jul. Expansi	Moon's mean Motion from the Sun. s	°	'	"	15	6	0	55	18
					16	10	22	44	10
					17	3	2	21	35
					18	7	11	58	58
20	4	13	25	13	19	11	21	36	21
40	8	26	50	26	20	4	13	25	13
60	1	10	15	39	Months.	Moon's mean Motion from the Sun. s	°	'	"
80	5	23	40	52					
100	10	7	6	5					
200	8	14	12	10					
300	6	21	18	15	*Jan.*	0	0	0	0
400	4	28	24	20	*Febr.*	0	17	54	47
500	3	5	30	25	*Mar.*	11	29	15	14
600	1	12	36	30	*Apr.*	0	17	10	2
700	11	19	42	35	*May*	0	22	53	23
800	9	26	48	40	*June*	1	10	48	11
900	8	3	54	45	*July*	1	16	31	33
1000	6	11	0	50	*Aug.*	2	4	26	19
2000	0	22	1	40	*Sept.*	2	21	21	7
3000	7	3	2	3	*Octob.*	2	28	4	28
4000	1	14	2	53	*Nov.*	3	15	59	16
5000	7	25	3	43	*Dec.*	3	21	42	36

In Leap-Year (after *February*) add a Day to the time given, and the Motion of a Day to the Motions before collected.

A Table of the mean Motions of the Moon from the Sun.

Days	Moon's mean Motion from the Sun. s	°	'	"	H. ' "	Mean Mot. ° ' "	' " '''	" ''' ''''	H. ' "	Mean Mot. ° ' "	' " '''	" ''' ''''
1	00	12	11	27	1	00	30	29	31	15	44	47
2	00	24	22	53	2	01	00	57	32	16	15	16
3	01	06	34	20	3	01	31	26	33	16	45	44
4	01	18	45	47	4	02	01	54	34	17	16	13
5	02	00	57	13	5	02	32	23	35	17	46	42
6	02	13	08	40	6	03	02	54	36	18	17	10
7	02	25	20	67	7	03	33	20	37	10	47	39
8	03	07	31	33	8	04	03	49	38	19	18	07
9	03	19	43	00	9	04	34	18	39	19	48	36
10	04	01	54	27	10	05	04	46	40	20	19	05
11	04	14	05	53	11	05	35	15	41	20	49	33
12	04	26	17	20	12	06	05	43	42	21	20	02
13	05	08	28	47	13	06	36	12	43	21	50	31
14	05	20	40	13	14	07	06	41	44	22	20	59
15	06	02	51	40	15	07	37	09	45	22	51	28
16	06	15	03	07	16	08	07	38	46	23	21	56
17	06	27	14	33	17	08	38	06	47	23	52	25
18	07	09	26	00	18	09	08	35	48	24	22	54
19	07	21	37	27	19	09	39	04	49	24	53	22
20	08	03	48	53	20	10	09	32	50	25	23	51
21	08	16	00	20	21	10	40	01	51	25	54	19
22	08	28	11	47	22	11	10	30	52	26	24	48
23	09	10	23	13	23	11	40	58	53	26	55	17
24	09	22	34	40	24	12	11	27	54	27	25	45
25	10	04	46	07	25	12	41	55	55	27	56	13
26	10	16	57	33	26	13	12	24	56	28	26	43
27	10	29	09	00	27	12	42	53	57	28	57	11
28	11	11	20	27	28	14	13	21	58	29	27	40
29	11	23	31	53	29	14	43	50	59	29	58	08
30	00	05	43	20	30	15	14	19	60	30	28	37
31	00	17	54	47	In Leap-Year, add a Day to the time given, and the Motion of a Day to the Motions before collected.							
32	01	00	06	13								

Sir *Isaac Newton* augments the equation of P. 355. as 71. is to 69. and P. 356. as 22 to 21.
And he diminishes that of P. 360. as 224 is to 228. in the Sun's Perigee: and as 198 to 228. in the Apogee; and that of P. 361. as 9 to 10.
The Ann. Equation of the Node to that of P. 355. as 95 to 118. of the same kind.
The Ann. Equation of the Apoge to the same as 120 to 71. of the contrary kind.

Eccentr. } P. 357 } Greatest, } 66782 } 11731 } Greatest Equat. } 7. 40.
358 } Middle, } 55050 } 11731 } Least Equat. } 4. 52.
359 } Least, } 43319.

A Table of the mean Motion of the *Hugenian* Satellite of *Saturn*, from the first Star in *Aries*.

Years from Christ.	Epochæ. s	°	'	Years.	MeanMo s	°	'	Days.	MeanMo s	°	'	H. M	M.Mo. '	"	H. M	Mean Mot. '	"
1641	8	29	17	1	10	29	36	1	0	22	35	1	0	56	31	29	10
1661	10	14	10	2	9	11	12	2	1	15	09	2	1	53	32	30	6
1681	11	29	3	3	8	1	48	3	2	7	44	3	2	49	33	31	3
1701	1	13	56	4	7	14	59	4	3	0	18	4	3	46	34	31	59
1721	2	28	49	5	6	5	35	5	3	22	53	5	4	42	35	32	55
1741	4	13	42	6	4	26	11	6	4	15	28	6	5	39	36	33	52
1761	5	28	37	7	3	16	47	7	5	8	2	7	6	35	37	34	48
1781	7	13	28	8	2	26	57	8	6	0	37	8	7	32	38	35	45
1801	8	28	21	9	1	20	23	9	6	23	12	9	8	28	39	36	41
Months	Mean Mot.			10	0	11	9	10	7	15	46	10	9	24	40	37	38
Jan.	0	0	0	11	11	1	45	11	8	8	21	11	10	21	41	38	34
Feb.	11	9	53	12	10	14	56	12	9	0	55	12	11	17	42	39	31
March	8	12	2	13	9	5	32	13	9	23	30	13	12	14	43	40	27
April	7	21	56	14	7	26	8	14	10	16	5	14	13	10	44	41	24
May	6	9	14	15	6	16	44	15	11	8	39	15	14	7	45	42	20
June	5	19	7	16	5	29	54	16	0	1	14	16	15	3	46	43	17
July	4	6	26	17	4	20	30	17	0	23	48	17	16	0	47	44	13
August	3	16	19	18	3	11	6	18	1	16	23	18	16	56	48	45	10
Sept.	2	26	12	19	2	1	42	19	2	8	58	19	17	52	49	46	6
October	1	13	31	20	1	4	53	20	3	1	32	20	18	49	50	47	3
Nov.	0	23	24					21	3	24	7	21	19	45	51	47	59
Decemb.	11	10	43					22	4	16	42	22	20	42	52	48	56
								23	5	9	16	23	21	38	53	49	52
								24	6	1	51	24	22	35	54	50	49
								25	6	24	25	25	23	31	55	51	45
								26	7	17	00	26	24	25	56	52	42
								27	8	9	35	27	25	24	57	53	38
								28	9	2	9	28	26	20	58	54	35
								29	9	24	44	29	27	17	59	55	31
								30	10	17	18	30	28	13	60	56	27
								31	11	9	53						
								32	0	2	28						

In Leap Year, after *February*, add one Day, and the proper Motion belonging to it.

A Table of the Declination of the Points of the Eclipric of *Saturn*, from his Equator or Ring.

Grad. Eclipt.	Declin. °	'	Grad. Eclipt.	Declin. °	'	Grad. Eclipt.	Declin. °	'
1	0	31	31	15	23	61	26	46
2	1	2	32	15	50	62	27	2
3	1	33	33	16	17	63	27	18
4	2	4	34	16	44	64	27	34
5	2	34	35	17	11	65	27	50
6	3	5	36	17	37	66	28	5
7	3	36	37	18	3	67	28	19
8	4	7	38	18	29	68	28	32
9	4	38	39	18	55	69	28	45
10	5	8	40	19	20	70	28	57
11	5	39	41	19	45	71	29	9
12	6	9	42	20	9	72	29	20
13	6	39	43	20	33	73	29	30
14	7	9	44	20	57	74	29	40
15	7	39	45	21	21	75	29	50
16	8	9	46	21	44	76	30	59
17	8	39	47	22	7	77	30	7
18	9	9	48	22	30	78	30	14
19	9	39	49	22	52	79	30	21
20	10	8	50	23	14	80	30	28
21	10	38	51	23	35	81	30	34
22	11	7	52	23	56	82	30	39
23	11	36	53	24	17	83	30	44
24	12	5	54	24	37	84	30	48
25	12	34	55	24	57	85	30	52
26	13	3	56	25	16	86	30	55
27	13	31	57	25	35	87	30	57
28	13	59	58	25	53	88	30	58
29	14	27	59	26	11	89	30	59
30	14	55	60	26	29	90	31	0

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The *Epocha* of the Revolutions of the first *Satellite* to the Shadow of *Jupiter*, under the Meridian of *London*.

Jul. Years	D.	h.	′	″	Num.I.	NumII
1660	0	11	5	48	968	200,6
61	0	1	17	24	1174	181,2
62	1	9	57	36	1381	162,9
63	1	0	9	12	1587	143,5
1664	1	8	49	24	1794	125,1
65	0	23	1	0	2000	105,7
66	0	13	12	36	2206	86,4
67	0	3	24	12	2412	67,0
68	0	12	4	24	171	48,6
1669	0	2	16	0	377	29,2
70	1	10	56	12	584	10,9
71	1	1	7	48	790	216,9
72	1	9	48	0	997	198,5
73	0	23	59	36	1203	179,1
1674	0	14	11	12	1409	159,7
75	0	14	22	48	1615	140,3
76	0	13	3	0	1822	121,9
77	0	3	14	36	2028	102,5
78	1	11	54	48	2235	84,1
1679	1	2	6	24	2441	64,7
80	1	10	46	36	200	46,4
81	1	0	58	12	406	27,0
82	0	15	9	48	612	7,6
83	0	5	21	24	818	213,6
1684	0	14	1	36	1025	195,3
85	0	4	13	12	1231	175,9
86	1	12	53	24	1438	157,5
87	1	3	5	0	1644	138,1
88	1	11	45	12	1851	119,7
1689	1	1	56	48	2057	100,4

The *Epocha* of the Revolutions of the first *Satellite* to the Shadow of *Jupiter* under the Meridian of *London*.

Jul. Years	D.	h.	′	″	Num.I.	NumII
1690	0	16	8	24	2263	81,0
91	0	6	20	0	21	61,6
92	0	15	0	12	228	43,3
93	0	5	11	48	434	23,9
94	1	13	52	0	641	5,5
1695	1	4	3	36	847	211,5
96	1	12	43	48	1054	193,1
97	1	2	55	24	1260	173,7
98	0	17	7	0	1466	154,4
99	0	7	18	36	1672	136,0
1700	0	15	58	48	1879	116,6
01	0	6	10	24	2085	97,3
02	1	14	50	36	2292	78,9
03	1	5	2	12	50	59,5
04	1	13	42	24	257	41,1
1705	1	3	54	0	463	21,8
06	0	18	5	36	669	2,4
07	0	8	17	12	875	208,4
08	0	16	57	24	1082	190,0
09	0	7	9	0	1288	170,6
1710	1	15	49	12	1495	152,3
11	1	6	0	48	1701	132,9
12	1	14	41	0	1908	114,5
13	1	4	52	36	2114	95,1
14	0	19	4	12	2320	75,8
1715	0	9	15	48	78	56,4
16	0	17	56	0	285	38,0
17	0	8	7	36	491	18,6
18	1	16	47	48	698	0,3
19	1	6	59	24	904	206,3
1720	1	15	39	36	1111	187,9

A Table

A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

January. D.	h.	′	″	Num.I	Num.II
0	0	0	0	0	0,0
1	18	28	36	1	1,0
3	12	57	12	2	2,1
5	7	25	48	3	3,1
7	1	54	24	4	4,1
8	20	23	0	5	5,2
10	14	51	36	6	6,2
12	9	20	12	7	7,2
14	3	48	48	8	8,2
15	22	17	24	9	9,3
17	16	46	0	10	10,3
19	11	14	36	11	11,3
21	5	43	12	12	12,3
23	0	11	48	13	13,4
24	18	40	24	14	14,4
26	13	9	0	15	15,4
28	7	37	36	16	16,5
30	2	6	12	17	17,5
31	20	34	48	18	18,5
February.					
0	20	34	48	18	18,5
2	15	3	24	19	19,6
4	9	32	0	20	20,6
6	4	0	36	21	21,6
7	22	29	12	22	22,6
9	16	57	48	23	23,7
11	11	26	24	24	24,7
13	5	55	0	25	25,7

February. D.	h.	′	″	Num.I	Num.II
13	5	55	0	25	25,7
15	0	23	36	26	26,7
16	18	52	12	27	27,7
18	13	20	48	28	28,7
20	7	49	24	29	29,7
22	2	18	0	30	30,8
23	20	46	36	31	31,8
25	15	15	12	32	32,8
27	9	43	48	33	33,8
March.					
1	4	12	24	34	34,8
2	22	41	0	35	35,8
4	17	9	36	36	36,8
6	11	38	12	37	37,9
8	6	6	48	38	38,9
10	0	35	24	39	39,9
11	19	4	0	40	40,9
13	13	32	36	41	41,9
15	8	1	12	42	42,9
17	2	29	48	43	43,9
18	20	58	24	44	44,9
20	15	27	0	45	45,9
22	9	55	36	46	46,9
24	4	24	12	47	47,9
25	22	52	48	48	48,9
27	17	21	24	49	49,9
29	11	50	0	50	50,9
31	6	18	36	51	51,9

A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

April. D.	h.	′	″	Num.I	Num.II
0	6	18	36	51	51,9
2	0	47	12	52	52,9
3	19	15	48	53	53,9
5	13	44	24	54	54,9
7	8	13	0	55	55,9
9	2	41	36	56	56,9
10	21	10	12	57	57,9
12	15	38	48	58	58,9
14	10	7	24	59	59,9
16	4	36	0	60	60,8
17	23	4	36	61	61,8
19	17	33	12	62	62,8
21	12	1	48	63	63,8
23	6	30	24	64	64,8
25	0	59	0	65	65,7
26	19	27	36	66	66,7
28	13	56	12	67	67,7
30	8	24	48	68	68,6
May.					
0	8	24	48	68	68,6
2	2	53	24	69	69,6
3	21	22	0	70	70,6
5	15	50	36	71	71,6
7	10	19	12	72	72,5
9	4	47	48	73	73,5
10	23	16	24	74	74,5
12	17	45	0	75	75,5
14	12	13	36	76	76,4

May. D.	h.	′	″	Num.I	Num.II
14	12	13	36	76	76,4
16	6	42	12	77	77,4
18	1	10	48	78	78,4
19	19	39	24	79	79,3
21	14	8	0	80	80,3
23	8	36	36	81	81,3
25	3	5	12	82	82,3
26	21	33	48	83	83,3
28	16	2	24	84	84,2
30	10	31	0	85	85,2
June.					
1	4	59	36	86	86,1
2	23	28	12	87	87,1
4	17	56	48	88	88,0
6	12	25	24	89	89,0
8	6	54	0	90	90,0
10	1	22	36	91	90,9
11	19	51	12	92	91,9
13	14	19	48	93	92,9
15	8	48	24	94	93,8
17	3	17	0	95	94,8
18	21	45	36	96	95,7
20	16	14	12	97	96,7
22	10	42	48	98	97,7
24	5	11	24	99	98,6
27	23	40	0	100	99,6
29	18	8	36	101	100,6
29	12	37	12	102	101,5

A Table

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A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

June. D.	h.	'	"	Num.I.	NumII	*August.* D.	h.	'	"	Num.I.	NumII
1	7	5	48	103	102,5	14	13	0	48	128	126,8
3	1	34	24	104	103,5	16	7	29	24	129	127,7
4	20	3	0	105	104,4	18	1	58	0	130	128,7
6	14	31	36	106	105,4	19	20	26	36	131	129,7
8	9	0	12	107	106,4	21	14	55	12	132	130,7
10	3	28	48	108	107,3	23	9	23	48	133	131,7
11	21	57	24	109	108,3	25	3	52	24	134	132,7
13	16	26	0	110	109,3	26	22	21	0	135	133,6
15	10	54	36	111	110,2	28	16	49	36	136	134,6
17	5	23	12	112	111,2	30	11	18	12	137	135,6
18	23	51	48	113	112,2						
20	18	20	24	114	113,1	*September.*					
22	12	49	0	115	114,1						
24	7	17	36	116	115,1	1	5	46	48	138	136,6
26	1	46	12	117	116,0	3	0	15	24	139	137,6
27	20	14	48	118	117,0	4	48	44	0	140	138,6
29	14	43	24	119	118,0	6	13	12	36	141	139,6
31	9	12	0	120	119,0	8	7	41	12	142	140,6
						10	2	9	48	143	141,5
August.						11	20	38	24	144	142,5
						13	15	7	0	145	143,5
						15	9	35	36	146	144,5
0	9	12	0	120	119,0	17	4	4	12	147	145,5
2	3	40	36	121	119,9	18	22	32	48	148	146,5
3	22	9	12	122	120,9	20	17	1	24	149	147,5
5	16	37	48	123	121,9	22	11	30	0	150	148,5
7	11	6	24	124	122,9						
9	5	35	0	125	123,8	24	5	58	36	151	149,5
11	0	3	36	126	124,8	26	0	27	12	152	150,5
12	18	32	12	127	125,8	27	18	55	48	153	151,5
14	13	0	48	128	126,8	29	13	24	24	154	152,5

A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

October. D.	h.	'	"	Num.I.	NumII	*November.* D.	h.	'	"	Num.I.	NumII
1	7	53	0	155	153,5	16	8	16	36	181	180,0
3	2	21	36	156	154,5	18	2	45	12	182	181,0
4	20	50	12	157	155,5	19	21	13	48	183	182,0
6	15	18	48	158	156,5	21	15	42	24	184	183,0
8	9	47	24	159	157,5	23	10	11	0	185	184,0
10	4	16	0	160	158,5	25	4	39	36	186	185,1
11	22	44	36	161	159,5	26	23	8	12	187	186,1
13	17	13	12	162	160,5	28	17	36	48	188	187,2
15	11	41	48	163	161,6	30	12	5	24	189	188,2
17	6	10	24	164	162,6	*December.*					
19	0	39	0	165	163,6						
20	19	7	36	166	164,6	0	12	5	24	189	188,2
22	13	36	12	167	165,6	2	6	34	0	190	189,2
24	8	4	48	168	166,6	4	1	2	36	191	190,3
26	2	33	24	169	167,7	5	19	31	12	192	191,3
27	21	2	0	170	168,7	7	13	59	48	193	192,3
29	15	30	36	171	169,7	9	8	28	24	194	193,4
31	9	59	12	172	170,7	11	2	57	0	195	194,4
November.						12	21	25	36	196	195,5
						14	15	54	12	197	196,5
0	9	59	12	172	170,7	16	10	22	48	198	197,6
2	4	27	48	173	171,8	18	4	51	24	199	198,6
3	22	56	24	174	172,8	19	23	20	0	200	199,7
5	17	25	0	175	173,8	21	17	48	36	201	200,7
7	11	53	36	176	174,8	23	12	17	12	202	201,8
9	6	22	12	177	175,9	25	6	45	48	203	202,8
11	0	50	48	178	176,9	27	1	14	24	204	203,9
12	19	19	24	179	177,9	28	19	43	0	205	204,9
14	13	48	0	180	178,9	30	14	11	36	206	206,0
16	8	16	36	181	80,0						

A Table

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A Table of the first Equation of the Conjunctions of the first *Satellite* with *Jupiter*.

Num. I.	Equat. ′	″	Num. I.	Equat. ′	″	Num. I.	Equat. ′	″	Num. I.	Equat. ′	″
0	0	0	300	28	9	610	39	5	920	26	37
10	1	3	310	28	54	620	39	3	930	25	53
20	2	5	320	29	35	630	38	58	940	25	8
30	3	8	330	30	11	640	38	51	950	24	23
40	4	12	340	30	45	650	38	44	960	23	37
50	5	15	350	31	28	660	38	34	970	22	50
60	6	16	360	32	10	670	38	24	980	22	3
70	7	19	370	32	44	680	38	10	990	21	15
80	8	20	380	33	15	690	37	56	1000	20	26
90	9	23	390	33	49	700	37	40	1010	19	37
100	10	25	400	34	20	710	37	24	1020	18	47
110	11	25	410	34	51	720	37	5	1030	17	56
120	12	25	420	35	21	730	36	45	1040	17	5
130	13	25	430	35	47	740	36	25	1050	16	13
140	14	25	440	36	6	750	36	4	1060	15	19
150	15	22	450	36	26	760	35	40	1070	14	25
160	16	18	460	36	47	770	45	15	1080	13	32
170	17	17	470	37	8	780	34	49	1090	12	37
180	18	11	480	37	29	790	34	19	1100	11	42
190	19	9	490	37	44	800	33	49	1110	10	47
200	20	5	500	37	59	810	33	21	1120	9	52
210	20	56	510	38	16	820	32	50	1130	8	57
220	21	49	520	38	29	830	32	17	1140	8	0
230	22	41	530	38	39	840	31	44	1150	7	3
240	23	32	540	38	49	850	31	10	1160	6	7
250	24	20	550	38	55	860	30	32	1170	5	10
260	25	7	560	38	59	870	29	56	1180	4	13
270	25	57	570	39	3	880	29	19	1190	3	15
280	26	43	580	39	6	890	28	40	1200	2	19
290	27	27	590	39	8	900	27	59	1210	1	21
300	28	9	600	39	7	910	27	19	1220	0	24
			610	39	5	920	26	37	1230	0	0

A Table of the second Equation of the Conjunctions of the first *Satellite* with *Jupiter*.

Num. II	Equat. add ′	″	Num. II	Equat. add ′	″	Num. II	Equat. add ′	″	Num. II	Equat. add ′	″
0	0	0	28	2	4	56	7	0	84	12	0
1	0	0	29	2	13	57	7	12	85	12	9
2	0	1	30	2	21	58	7	24	86	12	16
3	0	2	31	2	30	59	7	36	87	12	24
4	0	3	32	2	39	60	7	47	88	12	32
5	0	4	33	2	48	61	7	59	89	12	40
6	0	6	34	2	58	62	8	11	90	12	47
7	0	8	35	3	8	63	8	22	91	12	53
8	0	10	36	3	17	64	8	34	92	13	0
9	0	14	37	3	27	65	8	36	93	13	6
10	0	17	38	3	37	66	8	57	94	13	13
11	0	20	39	3	48	67	9	8	95	13	19
12	0	23	40	3	59	68	9	20	96	13	24
13	0	27	41	4	9	69	9	32	97	13	30
14	0	32	42	4	20	70	9	44	98	13	35
15	0	37	43	4	31	71	9	54	99	13	39
16	0	42	44	4	41	72	10	3	100	13	45
17	0	47	45	4	53	73	10	14	101	13	48
18	0	53	46	5	4	74	10	25	102	13	51
19	0	58	47	5	15	75	10	35	103	13	54
20	0	4	48	5	27	76	10	45	104	13	57
21	1	11	49	5	39	77	10	55	105	14	0
22	1	18	50	5	50	78	11	5	106	14	3
23	1	25	51	6	2	79	11	15	107	14	5
24	1	32	52	6	14	80	11	25	108	14	7
25	1	40	53	6	25	81	11	34	109	14	8
26	1	47	54	6	37	82	11	43	110	14	9
27	1	56	55	6	49	83	11	52	111	14	10
28	2	4	56	7	0	84	12	0	112	14	10

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A Table of the half Duration of the first *Satellite* in the Shadow of *Saturn*.

Num.I.	H.	′	″	Num.I.	H.	′	″
0	1	4	56	1200	1	5	6
40	1	4	33	1240	1	4	48
80	1	4	12	1280	1	4	26
120	1	3	59	1320	1	4	7
160	1	3	48	1360	1	3	54
200	1	3	36	1400	1	3	38
240	1	3	38	1440	1	3	38
280	1	3	48	1480	1	3	44
320	1	4	1	1520	1	3	52
360	1	4	16	1560	1	4	7
400	1	4	36	1600	1	4	24
440	1	4	56	1640	1	4	42
480	1	5	18	1680	1	5	0
520	1	5	41	1720	1	5	22
560	1	6	1	1760	1	5	46
600	1	6	21	1800	1	6	10
640	1	6	39	1840	1	6	28
680	1	6	53	1880	1	6	45
720	1	7	3	1920	1	6	57
760	1	7	11	1960	1	7	7
800	1	7	15	2000	1	7	13
840	1	7	13	2040	1	7	14
880	1	7	9	2080	1	7	15
920	1	7	2	2120	1	7	15
960	1	6	54	2160	1	7	10
1000	1	6	39	2200	1	6	49
1040	1	6	22	2240	1	6	32
1080	1	6	5	2280	1	6	15
1120	1	5	45	2320	1	5	58
1160	1	5	26	2360	1	5	38
1200	1	5	6	2400	1	5	18
				2440	1	5	2

A Table of the mean Motion of *Saturn* from the *Aphelion*.

Year from Christ	Anomaly. s	°	′	″
1	6	8	34	18
1501	5	10	11	48
1581	1	27	53	0
1601	10	2	18	18
1621	6	6	43	36
1641	2	11	8	54
1661	10	15	34	12
1681	6	19	59	30
1701	2	24	24	48
1721	10	28	50	6
1741	7	3	15	24
1761	3	7	40	42
1781	11	12	6	0
1801	7	16	31	18
1901	0	8	37	48
2001	5	0	44	18
Years	Anom. Mot.			
20	8	4	25	18
40	4	8	50	36
60	0	13	15	54
80	8	17	41	12
100	4	22	6	30
200	9	14	13	0
300	2	6	19	30
400	6	28	26	0
500	11	20	32	30
600	4	12	39	0
700	9	4	45	30
800	1	26	52	0
900	6	18	58	30
1000	11	11	5	0
2000	10	22	10	0
3000	10	3	15	0
4000	9	14	20	0
5000	8	25	25	0
6000	8	6	30	0

Years	Anom. Mot. s	°	′	″
1	0	12	12	46
2	0	24	25	32
3	1	6	38	17
4	1	18	53	4
5	2	1	5	49
6	2	13	18	35
7	2	25	31	21
8	3	7	46	7
9	3	19	58	53
10	4	2	11	39
11	4	14	24	25
12	4	26	39	11
13	5	8	51	57
14	5	21	4	42
15	6	3	17	28
16	6	15	32	14
17	6	27	45	0
18	7	9	57	46
19	7	22	10	32
20	8	4	25	18

Months	Anom. Mot. °	′	″
January	0	0	0
February	1	2	14
March	1	58	27
April	3	0	41
May	4	0	55
June	5	3	9
July	6	3	22
August	7	5	36
September	8	7	50
October	9	8	4
November	10	10	18
December	11	10	32

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

A Table

A Table of the mean Motion of *Saturn* from the *Aphelion*.

Days	Anom. Mot. ° ' "	H. '	Anom. Mot. ' " / " '''	H. '	Anom. Mot. ' " / " '''
1	0 2 0				
2	0 4 1				
3	0 6 1	1	0 5	31	2 36
4	0 8 2	2	0 10	32	2 41
5	0 10 2	3	0 15	33	2 46
6	0 12 3	4	0 20	34	2 51
7	0 14 3	5	0 25	35	2 56
8	0 16 4	6	0 30	36	3 1
9	0 18 4	7	0 35	37	3 6
10	0 20 5	8	0 40	38	3 11
11	0 22 5	9	0 45	39	3 16
12	0 24 5	10	0 50	40	3 21
13	0 26 6	11	0 55	41	3 16
14	0 28 6	12	0 0	42	3 21
15	0 30 7	13	1 5	43	3 26
16	0 32 7	14	1 10	44	3 31
17	0 34 8	15	1 15	45	3 46
18	0 36 8	16	1 20	46	3 51
19	0 38 9	17	1 25	47	3 56
20	0 40 9	18	1 30	48	4 1
21	0 42 10	19	1 35	49	4 6
22	0 44 10	20	1 40	50	4 11
23	0 46 10	21	1 45	51	4 16
24	0 48 11	22	1 50	52	4 21
25	0 50 11	23	1 55	53	4 26
26	0 52 12	24	2 0	54	4 31
27	0 54 12	25	2 5	55	4 36
28	0 56 13	26	2 10	56	4 41
29	0 58 13	27	2 16	57	4 46
30	1 0 14	28	2 21	58	4 51
31	1 2 14	29	2 26	59	4 56
32	1 4 15	30	2 31	60	5 1

	s	°	'	"
Long. Aph. ♄ à 1 ✳ ♈	7	28	30	0
Long. ☊ ♄ à 1 ✳ ♈	2	22	30	0
Inclin. Orb. ♄		2	30	0

Dist. Mid. ♄ à ☉ —— 953800

Eccentricity —— 54700

A Table of the Heliocentrick Place of *Saturn*.

Sign. 0.

Mid. Anom. °	Long. ♄ à 1 ✳ ♈ s	°	'	"	Inc. North. °	'	"	Dis. à ☉ Curt. Logarithm.
0	7	28	31	13	1	1	0	6. 003608
1	7	29	24	46	0	58	51	6. 003609
2	8	0	18	19	0	56	42	6. 003605
3	8	1	11	52	0	54	31	6. 003593
4	8	2	5	24	0	52	20	6. 003575
5	8	2	58	58	0	50	9	6. 003550
6	8	3	52	32	0	47	56	6. 003519
7	8	4	46	6	0	45	43	6. 003481
8	8	5	39	41	0	43	29	6. 003435
9	8	6	33	16	0	41	14	6. 003386
10	8	7	26	52	0	38	59	6. 003328
11	8	8	20	30	0	36	43	6. 003263
12	8	9	14	8	0	34	26	6. 003193
13	8	10	7	48	0	32	9	6. 003115
14	8	11	1	28	0	29	52	6. 003032
15	8	11	55	10	0	27	34	6. 002942
16	8	12	48	53	0	25	15	6. 002845
17	8	13	42	37	0	22	56	6. 002743
18	8	14	36	24	0	20	37	6. 002633
19	8	15	30	13	0	18	17	6. 002517
20	8	16	24	2	0	15	57	6. 002395
21	8	17	17	53	0	13	37	6. 002267
22	8	18	11	47	0	11	16	6. 002131
23	8	19	5	43	0	8	55	6. 001990
24	8	19	59	40	0	6	34	6. 001842
25	8	20	53	40	0	4	12	6. 001688
26	8	21	47	42	0	1	51	6. 001527
27	8	22	41	47	South		31	6. 001361
28	8	23	35	54	0	2	53	6. 001188
29	8	24	30	4	0	5	15	6. 001009
30	8	25	24	16	0	7	36	6. 000823

A Table

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 1. Long. ♄ à ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	8	25	24	16	0	7	36	6. 000823
1	8	26	18	32	0	9	58	6. 000632
2	8	27	12	50	0	12	20	6. 000435
3	8	28	7	11	0	14	42	6. 000232
4	8	29	1	36	0	17	4	6. 000022
5	8	29	56	3	0	19	25	5. 999806
6	9	0	50	34	0	21	47	5. 999585
7	9	1	45	8	0	24	8	5. 999358
8	9	2	34	46	0	26	29	5. 999125
9	9	3	39	27	0	28	50	5. 998887
10	9	4	29	11	0	31	10	5. 998642
11	9	5	24	0	0	33	30	5. 998391
12	9	6	18	53	0	35	50	5. 998135
13	9	7	13	49	0	38	10	5. 997874
14	9	8	8	49	0	40	29	5. 997607
15	9	9	3	53	0	42	47	5. 997334
16	9	9	59	2	0	45	5	5. 997056
17	9	10	54	15	0	47	23	5. 996772
18	9	11	49	32	0	49	40	5. 996484
19	9	12	44	54	0	51	57	5. 996189
20	9	13	40	20	0	54	12	5. 995890
21	9	14	35	51	0	56	27	5. 995585
22	9	15	31	26	0	58	42	5. 995277
23	9	16	27	6	1	0	56	5. 994962
24	9	17	22	52	1	3	9	5. 994643
25	9	18	18	42	1	5	21	5. 994319
26	9	19	14	38	1	7	32	5. 993989
27	9	20	10	39	1	9	42	5. 993656
28	9	21	6	43	1	11	52	5. 993317
29	9	22	2	54	1	14	1	5. 992973
30	9	22	59	10	1	16	8	5. 992625

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 2. Long. ♄ à ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	9	22	59	10	1	16	8	5. 992625
1	9	23	55	32	1	18	15	5. 992273
2	9	24	52	0	1	20	20	5. 991917
3	9	25	48	32	1	22	25	5. 991557
4	9	26	45	10	1	24	28	5. 991192
5	9	27	41	55	1	26	30	5. 990824
6	9	28	38	45	1	28	31	5. 990451
7	9	29	35	41	1	30	30	5. 990074
8	10	0	32	42	1	32	29	5. 989694
9	10	1	29	50	1	34	26	5. 989310
10	10	2	27	4	1	36	21	5. 988922
11	10	3	24	24	1	38	16	5. 988532
12	10	4	21	50	1	40	8	5. 988137
13	10	5	19	23	1	42	0	5. 987739
14	10	6	17	3	1	43	50	5. 987338
15	10	7	14	48	1	45	38	5. 986934
16	10	8	12	40	1	47	24	5. 986527
17	10	9	10	38	1	49	9	5. 986117
18	10	10	8	44	1	50	53	5. 985704
19	10	11	6	56	1	52	35	5. 985288
20	10	12	5	14	1	54	14	5. 984870
21	10	13	3	40	1	55	53	5. 984450
22	10	14	2	13	1	57	29	5. 984027
23	10	15	0	52	1	59	3	5. 983603
24	10	15	59	38	2	0	36	5. 983176
25	10	16	58	30	2	2	6	5. 982747
26	10	17	57	29	2	3	35	5. 982315
27	10	18	56	37	2	5	2	5. 981883
28	10	19	55	50	2	6	26	5. 981448
29	10	20	55	12	2	7	48	5. 981013
30	10	21	54	42	2	9	9	5. 980576

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 3. Long. ♄ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	10	21	54	42	2	9	9	5. 980576
1	10	22	54	18	2	10	27	5. 980139
2	10	23	54	1	2	11	43	5. 979700
3	10	24	53	51	2	12	57	5. 979260
4	10	25	53	49	2	14	8	5. 978819
5	10	26	53	54	2	15	17	5. 978378
6	10	27	54	6	2	16	24	5. 977936
7	10	28	54	25	2	17	29	5. 977494
8	10	29	54	52	2	18	31	5. 977051
9	11	0	55	27	2	19	30	5. 976609
10	11	1	56	8	2	20	27	5. 976166
11	11	2	56	58	2	21	22	5. 975724
12	11	3	57	54	2	22	14	5. 975282
13	11	4	58	59	2	23	3	5. 974841
14	11	6	0	12	2	23	50	5. 974400
15	11	7	1	31	2	24	34	5. 973960
16	11	8	2	58	2	25	16	5. 973520
17	11	9	4	32	2	25	54	5. 973083
18	11	10	6	13	2	26	30	5. 972647
19	11	11	8	2	2	27	4	5. 972211
20	11	12	10	0	2	27	34	5. 971777
21	11	13	12	3	2	28	2	5. 971345
22	11	14	14	15	2	28	27	5. 970915
23	11	15	16	33	2	28	49	5. 970487
24	11	16	18	59	2	29	8	5. 970060
25	11	17	21	34	2	29	24	5. 969637
26	11	18	24	14	2	29	37	5. 969216
27	11	19	27	3	2	29	47	5. 968798
28	11	20	29	57	2	29	55	5. 968382
29	11	21	33	1	2	29	59	5. 967970
30	11	22	36	10	2	30	0	5. 967559

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 4. Long. ♄ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	11	22	36	10	2	30	0	5. 967559
1	11	23	39	27	2	29	58	5. 967153
2	11	24	42	52	2	29	53	5. 966750
3	11	25	46	22	2	29	45	5. 966350
4	11	26	50	0	2	29	34	5. 965954
5	11	27	53	45	2	29	20	5. 965562
6	11	28	57	38	2	29	3	5. 965275
7	0	0	1	37	2	28	43	5. 964791
8	0	1	5	42	2	28	19	5. 964412
9	0	2	9	54	2	27	52	5. 964036
10	0	3	14	13	2	27	23	5. 963666
11	0	4	18	37	2	26	50	5. 963300
12	0	5	23	10	2	26	14	5. 962939
13	0	6	27	48	2	25	34	5. 962584
14	0	7	32	32	2	24	52	5. 962233
15	0	8	37	23	2	24	6	5. 961888
16	0	9	42	20	2	23	18	5. 961549
17	0	10	47	23	2	22	26	5. 961214
18	0	11	52	32	2	21	31	5. 960886
19	0	12	57	46	2	20	33	5. 960564
20	0	14	3	6	2	19	31	5. 960248
21	0	15	8	33	2	18	27	5. 959938
22	0	16	14	4	2	17	20	5. 959634
23	0	17	19	42	2	16	9	5. 959337
24	0	18	25	24	2	14	55	5. 959046
25	0	19	31	11	2	13	39	5. 958762
26	0	20	37	3	2	12	19	5. 958484
27	0	21	43	1	2	10	56	5. 958214
28	0	22	49	4	2	9	30	5. 957951
29	0	23	55	11	2	8	2	5. 957695
30	0	25	1	23	2	6	30	5. 957445

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A Table of the Heliocentrick Place of *Saturn*.

Mid. Auom.	Sign. 5.							
	Long. ♄ à 1 ✶ ♈				Inc. South.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	0	25	1	23	2	6	30	5. 957445
1	0	26	7	40	2	4	55	5. 957203
2	0	27	14	0	2	3	18	5. 956969
3	0	28	20	25	2	1	37	5. 956742
4	0	29	26	53	1	59	54	5. 956523
5	1	0	33	26	1	58	8	5. 956312
6	1	1	40	3	1	56	20	5. 956107
7	1	2	46	44	1	54	28	5. 955912
8	1	3	53	27	1	52	34	5. 955724
9	1	5	0	15	1	50	37	5. 955544
10	1	6	7	5	1	48	38	5. 955373
11	1	7	13	58	1	46	36	5. 955210
12	1	8	20	55	1	44	31	5. 955055
13	1	9	27	54	1	42	24	5. 954910
14	1	10	34	57	1	40	15	5. 954771
15	1	11	42	1	1	38	3	5. 254641
16	1	12	49	8	1	35	49	5. 954520
17	1	13	56	16	1	33	32	5. 954408
18	1	15	3	26	1	31	14	5. 954304
19	1	16	10	38	1	28	53	5. 954209
20	1	17	17	53	1	26	30	5. 954122
21	1	18	25	9	1	24	5	5. 954044
22	1	19	32	27	1	21	39	5. 953974
23	1	20	39	45	1	19	10	5. 953914
24	1	21	47	4	1	16	39	5. 953862
25	1	22	54	24	1	14	7	5. 953819
26	1	24	1	45	1	11	32	5. 953786
27	1	25	9	7	1	8	57	5. 953761
28	1	26	16	28	1	6	19	5. 953745
29	1	27	23	50	1	3	40	5. 953738
30	1	28	31	13	1	1	0	5. 953740

A Table of the Heliocentrick Place of *Saturn*.

Mid. Auom.	Sign. 6.							
	Long. ♄ à ✶ ♈				Inc. South.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	1	28	31	13	1	1	0	5. 953740
1	1	29	38	36	0	58	18	5. 953750
2	2	0	45	57	0	55	35	5. 953769
3	2	1	53	18	0	52	50	5. 953797
4	2	3	0	39	0	50	4	5. 953834
5	2	4	7	59	0	47	18	5. 953879
6	2	5	15	18	0	44	30	5. 953934
7	2	6	22	35	0	41	41	5. 953997
8	2	7	29	52	0	38	51	5. 954069
9	2	8	37	8	0	36	0	5. 954150
10	2	9	44	21	0	33	9	5. 954239
11	2	10	51	34	0	30	27	5. 954337
12	2	11	58	43	0	27	24	5. 954443
13	2	13	5	51	0	24	31	5. 954558
14	2	14	12	57	0	21	38	5. 954680
15	2	15	20	0	0	18	44	5. 954812
16	2	16	27	1	0	15	49	5. 954951
17	2	17	34	1	0	12	54	5. 955099
18	2	18	40	56	0	10	0	5. 955254
19	2	19	47	49	0	7	5	5. 955418
20	2	20	54	38	0	4	10	5. 955590
21	2	22	1	25	0	1	15	5. 955769
22	2	23	8	8	*North*	1	40	5. 955957
23	2	24	14	47	0	4	35	5. 956153
24	2	25	21	23	0	7	29	5. 956355
25	2	26	27	55	0	10	23	5. 956566
26	2	27	34	24	0	13	16	5. 956784
27	2	28	40	47	0	16	9	5. 957009
28	2	29	47	7	0	19	2	5. 957241
29	3	0	53	23	0	21	54	5. 957481
30	3	1	59	34	0	24	45	5. 957728

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 7. Long. ♄ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	'	"	°	'	"	
0	3	1	59	34	0	24	54	5. 957728
1	3	3	5	40	0	27	36	5. 957982
2	3	4	11	42	0	30	25	5. 958242
3	3	5	17	40	0	33	14	5. 958509
4	3	6	23	32	0	36	2	5. 958782
5	3	7	29	19	0	38	49	5. 959062
6	3	8	35	0	0	41	35	5. 959349
7	3	9	40	37	0	44	19	5. 959642
8	3	10	46	9	0	47	3	5. 959950
9	3	11	51	35	0	49	45	5. 960245
10	3	12	56	57	0	52	26	5. 960555
11	3	14	2	11	0	55	6	5. 960871
12	3	15	7	20	0	57	44	5. 961193
13	3	16	12	24	1	0	20	5. 961520
14	3	17	17	21	1	2	55	5. 961853
15	3	18	22	12	1	5	29	5. 962191
16	3	19	26	58	1	8	1	5. 962534
17	3	20	31	37	1	10	31	5. 962882
18	3	21	39	10	1	13	0	5. 963234
19	3	22	40	37	1	15	26	5. 963592
20	3	23	44	56	1	17	51	5. 963954
21	3	24	49	10	1	20	14	5. 964329
22	3	25	53	17	1	22	35	5. 964691
23	3	26	57	18	1	24	54	5. 965065
24	3	28	1	11	1	27	11	5. 965443
25	3	29	4	59	1	29	26	5. 965825
26	4	0	8	40	1	31	39	5. 966211
27	4	1	12	13	1	33	50	5. 966600
28	4	2	15	39	1	35	58	5. 966993
29	4	3	19	0	1	38	5	5. 967389
30	4	4	22	12	1	40	9	5. 967789

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 8. Long. ♄ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	'	"	°	'	"	
0	4	4	22	12	1	46	9	5. 967789
1	4	5	25	18	1	42	11	5. 968191
2	4	6	28	18	1	44	11	5. 968595
3	4	7	31	9	1	46	8	5. 969003
4	4	8	33	54	1	48	3	5. 969412
5	4	9	36	31	1	49	56	5. 969825
6	4	10	39	2	1	51	46	5. 970240
7	4	11	41	25	1	53	34	5. 970657
8	4	12	43	40	1	55	19	5. 971076
9	4	13	45	50	1	57	2	5. 971496
10	4	14	47	51	1	58	42	5. 971918
11	4	15	49	46	2	0	20	5. 972343
12	4	16	51	33	2	1	56	5. 972768
13	4	17	53	12	2	3	29	5. 973194
14	4	18	54	44	2	4	59	5. 973621
15	4	19	56	10	2	6	27	5. 974050
16	4	20	57	27	2	7	52	5. 974480
17	4	21	58	38	2	9	14	5. 974910
18	4	22	59	42	2	10	34	5. 975341
19	4	24	0	38	2	11	51	5. 975771
20	4	25	1	27	2	13	6	5. 976203
21	4	26	2	8	2	14	18	5. 976635
22	4	27	2	42	2	15	27	5. 977067
23	4	28	3	9	2	16	34	5. 977498
24	4	29	3	28	2	17	38	5. 977930
25	4	0	3	41	2	18	39	5. 978361
26	5	1	3	46	2	19	38	5. 978792
27	5	2	3	45	2	20	34	5. 979222
28	5	3	3	35	2	21	27	5. 979651
29	5	4	3	19	2	22	18	5. 980080
30	5	5	2	56	2	23	6	5. 980507

A Table

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 9. Long. ♄ à 1 * ♈				Inc. North.			Dis. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	5	5	2	56	2	23	6	5. 980507
1	5	6	2	27	2	23	52	5. 980933
2	5	7	1	50	2	24	34	5. 981358
3	5	8	1	5	2	25	14	5. 981789
4	5	9	0	14	2	25	52	5. 982205
5	5	9	59	15	2	26	27	5. 982627
6	5	10	58	10	2	26	59	5. 983046
7	5	11	56	58	2	27	28	5. 983463
8	5	12	55	40	2	27	55	5. 983879
9	5	13	54	15	2	28	19	5. 984293
10	5	14	52	43	2	28	41	5. 984704
11	5	15	51	4	2	29	0	5. 985113
12	5	16	49	19	2	29	16	5. 985520
13	5	17	47	28	2	29	30	5. 985925
14	5	18	45	29	2	29	41	5. 986327
15	5	19	43	25	2	29	49	5. 986726
16	5	20	41	13	2	29	56	5. 987123
17	5	21	38	56	2	29	59	5. 987517
18	5	22	36	32	2	30	0	5. 987907
19	5	23	34	3	2	29	58	5. 988296
20	5	24	31	36	2	29	54	5. 988680
21	5	25	28	44	2	29	48	5. 989062
22	5	26	25	57	2	29	39	5. 989439
23	5	27	23	2	2	29	27	5. 989814
24	5	28	20	1	2	29	13	5. 990186
25	5	29	16	56	2	28	57	5. 990553
26	6	0	13	45	2	28	38	5. 990917
27	6	1	10	27	2	28	17	5. 991278
28	6	2	7	4	2	27	54	5. 991634
29	6	3	3	36	2	27	28	5. 991986
30	6	4	0	2	2	27	0	5. 992335

A Table of the Heliocentrick Place of *Saturn*.

Mid. Anom.	Sign. 10. Long. ♄ à 1 * ♈				Inc. North.			Dis. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	6	4	0	2	2	27	0	5. 992335
1	6	4	56	23	2	26	29	5. 992680
2	6	5	52	39	2	25	56	5. 993021
3	6	6	48	48	2	25	21	5. 993357
4	6	7	44	53	2	24	44	5. 993688
5	6	8	40	54	2	24	4	5. 994016
6	6	9	36	48	2	23	22	5. 994338
7	6	10	32	39	2	22	38	5. 994656
8	6	11	28	24	2	21	52	5. 994970
9	6	12	24	4	2	21	3	5. 945278
10	6	13	19	39	2	20	13	5. 995583
11	6	14	15	9	2	19	20	5. 995882
12	6	15	10	36	2	18	25	5. 996177
13	6	16	5	58	2	17	28	5. 996466
14	6	17	1	16	2	16	29	5. 996751
15	6	17	56	29	2	15	28	5. 997031
16	6	18	51	38	2	14	25	5. 997305
17	6	19	46	43	2	13	20	5. 997574
18	6	20	41	43	2	12	13	5. 997838
19	6	21	36	40	2	11	4	5. 998096
20	6	22	31	34	2	9	53	5. 998350
21	6	23	26	23	2	8	41	5. 998598
22	6	24	21	8	2	7	26	5. 998840
23	6	25	15	50	2	6	10	5. 999076
24	6	26	10	29	2	4	51	5. 999308
25	6	27	5	4	2	3	31	5. 999533
26	6	27	59	34	2	2	9	5. 999753
27	6	28	54	3	2	0	46	5. 999968
28	6	29	48	28	1	59	20	6. 000176
29	7	0	42	50	1	57	53	6. 000379
30	7	1	37	10	1	56	24	6. 000575

A Table

Digitized by Google

A Table of the Heliocentrick Place of *Saturn.*

Mid. Anom.	Sign. II. Long. ♄ à I ✱ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
o	s	o	'	"	o	'	"	
0	7	1	37	10	1	56	24	6. 000575
1	7	2	31	26	1	54	54	6. 000767
2	7	3	25	39	1	53	22	6. 000951
3	7	4	19	50	1	51	48	6. 001131
4	7	5	13	58	1	50	13	6. 001304
5	7	6	8	4	1	48	36	6. 001472
6	7	7	2	7	1	46	57	6. 001632
7	7	7	56	7	1	45	17	6. 001787
8	7	8	50	6	1	43	36	6. 001936
9	7	9	44	3	1	41	53	6. 002079
10	7	10	37	57	1	40	9	6. 002216
11	7	11	31	49	1	38	23	6. 002345
12	7	12	25	40	1	36	36	6. 002470
13	7	13	19	28	1	34	47	6. 002588
14	7	14	13	14	1	32	58	6. 002698
15	7	15	7	0	1	31	7	6. 002803
16	7	16	0	44	1	29	14	6. 002902
17	7	16	54	26	1	27	20	6. 002994
18	7	17	48	8	1	25	25	6. 003081
19	7	18	41	48	1	23	29	6. 003160
20	7	19	35	27	1	21	34	6. 003234
21	7	20	29	4	1	19	34	6. 003301
22	7	21	22	41	1	17	34	6. 003360
23	7	22	16	17	1	15	33	6. 003414
24	7	23	9	52	1	13	31	6. 003462
25	7	24	3	26	1	11	29	6. 003502
26	7	24	57	0	1	9	25	6. 003536
27	7	25	50	33	1	7	20	6. 003565
28	7	26	44	7	1	5	14	6. 003585
29	7	27	37	40	1	3	7	6. 003600
30	7	28	31	13	1	1	0	6. 003608

A Table of the mean Motion of *Jupiter* from the *Aphelion.*

Years from Christ	Anomaly ♃ s	o	'	"
1	0	13	54	30
1501	5	28	17	0
1581	2	26	15	0
1601	11	3	14	30
1621	7	10	14	0
1641	3	17	13	30
1661	11	24	13	0
1681	8	1	12	30
1701	4	8	12	0
1721	0	15	11	30
1741	8	22	11	0
1761	4	29	10	30
1781	1	6	10	0
1801	9	13	9	30
1901	2	13	7	0
2001	7	23	4	30
Years	Anom. Mot.			
20	8	6	59	30
40	4	13	59	0
60	0	20	58	30
80	8	27	58	0
100	5	4	57	30
200	10	9	55	0
300	3	14	52	30
400	8	19	50	0
500	1	24	47	30
600	6	29	45	0
700	0	4	42	30
800	5	9	40	0
900	10	14	37	30
1000	3	19	55	0
2000	7	9	10	0
3000	10	28	45	0
4000	2	18	20	0
5000	6	7	55	0
6000	9	27	30	0

Years	Anom. Mot. s	o	'	"
1	1	0	19	44
2	2	0	39	27
3	3	0	59	11
4	4	1	23	54
5	5	1	43	38
6	6	2	3	21
7	7	2	23	5
8	8	2	47	48
9	9	3	7	52
10	10	3	27	15
11	11	3	46	59
12	0	4	11	42
13	1	4	31	26
14	2	4	51	9
15	3	5	10	53
16	4	5	35	36
17	5	5	55	20
18	6	6	15	3
19	7	6	34	47
20	8	6	59	30
Months	Anom. Mot.	o	'	"
January		0	0	0
February		2	34	33
March		4	54	9
April		7	28	42
May		9	58	16
June		12	32	49
July		15	2	23
August		17	36	56
September		20	11	29
October		22	41	3
November		25	15	37
December		27	45	11

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

A Table

A Table of the mean Motion of *Jupiter* from the *Aphelion*.

Days	Anom. Mot. °	'	"	H. '	Anom. Mot. ' "	" '''	H. '	Anom. Mot. ' "	" '''
1	0	4	59						
2	0	9	58						
3	0	14	57	1	0	12	31	6	26
4	0	19	57	2	0	25	32	6	39
5	0	24	56	3	0	37	33	6	51
6	0	29	55	4	0	50	34	7	4
7	0	34	54	5	1	2	35	7	16
8	0	39	53	6	1	15	36	7	29
9	0	44	52	7	1	27	37	7	41
10	0	49	51	8	1	40	38	7	44
11	0	54	50	9	1	52	39	8	6
12	0	49	50	10	2	5	40	8	19
13	1	4	49	11	2	17	41	8	31
14	1	9	48	12	2	30	42	8	43
15	1	14	47	13	2	42	43	8	56
16	1	19	46	14	2	54	44	8	8
17	1	24	45	15	3	7	45	9	21
18	1	29	44	16	3	19	46	9	33
19	1	34	44	17	3	32	47	9	46
20	1	39	43	18	3	44	48	9	58
21	1	44	42	19	3	57	49	10	11
22	1	49	41	20	4	9	50	10	23
23	1	54	40	21	4	22	51	10	36
24	1	59	39	22	4	34	52	10	48
25	2	4	38	23	4	47	53	11	1
26	2	9	37	24	4	59	54	11	13
27	2	14	37	25	5	12	55	11	26
28	2	19	36	26	5	24	56	11	38
29	2	24	35	27	5	35	57	11	50
30	2	29	34	28	5	49	58	11	3
31	2	34	33	29	6	1	59	12	15
32	2	39	32	30	6	14	60	12	28

	s	°	'	"
Long. Aph. ♃ à 1 ✱ ♈ —	5	9	50	0
Long. ☊ ♃ à 1 ✱ ♈ —	2	8	00	0
Inclin. Orb. ♃ —		1	20	0

Dist. Mid. ♃ à ☉ — 520110

Eccentricity — 25050

A Table of the Heliocentrick Place of *Jupiter*. 36

Mid. Anom.	Sign. 0. Long. ♃ à 1 ✱ ♈ s	°	'	"	Inc. North. °	'	"	Dis. à ☉ Curt. Logarithm.
0	5	9	50	9	1	19	58	5. 736406
1	5	10	44	36	1	19	55	5. 736403
2	5	11	39	10	1	19	51	5. 736395
3	5	12	33	44	1	19	45	5. 736381
4	5	13	28	18	1	19	38	5. 736362
5	5	14	22	53	1	19	30	5. 736338
6	5	15	17	28	1	19	21	5. 736308
7	5	16	12	4	1	19	11	5. 736273
8	5	17	6	40	1	18	59	5. 736231
9	5	18	1	17	1	18	47	5. 736185
10	5	18	55	55	1	18	33	5. 736134
11	5	19	50	32	1	18	18	5. 736076
12	5	20	45	11	1	18	2	5. 736014
13	5	21	39	52	1	17	44	5. 735947
14	5	22	34	33	1	17	26	5. 735873
15	5	23	29	15	1	17	6	5. 735795
16	5	24	23	59	1	16	45	5. 735710
17	5	25	18	44	1	16	23	5. 735621
18	5	26	13	30	1	15	59	5. 735526
19	5	27	8	18	1	15	35	5. 735426
20	5	28	3	8	1	15	9	5. 735321
21	5	28	57	59	1	14	42	5. 735210
22	5	29	52	52	1	14	14	5. 735094
23	6	0	47	46	1	13	45	5. 734973
24	6	1	42	43	1	13	15	5. 734846
25	6	2	37	40	1	11	44	5. 734714
26	6	3	32	41	1	12	11	5. 734577
27	6	4	27	43	1	11	37	5. 734436
28	6	5	42	47	1	11	2	5. 734289
29	6	6	17	55	1	10	27	5. 734137
30	6	7	13	4	1	9	50	5. 733980

A Table of the Heliocentrick Place of *Jupiter.*

Mid. Anom.	Sign. 1. Long. ♃ à 1 * ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	6	7	13	4	1	9	50	5. 733980
1	6	8	8	15	1	9	11	5. 733818
2	6	9	3	30	1	8	32	5. 733652
3	6	9	58	46	1	7	52	5. 733479
4	6	10	54	5	1	7	10	5. 733302
5	6	11	49	28	1	6	28	5. 733120
6	6	12	44	53	1	5	44	5. 732934
7	6	13	40	20	1	5	0	5. 732741
8	6	14	35	52	1	4	14	5. 732545
9	6	15	31	26	1	3	27	5. 732344
10	6	16	27	3	1	2	39	5. 732139
11	6	17	22	43	1	1	51	5. 731928
12	6	18	18	26	1	1	1	5. 731713
13	6	19	14	14	1	0	10	5. 731492
14	6	20	10	4	0	59	18	5. 731268
15	6	21	5	58	0	58	25	5. 731039
16	6	22	1	55	0	57	31	5. 730807
17	6	22	57	56	0	56	36	5. 730570
18	6	23	54	1	0	55	41	5. 730327
19	6	24	50	9	0	54	44	5. 730081
20	6	25	46	22	0	53	46	5. 729831
21	6	26	42	38	0	52	48	5. 729576
22	6	27	38	57	0	51	48	5. 729318
23	6	28	35	21	0	50	48	5. 729055
24	6	29	31	50	0	49	46	5. 728788
25	7	0	28	23	0	48	44	5. 728517
26	7	1	25	0	0	47	41	5. 728243
27	7	2	21	41	0	46	37	5. 727965
28	7	3	18	26	0	45	32	5. 727683
29	7	4	15	17	0	44	27	5. 727397
30	7	5	12	10	0	43	20	5. 727106

A Table of the Heliocentrick Place of *Jupiter.*

Mid. Anom.	Sign. 2. Long. ♃ à 1 * ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	7	5	12	10	0	43	20	5. 727106
1	7	6	9	10	0	42	13	5. 726813
2	7	7	6	14	0	41	5	5. 726517
3	7	8	3	22	0	39	56	5. 726216
4	7	9	0	36	0	38	47	5. 725912
5	7	9	57	54	0	37	36	5. 725607
6	7	10	55	16	0	36	25	5. 725297
7	7	11	52	45	0	35	14	5. 724983
8	7	12	50	17	0	34	1	5. 724667
9	7	13	47	56	0	32	48	5. 724348
10	7	14	45	39	0	31	34	5. 724026
11	7	15	43	28	0	30	20	5. 723700
12	7	16	41	21	0	29	5	5. 723372
13	7	17	39	19	0	27	49	5. 723043
14	7	18	37	23	0	26	33	5. 722709
15	7	19	35	32	0	25	16	5. 722373
16	7	20	33	48	0	23	59	5. 722035
17	7	21	32	8	0	22	41	5. 721696
18	7	22	30	34	0	21	22	5. 721354
19	7	23	29	6	0	20	3	5. 721009
20	7	24	27	43	0	18	44	5. 720662
21	7	25	26	26	0	17	24	5. 720312
22	7	26	25	14	0	16	4	5. 719962
23	7	27	24	9	0	14	43	5. 719610
24	7	28	23	9	0	13	22	5. 719256
25	7	29	22	14	0	12	0	5. 718900
26	8	0	21	26	0	10	39	5. 718543
27	8	1	20	43	0	9	16	5. 718184
28	8	2	20	7	0	7	54	5. 717825
29	8	3	19	36	0	6	31	5. 717463
30	8	4	19	11	0	5	8	5. 717101

A Table of the Heliocentrick Place of *Jupiter.*

Mid. Anom.	Sign. 3. Long. ♃ à 1 * ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	8	4	19	11	0	5	8	5. 717101
1	8	5	18	52	0	3	45	5. 716738
2	8	6	18	39	0	2	22	5. 716374
3	8	7	18	32	0	0	58	5. 716009
4	8	8	18	32	Sou.	0	26	5. 715644
5	8	9	18	37	0	1	50	5. 715278
6	8	10	18	49	0	3	14	5. 714911
7	8	11	19	6	0	4	38	5. 714545
8	8	12	19	30	0	6	2	5. 714177
9	8	13	20	0	0	7	26	5. 713809
10	8	14	20	36	0	8	50	5. 713443
11	8	15	21	18	0	10	15	5. 713076
12	8	16	22	6	0	11	39	5. 712710
13	8	17	23	1	0	13	3	5. 712342
14	8	18	24	2	0	14	27	5. 711976
15	8	19	25	9	0	15	50	5. 711611
16	8	20	26	22	0	17	14	5. 711248
17	8	21	27	41	0	18	38	5. 710884
18	8	22	29	6	0	20	1	5. 710521
19	8	23	30	38	0	21	24	5. 710159
20	8	24	32	15	0	22	47	5. 709798
21	8	25	34	0	0	24	9	5. 709439
22	8	26	35	50	0	25	31	5. 709081
23	8	27	37	46	0	26	53	5. 708725
24	8	28	39	48	0	28	14	5. 708371
25	8	29	41	56	0	29	35	5. 708018
26	9	0	44	11	0	30	55	5. 707667
27	9	1	46	31	0	32	15	5. 707319
28	9	2	48	58	0	33	35	5. 706972
29	9	3	51	30	0	34	54	5. 706629
30	9	4	54	9	0	36	12	5. 706287

A Table of the Heliocentrick Place of *Jupiter.*

Mid. Anom.	Sign. 4. Long. ♃ à 1 * ♈				Inc. South.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	9	4	54	9	0	36	12	5. 706287
1	9	5	56	53	0	37	30	5. 705948
2	9	6	59	43	0	38	47	5. 705611
3	9	8	2	39	0	40	4	5. 705278
4	9	9	5	40	0	41	19	5. 704948
5	9	10	8	48	0	42	34	5. 704620
6	9	11	12	1	0	43	49	5. 704296
7	9	12	15	19	0	45	2	5. 703975
8	9	13	18	44	0	46	15	5. 703658
9	9	14	22	14	0	47	27	5. 703344
10	9	15	25	49	0	48	38	5. 703034
11	9	16	29	30	0	49	48	5. 702727
12	9	17	33	16	0	50	57	5. 702424
13	9	18	37	7	0	52	5	5. 702126
14	9	19	41	4	0	53	12	5. 701832
15	9	20	45	6	0	54	19	5. 701542
16	9	21	49	13	0	55	24	5. 701257
17	9	22	53	24	0	56	28	5. 700974
18	9	23	57	41	0	57	31	5. 700698
19	9	25	2	3	0	58	33	5. 700427
20	9	26	6	29	0	59	33	5. 700160
21	9	27	11	1	1	0	33	5. 699899
22	9	28	15	37	1	1	31	5. 699642
23	9	29	20	17	1	2	28	5. 699391
24	10	0	25	2	1	3	24	5. 699145
25	10	1	29	52	1	4	19	5. 698904
26	10	2	34	45	1	5	12	5. 698669
27	10	3	39	41	1	6	4	5. 698440
28	10	4	44	44	1	6	54	5. 698216
29	10	5	49	49	1	7	43	5. 697999
30	10	6	54	58	1	8	31	5. 697786

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A Table of the Heliocentrick Place of *Jupiter*.

Mid. Anom.	Sign. 5.							
	Long. ♃ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	10	6	54	58	1	8	31	5. 697786
1	10	8	0	12	1	9	17	5. 697580
2	10	9	5	28	1	10	2	5. 697380
3	10	10	10	49	1	10	45	5. 697186
4	10	11	16	13	1	11	27	5. 696998
5	10	12	21	39	1	12	8	5. 696817
6	10	13	27	10	1	12	46	5. 696643
7	10	14	32	44	1	13	24	5. 696474
8	10	15	38	19	1	13	59	5. 696313
9	10	16	43	59	1	14	33	5. 696159
10	10	17	49	41	1	15	6	5. 696010
11	10	18	55	26	1	15	36	5. 695869
12	10	20	1	13	1	16	6	5. 695734
13	10	21	7	2	1	16	33	5. 695606
14	10	22	12	53	1	16	59	5. 695486
15	10	23	18	47	1	17	23	5. 695372
16	10	24	24	43	1	17	46	5. 695266
17	10	25	30	41	1	18	6	5. 695167
18	10	26	36	41	1	18	26	5. 695074
19	10	27	42	42	1	18	43	5. 694989
20	10	28	48	44	1	18	58	5. 694911
21	10	29	54	48	1	19	12	5. 694842
22	11	1	0	53	1	19	24	5. 694779
23	11	2	6	59	1	19	35	5. 694723
24	11	3	13	6	1	19	43	5. 694675
25	11	4	19	14	1	19	50	5. 694634
26	11	5	25	23	1	19	55	5. 694601
27	11	6	31	33	1	19	58	5. 694575
28	11	7	37	42	1	20	0	5. 694555
29	11	8	43	52	1	20	0	5. 694544
20	11	9	50	2	1	19	58	5. 694540

A Table of the Heliocentrick Place of *Jupiter*.

Mid. Anom.	Sign. 6.							
	Long. ♃ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	11	9	50	2	1	19	58	5. 694540
1	11	10	56	12	1	19	54	5. 694545
2	11	12	2	22	1	19	48	5. 694556
3	11	13	8	31	1	19	41	5. 694576
4	11	14	14	40	1	19	32	5. 694602
5	11	15	20	49	1	19	21	5. 694635
6	11	16	26	57	1	19	8	5. 694677
7	11	17	33	4	1	18	53	5. 694725
8	11	18	39	10	1	18	37	5. 694781
9	11	19	45	15	1	18	19	5. 694844
10	11	20	51	19	1	18	0	5. 694914
11	11	21	57	21	1	17	38	5. 694992
12	11	23	3	22	1	17	15	5. 695077
13	11	24	9	22	1	16	51	5. 695171
14	11	25	15	20	1	16	24	5. 695270
15	11	26	21	15	1	15	56	5. 695376
16	11	27	27	9	1	15	26	5. 695490
17	11	28	33	0	1	14	55	5. 695611
18	11	29	38	50	1	14	22	5. 695738
19	0	0	44	37	1	13	47	5. 695874
20	0	1	50	22	1	13	11	5. 696016
21	0	2	56	3	1	12	33	5. 696164
22	0	4	1	43	1	11	53	5. 696319
23	0	5	7	18	1	11	12	5. 696481
24	0	6	12	52	1	10	30	5. 696649
25	0	7	18	23	1	9	46	5. 6.6824
26	0	8	23	49	1	9	0	5. 697005
27	0	9	29	13	1	8	14	5. 697192
28	0	10	34	33	1	7	25	5. 697386
29	0	11	39	50	1	6	35	5. 697587
30	0	12	45	3	1	5	44	5. 697793

A Table

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A Table of the Heliocentrick Place of *Jupiter.*

Mid. Anom.	Sign. 7. Long. ♃ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	0	12	45	3	1	5	44	5. 697793
1	0	13	50	12	1	4	52	5. 698006
2	0	14	55	18	1	3	58	5. 698223
3	0	16	0	20	1	3	3	5. 698447
4	0	17	5	16	1	2	6	5. 698676
5	0	18	10	9	1	1	8	5. 698911
6	0	19	14	59	1	0	9	5. 699153
7	0	20	19	44	0	59	9	5. 699399
8	0	21	24	24	0	58	7	5. 699650
9	0	22	28	59	0	57	5	5. 699906
10	0	23	33	31	0	56	1	5. 700167
11	0	24	37	57	0	54	56	5. 700435
12	0	25	42	19	0	53	50	5. 700706
13	0	26	46	36	0	52	44	5. 700982
14	0	27	50	46	0	51	36	5. 701264
15	0	28	54	53	0	50	27	5. 701549
16	0	29	38	55	0	49	17	5. 701839
17	1	1	2	52	0	48	6	5. 702133
18	1	2	6	43	0	46	54	5. 702432
19	1	3	10	29	0	45	41	5. 702735
20	1	4	14	10	0	44	28	5. 703041
21	1	5	17	45	0	43	14	5. 703351
22	1	6	21	15	0	41	59	5. 703665
23	1	7	24	40	0	40	43	5. 703982
24	1	8	27	58	0	39	26	5. 704302
25	1	9	31	10	0	38	9	5. 704626
26	1	10	34	17	0	36	51	5. 704954
27	1	11	37	19	0	35	33	5. 705284
28	1	12	40	14	0	34	14	5. 705617
29	1	13	43	5	0	32	54	5. 705954
30	1	14	45	49	0	31	34	5. 706293

A Table of the Heliocentrick Place of *Jupiter.*

Mid. Anom.	Sign. 8. Long. ♃ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	1	14	45	49	0	31	34	5. 706293
1	1	15	48	28	0	30	13	5. 706634
2	1	16	51	0	0	28	52	5. 706978
3	1	17	53	26	0	27	31	5. 707324
4	1	18	55	46	0	26	9	5. 707672
5	1	19	58	0	0	24	46	5. 708023
6	1	21	0	9	0	23	23	5. 708376
7	1	22	2	11	0	22	0	5. 708729
8	1	23	4	7	0	20	37	5. 709085
9	1	24	5	57	0	19	13	5. 709443
10	1	25	7	41	0	17	49	5. 709820
11	1	26	9	18	0	16	25	5. 710162
12	1	27	10	51	0	15	1	5. 710524
13	1	28	12	16	0	13	37	5. 710887
14	1	29	13	35	0	12	12	5. 711250
15	2	0	14	48	0	10	48	5. 711614
16	2	1	15	55	0	9	23	5. 711978
17	2	2	16	56	0	7	58	5. 712344
18	2	3	17	51	0	6	34	5. 712711
19	2	4	18	39	0	5	9	5. 713078
20	2	5	19	21	0	3	44	5. 713444
21	2	6	19	57	0	2	20	5. 713810
22	2	7	20	27	0	0	55	5. 714178
23	2	8	20	51	North	0	29	5. 714545
24	2	9	21	8	0	1	53	5. 714911
25	2	10	21	20	0	3	17	5. 715278
26	2	11	21	25	0	4	41	5. 715644
27	2	12	21	25	0	6	5	5. 716008
28	2	13	21	18	0	7	28	5. 716373
29	2	14	21	5	0	8	51	5. 716737
30	2	15	20	46	0	10	14	5. 717099

A Table

A Table of the Heliocentrick Place of *Jupiter*.

Mid. Anom.	Sign. 9.							
	Long. ♃ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	2	15	20	46	0	10	14	5. 717099
1	2	16	20	21	0	11	36	5. 717462
2	2	17	19	50	0	12	58	5. 717823
3	2	18	19	14	0	14	20	5. 718182
4	2	19	18	31	0	15	41	5. 718540
5	2	20	17	44	0	17	2	5. 718898
6	2	21	16	49	0	18	23	5. 719253
7	2	22	15	49	0	19	43	5. 719607
8	2	23	14	43	0	21	2	5. 719959
9	2	24	13	31	0	22	21	5. 720309
10	2	25	12	14	0	23	40	5. 720658
11	2	26	10	52	0	24	58	5. 721005
12	2	27	9	23	0	26	15	5. 721349
13	2	28	7	49	0	27	32	5. 721691
14	2	29	6	9	0	28	48	5. 722031
15	3	0	4	24	0	30	4	5. 722368
16	3	1	2	34	0	31	19	5. 722704
17	3	2	0	38	0	32	33	5. 723038
18	3	2	58	37	0	33	47	5. 723367
19	3	3	56	30	0	35	0	5. 723694
20	3	4	54	19	0	36	12	5. 724020
21	3	5	52	2	0	37	24	5. 724342
22	3	6	49	40	0	38	35	5. 724661
23	3	7	47	13	0	39	45	5. 724977
24	3	8	44	41	0	40	54	5. 725290
25	3	9	42	4	0	42	3	5. 725601
26	3	10	39	23	0	43	10	5. 725906
27	3	11	36	36	0	44	17	5. 726209
28	3	12	33	45	0	45	23	5. 726510
29	3	13	30	49	0	46	29	5. 726806
30	3	14	27	49	0	47	33	5. 727099

A Table of the Heliocentrick Place of *Jupiter*.

Mid. Anom.	Sign. 10.							
	Long. ♃ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	3	14	27	49	0	47	33	5. 727099
1	3	15	24	42	0	48	37	5. 727390
2	3	16	21	33	0	49	39	5. 727676
3	3	17	18	18	0	50	41	5. 727958
4	3	18	15	0	0	51	42	5. 728236
5	3	19	11	36	0	52	42	5. 728510
6	3	20	8	9	0	53	41	5. 728781
7	3	21	4	38	0	54	39	5. 729047
8	3	22	1	2	0	55	36	5. 729310
9	3	22	57	22	0	56	32	5. 729568
10	3	23	53	38	0	57	27	5. 729823
11	3	24	49	51	0	58	21	5. 730073
12	3	25	45	59	0	59	14	5. 730320
13	3	26	42	4	1	0	6	5. 730563
14	3	27	38	6	1	0	58	5. 730800
15	3	28	34	3	1	1	48	5. 731032
16	3	29	29	57	1	2	37	5. 731261
17	4	0	25	47	1	3	25	5. 731485
18	4	1	21	34	1	4	12	5. 731705
19	4	2	17	18	1	4	58	5. 731920
20	4	3	12	58	1	5	43	5. 732132
21	4	4	8	35	1	6	26	5. 732337
22	4	5	4	10	1	7	9	5. 732538
23	4	5	59	41	1	7	51	5. 732734
24	4	6	55	8	1	8	31	5. 732927
25	4	7	50	34	1	9	11	5. 733113
26	4	8	45	56	1	9	49	5. 733295
27	4	9	41	16	1	10	26	5. 733473
28	4	10	36	33	1	11	2	5. 733645
29	4	11	31	47	1	11	37	5. 733812
30	4	12	26	58	1	12	11	5. 733974

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A Table of the Heliocentrick Place of *Jupiter*.

Mid. Anom.	Sign. 11. Long. ♃ à 1 ✱ ♈ s	°	′	″	Inc. North. °	′	″	Dis. à ☉ Curt. Logarithm.
°								
0	4	12	26	58	1	12	11	5. 733974
1	4	13	22	7	1	12	43	5. 734131
2	4	14	17	14	1	13	15	5. 734283
3	4	15	12	19	1	13	45	5. 734430
4	4	16	7	21	1	14	14	5. 734572
5	4	17	2	22	1	14	42	5. 734708
6	4	17	57	20	1	15	9	5. 734841
7	4	18	52	17	1	15	35	5. 734968
8	4	19	47	12	1	16	0	5. 735089
9	4	20	42	4	1	16	23	5. 735206
10	4	21	36	55	1	16	45	5. 735317
11	4	22	31	45	1	17	6	5. 735422
12	4	23	26	32	1	17	26	5. 735522
13	4	24	21	19	1	17	45	5. 735617
14	4	25	16	4	1	18	2	5. 735706
15	4	26	10	48	1	18	18	5. 735791
16	4	27	5	30	1	18	33	5. 735870
17	4	28	0	11	1	18	47	5. 735944
18	4	28	54	52	1	19	0	5. 736011
19	4	29	49	31	1	19	11	5. 736074
20	5	0	44	9	1	19	21	5. 736131
21	5	1	38	47	1	19	31	5. 736183
22	5	2	33	24	1	19	38	5. 736229
23	5	3	28	0	1	19	45	5. 736271
24	5	4	22	35	1	19	50	5. 736307
25	5	5	17	10	1	19	55	5. 736337
26	5	6	11	45	1	19	58	5. 736361
27	5	7	6	20	1	19	59	5. 736380
28	5	8	0	54	1	20	0	5. 736394
29	5	8	55	28	1	19	59	5. 736402
30	5	9	50	2	1	19	58	5. 736406

A Table of the mean Motion of *Mars* from the *Aphelion*.

Years from Christ	Anomaly ♂ s	°	′	″	Years.	Anom. Mot. s	°	′	″
1	9	2	3	36	1	6	11	16	22
1501	3	7	32	36	2	0	22	32	43
1581	9	19	51	12	3	7	3	49	5
1601	5	7	55	36	4	1	15	36	53
1621	0	26	0	0	5	7	26	53	14
1641	8	14	4	24	6	2	8	9	30
1661	4	2	8	48	7	8	19	25	58
1681	11	20	13	12	8	3	1	13	46
1701	7	8	17	36	9	9	12	30	7
1721	2	26	22	0	10	3	23	46	29
1741	10	14	26	24	11	10	5	2	50
1761	6	2	30	48	12	4	16	50	38
1781	1	20	35	12	13	10	28	7	0
1801	9	8	39	36	14	5	9	23	22
1901	11	9	1	36	15	11	20	39	43
2001	1	9	23	36	16	6	2	27	31
Years	Anom. Mot.				17	0	13	43	53
	s	°	′	″	18	6	25	0	14
20	7	18	4	24	19	1	6	16	36
40	3	6	8	48	20	7	18	4	24
60	10	24	13	12	Months	Anom. Mot.			
80	6	12	17	36		s	°	′	″
100	2	0	22	0	*January*	0	0	0	0
200	4	0	44	0	*February*	0	16	14	42
300	6	1	6	0	*March*	1	0	55	5
400	8	1	28	0	*April*	1	17	9	47
500	10	1	50	0	*May*	2	2	53	3
600	0	2	12	0	*June*	2	19	7	45
700	2	2	34	0	*July*	3	4	51	1
800	4	2	56	0	*August*	3	21	5	43
900	6	3	18	0	*September*	4	7	20	26
1000	8	3	40	0	*October*	4	23	3	41
2000	4	7	20	0	*November*	5	9	18	24
3000	0	11	0	0	*December*	5	25	1	39
4000	8	14	40	0	In Leap-Year (after *February*) add one Day, and the Motion of a Day.				
5000	4	18	20	0					
6000	0	22	0	0					

A Table

A Table of the mean Motion of *Mars* from the *Aphelion.*

Days	Anom. Mot. °	'	"
1	0	31	27
2	1	2	53
3	1	34	20
4	2	5	46
5	2	37	13
6	3	8	39
7	3	40	6
8	4	11	32
9	4	42	59
10	5	14	25
11	5	45	52
12	6	17	18
13	6	48	45
14	7	20	11
15	7	51	38
16	8	23	4
17	8	54	31
18	9	25	57
19	9	57	24
20	10	28	50
21	11	0	17
22	11	31	44
23	12	3	10
24	12	34	37
25	13	6	3
26	13	37	30
27	14	8	56
28	14	40	23
29	15	11	49
30	15	43	16
31	16	14	42
32	16	46	9

H. '	Anom. Mot. ° '	' "	" '''	H. '	Anom. Mot. ° '	' "	" '''
1	0	1	19	31	0	40	37
2	0	2	37	32	0	41	55
3	0	3	56	33	0	43	14
4	0	5	14	34	0	44	33
5	0	6	33	35	0	45	51
6	0	7	52	36	0	47	10
7	0	9	10	37	0	48	28
8	0	10	29	38	0	49	47
9	0	11	47	39	0	51	6
10	0	13	6	40	0	52	24
11	0	14	25	41	0	53	43
12	0	15	43	42	0	55	1
13	0	17	2	43	0	56	20
14	0	18	20	44	0	57	39
15	0	19	39	45	0	58	57
16	0	20	58	46	1	0	16
17	0	22	16	47	1	1	34
18	0	23	35	48	1	2	53
19	0	24	53	49	1	4	12
20	0	26	12	50	1	5	30
21	0	27	31	51	1	6	49
22	0	28	49	52	1	8	7
23	0	30	8	53	1	9	26
24	0	31	27	54	1	10	45
25	0	32	45	55	1	12	3
26	0	34	4	56	1	13	22
27	0	35	22	57	1	14	40
28	0	36	41	58	1	15	59
29	0	38	0	59	1	17	18
30	0	39	18	60	1	18	36

	s	°	'	"
Long. Aph. ♂ à 1 ✻ ♈	4	1	12	0
Long. ☊ ♂ à 1 ✻ ♈	0	19	10	0
Inclin. Orb. ♂		1	52	0

Dist. Mid. ♂ à ☉ — 152369
Eccentricity — 14100

A Table of the Heliocentrick Place of *Mars.*

Sign. 0.

Med. Anom. °	Long. ♂ à 1 ✻ ♈ s	°	'	"	Inc. North. °	'	"	Dis. à ☉ Curt. Logarithm.
0	4	1	12	22	1	49	32	5. 221113
1	4	2	2	27	1	49	11	5. 221110
2	4	2	52	32	1	48	49	5. 221098
3	4	3	42	37	1	48	25	5. 221076
4	4	4	32	42	1	48	0	5. 221044
5	4	5	22	47	1	47	33	5. 221003
6	4	6	12	53	1	47	5	5. 220953
7	4	7	3	1	1	46	36	5. 220894
8	4	7	53	8	1	46	5	5. 220826
9	4	8	43	17	1	45	33	5. 220748
10	4	9	33	27	1	44	59	5. 220661
11	4	10	23	38	1	44	24	5. 220565
12	4	11	13	51	1	43	48	5. 220460
13	4	12	4	6	1	43	11	5. 220345
14	4	12	54	22	1	42	32	5. 220221
15	4	13	44	39	1	41	52	5. 220088
16	4	14	34	58	1	41	10	5. 219946
17	4	15	25	19	1	40	27	5. 219795
18	4	16	15	43	1	39	43	5. 219634
19	4	17	6	8	1	38	57	5. 219464
20	4	17	56	37	1	38	11	5. 219285
21	4	18	47	8	1	37	22	5. 219097
22	4	19	37	40	1	36	33	5. 218900
23	4	20	28	17	1	35	42	5. 218694
24	4	21	18	56	1	34	50	5. 218478
25	4	22	9	38	1	33	57	5. 218254
26	4	23	0	24	1	33	2	5. 218020
27	4	23	51	12	1	32	6	5. 217777
28	4	24	42	4	1	31	9	5. 217526
29	4	25	32	59	1	30	11	5. 217267
30	4	26	23	59	1	29	11	5. 216997

A Table

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A Table of the Heliocentrick Place of *Mars.*

Mid. Anom.	Sign. 1. Long. ♂ à ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	4	26	23	59	1	29	11	5. 216997
1	4	27	15	2	1	28	10	5. 216719
2	4	28	6	9	1	27	8	5. 216433
3	4	28	57	20	1	26	4	5. 216137
4	4	29	48	34	1	25	0	5. 215832
5	5	0	39	54	1	23	54	5. 215519
6	5	1	31	18	1	22	47	5. 215197
7	5	2	22	47	1	21	39	5. 214866
8	5	3	14	20	1	20	29	5. 214527
9	5	4	5	58	1	19	18	5. 214179
10	5	4	57	41	1	18	6	5. 213823
11	5	5	49	29	1	16	53	5. 213458
12	5	6	41	22	1	15	39	5. 213084
13	5	7	33	21	1	14	24	5. 212702
14	5	8	25	26	1	13	7	5. 212312
15	5	9	17	36	1	11	49	5. 211914
16	5	10	9	52	1	10	30	5. 211507
17	5	11	2	13	1	9	10	5. 211092
18	5	11	54	41	1	7	49	5. 210668
19	5	12	47	15	1	6	27	5. 210237
20	5	13	39	55	1	5	3	5. 209798
21	5	14	32	42	1	3	39	5. 209351
22	5	15	25	35	1	2	13	5. 208896
23	5	16	18	35	1	0	47	5. 208433
24	5	17	11	41	0	59	19	5. 207962
25	5	18	4	55	0	57	50	5. 207484
26	5	18	58	15	0	56	21	5. 206998
27	5	19	51	43	0	54	50	5. 206504
28	5	20	45	19	0	53	18	5. 206003
29	5	21	39	2	0	51	45	5. 205495
30	5	22	32	53	0	50	12	5. 204979

A Table of the Heliocentrick Place of *Mars.*

Mid. Anom.	Sign. 2. Long. ♂ à ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	5	22	32	53	0	50	12	5. 204979
1	5	23	26	51	0	48	37	5. 204456
2	5	24	20	57	0	47	1	5. 203925
3	5	25	15	12	0	45	25	5. 203388
4	5	26	9	34	0	43	47	5. 202844
5	5	27	4	4	0	42	9	5. 202292
6	5	27	58	42	0	40	30	5. 201734
7	5	28	53	29	0	38	49	5. 201169
8	5	29	48	25	0	37	18	5. 200598
9	6	0	43	30	0	35	26	5. 200020
10	6	1	38	44	0	33	44	5. 199436
11	6	2	34	7	0	32	0	5. 198846
12	6	3	29	39	0	30	16	5. 198249
13	6	4	25	21	0	28	31	5. 197646
14	6	5	21	12	0	26	45	5. 197038
15	6	6	17	11	0	24	58	5. 196424
16	6	7	13	21	0	23	11	5. 195804
17	6	8	9	41	0	21	23	5. 195178
18	6	9	6	10	0	19	35	5. 194546
19	6	10	2	49	0	17	45	5. 193909
20	6	10	59	38	0	15	56	5. 193267
21	6	11	56	38	0	14	5	5. 192620
22	6	12	53	48	0	12	14	5. 191969
23	6	13	51	9	0	10	23	5. 191313
24	6	14	48	39	0	8	31	5. 190652
25	6	15	46	21	0	6	38	5. 189987
26	6	16	44	13	0	4	45	5. 189318
27	6	17	42	16	0	2	52	5. 188644
28	6	18	40	29	0	0	58	5. 187966
29	6	19	38	54	Sou. 0	0	57	5. 187285
30	6	20	37	31	0	2	51	5. 186600

A Table of the Heliocentrick Place of *Mars*.

Mid. Anom.	Sign. 3.								
	Long. ♂ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	6	20	37	31	0	2	51	5.	186600
1	6	21	36	18	0	4	46	5.	185911
2	6	22	35	17	0	6	41	5.	185219
3	6	23	34	27	0	8	37	5.	184525
4	6	24	33	48	0	10	32	5.	183827
5	6	25	33	21	0	12	28	5.	183127
6	6	26	33	7	0	14	24	5.	182424
7	6	27	33	3	0	16	20	5.	181719
8	6	28	33	12	0	18	16	5.	181012
9	6	29	33	32	0	20	13	5.	180302
10	7	0	34	5	0	22	9	5.	179592
11	7	1	34	49	0	24	5	5.	178880
12	7	2	35	45	0	26	1	5.	178167
13	7	3	36	55	0	27	57	5.	177452
14	7	4	38	15	0	29	53	5.	176737
15	7	5	39	48	0	31	49	5.	176021
16	7	6	41	34	0	33	44	5.	175305
17	7	7	43	31	0	35	39	5.	174589
18	7	8	45	41	0	37	34	5.	173872
19	7	9	48	3	0	39	29	5.	173156
20	7	10	50	38	0	41	23	5.	172442
21	7	11	53	25	0	43	17	5.	171728
22	7	12	56	24	0	45	10	5.	171015
23	7	13	59	37	0	47	2	5.	170304
24	7	15	3	2	0	48	54	5.	169594
25	7	16	6	39	0	50	46	5.	168886
26	7	17	10	29	0	52	37	5.	168180
27	7	18	14	31	0	54	27	5.	167478
28	7	19	18	46	0	56	16	5.	166777
29	7	20	23	13	0	58	4	5.	166079
30	7	21	27	53	0	59	52	5.	165385

A Table of the Heliocentrick Place of *Mars*.

Mid. Anom.	Sign. 4.								
	Long. ♂ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	7	21	27	53	0	59	52	5.	165385
1	7	22	32	44	1	1	38	5.	164695
2	7	23	37	49	1	3	24	5.	164008
3	7	24	43	5	1	5	8	5.	163326
4	7	25	48	34	1	6	52	5.	162648
5	7	26	54	16	1	8	34	5.	161976
6	7	28	0	9	1	10	15	5.	161308
7	7	29	6	15	1	11	55	5.	160645
8	8	0	12	33	1	13	33	5.	159988
9	8	1	19	3	1	15	11	5.	159337
10	8	2	25	44	1	16	46	5.	158692
11	8	3	32	37	1	18	21	5.	158054
12	8	4	39	43	1	19	53	5.	157423
13	8	5	47	0	1	21	25	5.	156798
14	8	6	54	29	1	22	54	5.	156182
15	8	8	2	8	1	24	22	5.	155573
16	8	9	9	59	1	25	49	5.	154972
17	8	10	18	1	1	27	13	5.	154379
18	8	11	26	15	1	28	36	5.	153795
19	8	12	34	39	1	29	56	5.	153220
20	8	13	43	14	1	31	15	5.	152655
21	8	14	51	59	1	32	32	5.	152099
22	8	16	0	55	1	33	47	5.	151553
23	8	17	10	2	1	35	0	5.	151017
24	8	18	19	18	1	36	10	5.	150491
25	8	19	28	44	1	37	18	5.	149976
26	8	20	38	20	1	38	25	5.	149472
27	8	21	48	6	1	39	28	5.	148979
28	8	22	58	1	1	40	30	5.	148497
29	8	24	8	4	1	41	29	5.	148028
30	8	25	18	17	1	42	26	5.	147570

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A Table of the Heliocentrick Place of *Mars*.

Mid. Anom.	Sign. 5. Long. ♂ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	8	25	18	17	1	42	26	5.	147570
1	8	26	28	39	1	43	20	5.	147125
2	8	27	39	9	1	44	12	5.	146692
3	8	28	49	48	1	45	1	5.	146273
4	9	0	0	34	1	45	48	5.	145866
5	9	1	11	27	1	46	32	5.	145472
6	9	2	22	29	1	47	14	5.	145093
7	9	3	33	37	1	47	52	5.	144727
8	9	4	44	53	1	48	28	5.	144375
9	9	5	56	16	1	49	2	5.	144037
10	9	7	7	44	1	49	32	5.	143713
11	9	8	19	19	1	50	0	5.	143405
12	9	9	31	0	1	50	25	5.	143110
13	9	10	42	46	1	50	47	5.	142831
14	9	11	54	38	1	51	6	5.	142567
15	9	13	6	35	1	51	23	5.	142318
16	9	14	18	36	1	51	36	5.	142085
17	9	15	30	43	1	51	46	5.	141867
18	9	16	42	53	1	51	54	5.	141686
19	9	17	55	7	1	51	58	5.	141480
20	9	19	7	25	1	52	0	5.	141309
21	9	20	19	45	1	51	58	5.	141156
22	9	21	32	9	1	51	54	5.	141018
23	9	22	44	35	1	51	47	5.	140896
24	9	23	57	4	1	51	37	5.	140791
25	9	25	9	34	1	51	23	5.	140702
26	9	25	22	6	1	51	7	5.	140629
27	9	27	34	49	1	50	48	5.	140572
28	9	28	47	13	1	50	26	5.	140533
29	9	29	59	47	1	50	0	5.	140511
30	10	1	12	22	1	49	32	5.	140505

A Table of the Heliocentrick Place of *Mars*.

Mid. Anom.	Sign. 6. Long. ♂ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	10	1	12	22	1	49	32	5.	140505
1	10	2	24	57	1	49	1	5.	140515
2	10	3	37	31	1	48	27	5.	140541
3	10	4	50	5	1	47	50	5.	140584
4	10	6	2	38	1	47	11	5.	140645
5	10	7	15	10	1	46	28	5.	140722
6	10	8	27	40	1	45	43	5.	140815
7	10	9	40	8	1	44	55	5.	140924
8	10	10	52	34	1	44	4	5.	141049
9	10	12	4	57	1	43	10	5.	141190
10	10	13	17	26	1	42	14	5.	141348
11	10	14	29	33	1	41	15	5.	141522
12	10	15	41	46	1	40	13	5.	141711
13	10	16	53	55	1	39	9	5.	141916
14	10	18	6	0	1	38	2	5.	142137
15	10	19	18	0	1	36	52	5.	142374
16	10	20	29	56	1	35	41	5.	142626
17	10	21	41	48	1	34	26	5.	142893
18	10	22	53	33	1	33	10	5.	143174
19	10	24	5	13	1	31	51	5.	143471
20	10	25	16	46	1	30	29	5.	143783
21	10	26	28	13	1	29	9	5.	144109
22	10	27	39	34	1	27	40	5.	144449
23	10	28	50	49	1	26	13	5.	144804
24	11	0	1	55	1	24	43	5.	145172
25	11	1	12	55	1	23	11	5.	145554
26	11	2	23	48	1	21	37	5.	145950
27	11	3	34	32	1	20	1	5.	146358
28	11	4	45	9	1	18	24	5.	146779
29	11	5	55	37	1	16	44	5.	147213
30	11	7	5	56	1	15	3	5.	147659

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A Table of the Heliocentrick Place of *Mars.*

Mid. Anom.	Sign. 7. Long. ♂ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	11	7	5	56	1	15	3	5.	147659
1	11	8	16	8	1	13	21	5.	148118
2	11	9	26	10	1	11	36	5.	148589
3	11	10	36	4	1	9	50	5.	149071
4	11	11	45	47	1	8	3	5.	149564
5	11	12	55	21	1	6	14	5.	150069
6	11	14	4	46	1	4	24	5.	150585
7	11	15	14	0	1	2	32	5.	151111
8	11	16	23	5	1	0	39	5.	151647
9	11	17	31	59	0	58	45	5.	152193
10	11	18	40	42	0	56	50	5.	152749
11	11	19	49	15	0	54	54	5.	153314
12	11	20	57	37	0	52	57	5.	153888
13	11	22	5	49	0	50	59	5.	154471
14	11	23	13	50	0	49	0	5.	155063
15	11	24	21	40	0	47	0	5.	155663
16	11	25	29	18	0	45	0	5.	156271
17	11	26	36	44	0	42	58	5.	156886
18	11	27	43	59	0	40	56	5.	157509
19	11	28	51	3	0	38	54	5.	158139
20	11	29	57	54	0	36	51	5.	158776
21	0	1	4	35	0	34	47	5.	159419
22	0	2	11	3	0	32	43	5.	160068
23	0	3	17	20	0	30	39	5.	160723
24	0	4	23	24	0	28	35	5.	161383
25	0	5	29	16	0	26	30	5.	162049
26	0	6	34	56	0	24	25	5.	162719
27	0	7	40	24	0	22	19	5.	163395
28	0	8	45	40	0	20	14	5.	164075
29	0	9	50	44	0	18	9	5.	164749
30	0	10	55	34	0	16	4	5.	165446

A Table of the Heliocentrick Place of *Mars.*

Mid. Anom.	Sign. 8. Long. ♂ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	0	10	55	34	0	16	4	5.	165446
1	0	12	0	13	0	13	58	5.	166137
2	0	13	4	39	0	11	53	5.	166832
3	0	14	8	53	0	9	48	5.	167530
4	0	15	12	54	0	7	43	5.	168230
5	0	16	16	43	0	5	39	5.	168932
6	0	17	20	19	0	3	35	5.	169638
7	0	18	23	43	0	1	31	5.	170345
8	0	19	26	54	Nor.	0	33	5.	171053
9	0	20	29	53	0	2	36	5.	171762
10	0	21	32	40	0	4	39	5.	172473
11	0	22	35	14	0	6	41	5.	173184
12	0	23	37	36	0	8	43	5.	173897
13	0	24	39	45	0	10	44	5.	174610
14	0	25	41	42	0	12	44	5.	175323
15	0	26	43	27	0	14	44	5.	176036
16	0	27	45	1	0	16	43	5.	176748
17	0	28	46	21	0	18	42	5.	177460
18	0	29	47	30	0	20	39	5.	178171
19	1	0	48	26	0	22	36	5.	178882
20	1	1	49	11	0	24	32	5.	179590
21	1	2	49	43	0	26	28	5.	180297
22	1	3	50	3	0	28	22	5.	181003
23	1	4	50	12	0	30	16	5.	181707
24	1	5	50	9	0	32	8	5.	182409
25	1	6	49	55	0	34	0	5.	183109
26	1	7	49	28	0	35	51	5.	183806
27	1	8	48	50	0	37	40	5.	184500
28	1	9	48	1	0	39	29	5.	185191
29	1	10	47	0	0	41	16	5.	185880
30	1	11	45	47	0	43	3	5.	186566

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A Table of the Heliocentrick Place of *Mars.*

Mid. Anom.	Sign. 9. Long. ♂ à 1 ✳ ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	1	11	45	47	0	43	3	5. 186566
1	1	12	44	24	0	44	48	5. 187248
2	1	13	42	50	0	46	33	5. 187926
3	1	14	41	4	0	48	16	5. 188601
4	1	15	39	9	0	49	58	5. 189272
5	1	16	37	2	0	51	39	5. 189939
6	1	17	34	45	0	53	18	5. 190601
7	1	18	32	16	0	54	57	5. 191260
8	1	19	29	37	0	56	34	5. 191913
9	1	20	26	48	0	58	10	5. 192562
10	1	21	23	48	0	59	45	5. 193206
11	1	22	20	38	1	1	18	5. 193846
12	1	23	17	18	1	2	51	5. 194480
13	1	24	13	48	1	4	21	5. 195110
14	1	25	10	9	1	5	51	5. 195733
15	1	26	6	20	1	7	19	5. 196351
16	1	27	2	21	1	8	46	5. 196964
17	1	27	58	12	1	10	12	5. 197570
18	1	28	53	55	1	11	36	5. 198172
19	1	29	49	29	1	12	59	5. 198767
20	2	0	44	53	1	14	21	5. 199355
21	2	1	40	7	1	15	41	5. 199938
22	2	2	35	13	1	17	0	5. 200514
23	2	3	30	11	1	18	17	5. 201084
24	2	4	24	59	1	19	33	5. 201648
25	2	5	19	39	1	20	48	5. 202205
26	2	6	14	11	1	22	1	5. 202755
27	2	7	8	35	1	23	13	5. 203299
28	2	8	2	51	1	24	23	5. 203835
29	2	8	56	58	1	25	32	5. 204365
30	2	9	50	57	1	26	40	5. 204887

A Table of the Heliocentrick Place of *Mars.*

Mid. Anom.	Sign. 10. Long. ♂ à 1 ✳ ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	2	9	50	57	1	26	40	5. 204887
1	2	10	44	49	1	27	46	5. 205402
2	2	11	38	33	1	28	50	5. 205910
3	2	12	32	10	1	29	53	5. 206411
4	2	13	25	40	1	30	55	5. 206904
5	2	14	19	2	1	31	55	5. 207390
6	2	15	12	17	1	32	54	5. 207868
7	2	16	5	25	1	33	52	5. 208339
8	2	16	58	27	1	34	47	5. 208802
9	2	17	51	21	1	35	42	5. 209257
10	2	18	44	9	1	36	35	5. 209705
11	2	19	36	50	1	37	26	5. 210144
12	2	20	29	26	1	38	16	5. 210576
13	2	21	21	55	1	39	5	5. 211000
14	2	22	14	18	1	39	52	5. 211415
15	2	23	6	35	1	40	37	5. 211823
16	2	23	58	46	1	41	21	5. 212222
17	2	24	50	52	1	42	4	5. 212613
18	2	25	42	52	1	42	45	5. 212995
19	2	26	34	47	1	43	25	5. 213369
20	2	27	26	37	1	44	3	5. 213736
21	2	28	18	21	1	44	40	5. 214094
22	2	29	10	0	1	45	15	5. 214443
23	3	0	1	35	1	45	49	5. 214783
24	3	0	53	4	1	46	21	5. 215115
25	3	1	44	29	1	46	52	5. 215438
26	3	2	35	50	1	47	21	5. 215753
27	3	3	27	6	1	47	49	5. 216059
28	3	4	18	18	1	48	15	5. 216357
29	3	5	9	26	1	48	40	5. 216645
30	3	6	0	30	1	49	4	5. 216925

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A Table of the Heliocentrick Place of *Mars.*

Mid. Anom.	Sign. II. Long. ♂ à I ✱ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	3	6	0	30	1	49	4	5. 216925
1	3	6	51	30	1	49	26	5. 217196
2	3	7	42	27	1	49	46	5. 217458
3	3	8	33	19	1	50	5	5. 217710
4	3	9	24	8	1	50	23	5. 217955
5	3	10	14	55	1	50	39	5. 218191
6	3	11	5	37	1	50	53	5. 218417
7	3	11	56	17	1	51	7	5. 218635
8	3	12	46	54	1	51	18	5. 218843
9	3	13	37	28	1	51	29	5. 219042
10	3	14	28	0	1	51	37	5. 219233
11	3	15	18	29	1	51	45	5. 219415
12	3	16	8	55	1	51	51	5. 219587
13	3	16	59	19	1	51	55	5. 219750
14	3	17	49	41	1	51	58	5. 219904
15	3	18	40	2	1	52	0	5. 220048
16	3	19	30	20	1	52	0	5. 220184
17	3	20	20	36	1	51	59	5. 220311
18	3	21	10	51	1	51	56	5. 220428
19	3	22	1	4	1	51	52	5. 220536
20	3	22	51	15	1	51	46	5. 220634
21	3	23	41	26	1	51	39	5. 220724
22	3	24	31	36	1	51	31	5. 220804
23	3	25	21	43	1	51	21	5. 220875
24	3	26	11	51	1	51	10	5. 220937
25	3	27	1	57	1	50	57	5. 220990
26	3	27	52	3	1	50	43	5. 221033
27	3	28	42	8	1	50	27	5. 221067
28	3	29	32	14	1	50	10	5. 221092
29	4	0	22	18	1	49	52	5. 221107
30	4	1	12	22	1	49	32	5. 221113

A Table of the mean Motion of *Venus* from the *Aphelion.*

Years from Christ	Anomaly ♀ s	°	′	″
1	4	3	48	55
1501	7	0	22	40
1581	7	14	35	40
1601	1	18	8	55
1621	7	21	42	10
1641	1	25	15	25
1661	7	28	48	40
1681	2	2	21	55
1701	8	5	55	10
1721	2	9	28	25
1741	8	13	1	40
1761	2	16	34	55
1781	8	20	8	10
1801	2	23	41	25
1901	9	11	27	40
2001	3	29	13	55
Years	Anom. Mot. s	°	′	″
20	6	3	33	15
40	0	7	6	30
60	6	10	39	45
80	0	14	13	0
100	6	17	46	15
200	1	5	33	30
300	7	23	18	45
400	2	11	5	0
500	8	28	51	15
600	3	16	37	30
700	10	4	23	45
800	4	22	10	0
900	11	9	56	15
1000	5	27	42	30
2000	11	52	25	0
3000	5	23	7	30
4000	11	20	50	0
5000	5	18	32	30
6000	11	16	15	0

Years.	Anom. Mot. s	°	′	″
1	7	14	46	38
2	2	29	33	16
3	10	14	19	54
4	6	0	42	39
5	1	15	29	17
6	9	0	15	55
7	4	15	2	33
8	0	1	25	18
9	7	16	11	56
10	3	0	58	34
11	10	15	45	12
12	6	2	7	57
13	1	16	54	35
14	9	1	41	13
15	4	16	27	51
16	0	2	50	36
17	7	17	37	14
18	3	2	23	52
19	0	17	10	30
20	16	3	33	15
Months	Anom. Mot. s	°	′	″
January	0	0	0	0
February	1	19	39	58
March	3	4	31	32
April	4	24	11	30
May	6	12	15	29
June	8	1	55	17
July	9	19	59	7
August	11	9	39	5
September	0	29	19	3
October	2	17	22	53
November	4	7	2	50
December.	5	25	6	40

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

A Table of the mean Motion of *Venus* from the *Aphelion*.

Days	Anom. Mot. s	°	'	"
1	0	1	36	8
2	0	3	12	15
3	0	4	48	23
4	0	6	24	31
5	0	8	0	38
6	0	9	36	46
7	0	11	12	54
8	0	12	49	1
9	0	14	25	9
10	0	16	1	17
11	0	17	37	24
12	0	19	13	33
13	0	20	49	40
14	0	22	25	47
15	0	24	1	55
16	0	25	33	3
17	0	27	14	10
18	0	28	50	18
19	1	0	26	26
20	1	2	2	33
21	1	3	38	41
22	1	5	14	49
23	1	6	50	56
24	1	8	27	4
25	1	10	3	12
26	1	11	39	19
27	1	13	15	27
28	1	14	51	35
29	1	16	27	42
30	1	18	3	50
31	1	19	39	58
32	1	21	16	5

H. '	Anom. Mot. ° '	' "	" '''	H. '	Anom. Mot. ° '	' "	" '''
1	0	4	0	31	2	4	10
2	0	8	1	32	2	8	10
3	0	12	1	33	2	12	11
4	0	16	1	34	2	16	11
5	0	20	2	35	2	20	11
6	0	24	2	36	2	24	11
7	0	28	2	37	2	28	12
8	0	32	3	38	2	32	12
9	0	36	3	39	2	36	12
10	0	40	3	40	2	40	13
11	0	44	4	41	2	44	13
12	0	48	4	42	2	48	13
13	0	52	4	43	2	52	14
14	0	56	4	44	2	56	14
15	1	0	5	45	3	0	14
16	1	4	5	46	3	4	15
17	1	8	5	47	3	8	15
18	1	12	6	48	3	12	15
19	1	16	6	49	3	16	16
20	1	20	6	50	3	20	16
21	1	24	7	51	3	24	16
22	1	28	7	52	3	28	17
23	1	32	7	53	3	32	17
24	1	36	8	54	3	36	17
25	1	40	8	55	3	40	18
26	1	44	8	56	3	44	18
27	1	48	9	57	3	48	18
28	1	52	9	58	3	52	19
29	1	56	9	59	3	56	19
30	2	0	10	60	4	0	19

	s	°	'	"
Long. Aph. ♀ à 1 * ♈	9	5	0	0
Long. ☊ ♀ à 1 * ♈	1	15	16	0
Inclin. Orb. ♀		3	24	0

Dist. Mid. ♀ à ☉ ——— 72333
Eccentricity ——— 517

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom. 0. °	Long. ♀ à 1 * ♈ s	°	'	"	Inc. South. °	'	"	Dist. à ☉ Curt. Logarithm.
0	9	4	57	1	2	35	37	4. 861985
1	9	5	56	11	2	37	52	4. 861971
2	9	6	55	21	2	40	4	4. 861957
3	9	7	54	32	2	42	13	4. 861941
4	9	8	53	42	2	44	20	4. 861926
5	9	9	52	53	2	46	23	4. 861909
6	9	10	52	5	2	48	23	4. 861892
7	9	11	51	17	2	50	11	4. 861874
8	9	12	50	29	2	52	15	4. 861854
9	9	13	49	42	2	54	6	4. 861834
10	9	14	48	55	2	55	55	4. 861814
11	9	15	48	7	2	57	40	4. 861793
12	9	16	47	20	2	59	22	4. 861772
13	9	17	46	34	3	1	1	4. 861750
14	9	18	45	48	3	2	36	4. 861726
15	9	19	45	2	3	4	9	4. 861703
16	9	20	44	17	3	5	38	4. 861679
17	9	21	43	32	3	7	3	4. 861654
18	9	22	42	48	3	8	26	4. 861628
19	9	23	42	4	3	9	45	4. 861602
20	9	24	41	20	3	11	1	4. 861575
21	9	25	40	37	3	12	13	4. 861548
22	9	26	39	55	3	13	22	4. 861521
23	9	27	39	12	3	14	27	4. 861492
24	9	28	38	31	3	15	29	4. 861463
25	9	29	37	50	3	16	28	4. 861434
26	10	0	37	9	3	17	23	4. 861405
27	10	1	36	29	3	18	15	4. 861375
28	10	2	35	50	3	19	3	4. 861345
29	10	3	35	10	3	19	47	4. 861315
30	10	4	34	3[illegible]	3	20	28	4. 861284

A Table

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	*Sign.* 1. Long. ♀ à 1 ✶ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	10	4	34	31	3	20	28	4. 861284
1	10	5	33	53	3	21	5	4. 861253
2	10	6	33	15	3	21	39	4. 861221
3	10	7	32	38	3	22	9	4. 861189
4	10	8	32	1	3	22	36	4. 861155
5	10	9	31	25	3	22	59	4. 861122
6	10	10	30	49	3	23	18	4. 861088
7	10	11	30	14	3	23	34	4. 861055
8	10	12	29	40	3	23	46	4. 861021
9	10	13	29	6	3	23	54	4. 860987
10	10	14	28	33	3	23	59	4. 860952
11	10	15	28	0	3	24	0	4. 860917
12	10	16	27	27	3	23	57	4. 860882
13	10	17	26	56	3	23	51	4. 860847
14	10	18	26	25	3	23	41	4. 860811
15	10	19	25	54	3	23	28	4. 860776
16	10	20	25	25	3	23	11	4. 860740
17	10	21	24	56	3	22	50	4. 860704
18	10	22	24	27	3	22	25	4. 860668
19	10	23	23	59	3	21	57	4. 860631
20	10	24	23	31	3	21	25	4. 860594
21	10	25	23	4	3	20	50	4. 860557
22	10	26	22	38	3	20	11	4. 860520
23	10	27	22	12	3	19	29	4. 860483
24	10	28	21	46	3	18	42	4. 860446
25	10	29	21	22	3	17	53	4. 860408
26	11	0	20	59	3	16	59	4. 860371
27	11	1	20	35	3	16	2	4. 860334
28	11	2	20	13	3	15	2	4. 860295
29	11	3	19	51	3	13	58	4. 860256
30	11	4	19	30	3	12	51	4. 860218

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	*Sign.* 2. Long. ♀ à 1 ✶ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	11	4	19	30	3	12	51	4. 860218
1	11	5	19	9	3	11	40	4. 860181
2	11	6	18	48	3	10	25	4. 860142
3	11	7	18	29	3	9	7	4. 860104
4	11	8	18	10	3	7	46	4. 860065
5	11	9	17	52	3	6	21	4. 860027
6	11	10	17	35	3	4	53	4. 859988
7	11	11	17	18	3	3	22	4. 859949
8	11	12	17	2	3	1	47	4. 859910
9	11	13	16	46	3	0	9	4. 859870
10	11	14	16	32	2	58	27	4. 859831
11	11	15	16	17	2	56	43	4. 859792
12	11	16	16	4	2	54	55	4. 859753
13	11	17	15	51	2	53	4	4. 859713
14	11	18	15	39	2	51	10	4. 859673
15	11	19	15	27	2	49	12	4. 859634
16	11	20	15	16	2	47	12	4. 859594
17	11	21	15	6	2	45	8	4. 859554
18	11	22	14	56	2	43	2	4. 859514
19	11	23	14	47	2	40	52	4. 859474
20	11	24	14	39	2	38	40	4. 859434
21	11	25	14	31	2	36	24	4. 859394
22	11	26	14	24	2	34	6	4. 859353
23	11	27	14	18	2	31	45	4. 859313
24	11	28	14	12	2	29	21	4. 859273
25	11	29	14	7	2	26	54	4. 859232
26	0	0	14	3	2	24	25	4. 859192
27	0	1	13	59	2	21	53	4. 859151
28	0	2	13	56	2	19	18	4. 859110
29	0	3	13	54	2	16	41	4. 859070
30	0	4	13	52	2	14	1	4. 859029

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A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	Sign. 3.							
	Long. ♀ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curr. Logarithm.
°	s	°	′	″	°	′	″	
0	0	4	13	52	2	14	1	4. 859029
1	0	5	13	51	2	11	19	4. 858988
2	0	6	13	51	2	8	34	4. 858946
3	0	7	13	50	2	5	47	4. 858905
4	0	8	13	52	2	2	58	4. 858864
5	0	9	13	54	2	0	6	4. 858823
6	0	10	13	56	1	57	12	4. 858782
7	0	11	13	59	1	54	16	4. 858740
8	0	12	14	3	1	51	18	4. 858698
9	0	13	14	7	1	48	17	4. 858657
10	0	14	14	12	1	45	15	4. 858615
11	0	15	14	18	1	42	11	4. 858573
12	0	16	14	25	1	39	4	4. 858532
13	0	17	14	32	1	35	56	4. 858490
14	0	18	14	40	1	32	46	4. 858448
15	0	19	14	49	1	29	35	4. 858406
16	0	20	14	58	1	26	21	4. 858364
17	0	21	15	8	1	23	6	4. 858321
18	0	22	15	18	1	19	50	4. 858279
19	0	23	15	30	1	16	31	4. 858236
20	0	24	15	42	1	13	12	4. 858194
21	0	25	15	55	1	9	51	4. 858152
22	0	26	16	9	1	6	29	4. 858110
23	0	27	16	24	1	3	5	4. 858068
24	0	28	16	39	0	59	40	4. 858026
25	0	29	16	54	0	56	34	4. 857983
26	1	0	17	10	0	52	47	4. 857941
27	1	1	17	27	0	49	19	4. 857898
28	1	2	17	45	0	45	50	4. 857855
29	1	3	18	4	0	42	21	4. 857813
30	1	4	18	23	0	38	50	4. 857770

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	Sign. 4.							
	Long. ♀ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curr. Logarithm.
°	s	°	′	″	°	′	″	
0	1	4	18	23	0	38	50	4. 857770
1	1	5	18	43	0	35	18	4. 857728
2	1	6	19	4	0	31	46	4. 857685
3	1	7	19	25	0	28	13	4. 857643
4	1	8	19	48	0	24	40	4. 857601
5	1	9	20	11	0	21	6	4. 857559
6	1	10	20	34	0	17	32	4. 859516
7	1	11	20	58	0	13	57	4. 857474
8	1	12	21	22	0	10	22	4. 857433
9	1	13	21	48	0	6	47	4. 857391
10	1	14	22	14	0	3	12	4. 857350
11	1	15	22	41	Nor. 0	0	24	4. 857308
12	1	16	23	8	0	3	59	4. 857267
13	1	17	23	37	0	7	35	4. 857226
14	1	18	24	6	0	11	10	4. 857185
15	1	19	24	36	0	14	45	4. 857143
16	1	20	25	6	0	18	20	4. 857103
17	1	21	25	37	0	21	55	4. 857062
18	1	22	26	9	0	25	29	4. 857022
19	1	23	26	42	0	29	3	4. 856081
20	1	24	27	15	0	32	37	4. 856941
21	1	25	27	49	0	36	9	4. 856902
22	1	26	28	23	0	39	41	4. 856863
23	1	27	28	58	0	43	13	4. 856824
24	1	28	29	34	0	46	44	4. 856786
25	1	29	30	10	0	50	13	4. 856748
26	2	0	30	47	0	53	42	4. 856709
27	2	1	31	24	0	57	10	4. 856672
28	2	2	32	2	1	0	37	4. 856635
29	2	3	32	41	1	4	3	4. 856598
30	2	4	33	20	1	7	28	4. 856562

A Table

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A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	Sign. 5.							
	Long. ♀ à 1 ✱ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	2	4	33	20	1	7	28	4. 856562
1	2	5	34	0	1	10	51	4. 856526
2	2	6	34	42	1	14	13	4. 856491
3	2	7	35	24	1	17	34	4. 856456
4	2	8	36	5	1	20	53	4. 856422
5	2	9	36	47	1	24	11	4. 856388
6	2	10	37	30	1	27	27	4. 856354
7	2	11	38	13	1	30	42	4. 856322
8	2	12	38	58	1	33	55	4. 856290
9	2	13	39	43	1	37	6	4. 856259
10	2	14	40	28	1	40	15	4. 856228
11	2	15	41	14	1	43	23	4. 856198
12	2	16	42	0	1	46	29	4. 856169
13	2	17	42	47	1	49	32	4. 856140
14	2	18	43	33	1	52	34	4. 856112
15	2	19	44	20	1	55	33	4. 856085
16	2	20	45	8	1	58	31	4. 856058
17	2	21	45	57	2	1	26	4. 856032
18	2	22	46	46	2	4	19	4. 856007
19	2	23	47	36	2	7	10	4. 855983
20	2	24	48	25	2	9	58	4. 855960
21	2	25	49	15	2	12	43	4. 855937
22	2	26	50	6	2	15	27	4. 855915
23	2	27	50	57	2	18	7	4. 855894
24	2	28	51	48	2	20	46	4. 855875
25	2	29	52	39	2	23	21	4. 855856
26	3	0	53	30	2	25	54	4. 855838
27	3	1	54	22	2	28	24	4. 855821
28	3	2	55	15	2	30	51	4. 855805
29	3	3	56	8	2	33	16	4. 855790
30	3	4	57	1	2	35	37	4. 855776

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	Sign. 6.							
	Long. ♀ à 1 ✱ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	3	4	57	1	2	35	37	4. 855776
1	3	5	57	54	2	37	56	4. 855763
2	3	6	58	48	2	40	12	4. 855751
3	3	7	59	41	2	42	24	4. 855741
4	3	9	0	35	2	44	34	4. 855731
5	3	10	1	28	2	46	41	4. 855722
6	3	11	2	22	2	48	44	4. 855715
7	3	12	3	16	2	50	44	4. 855709
8	3	13	4	11	2	52	41	4. 855704
9	3	14	5	5	2	54	35	4. 855700
10	3	15	5	59	2	56	25	4. 855698
11	3	16	6	53	2	58	13	4. 855696
12	3	17	7	48	2	59	56	4. 855696
13	3	18	8	42	3	1	37	4. 855697
14	3	19	9	37	3	3	14	4. 855699
15	3	20	10	31	3	4	47	4. 855702
16	3	21	11	25	3	6	17	4. 855707
17	3	22	12	19	3	7	44	4. 855713
18	3	23	13	13	3	9	7	4. 855720
19	3	24	14	7	3	10	6	4. 855728
20	3	25	15	0	3	11	42	4. 855737
21	3	26	15	53	3	12	54	4. 855748
22	3	27	16	47	3	14	3	4. 855760
23	3	28	17	40	3	15	8	4. 855773
24	3	29	18	33	3	16	9	4. 855788
25	4	0	19	25	3	17	7	4. 855804
26	4	1	20	18	3	18	1	4. 855821
27	4	2	21	10	3	18	51	4. 855839
28	4	3	22	2	3	19	38	4. 855859
29	4	4	22	54	3	20	20	4. 855880
30	4	5	23	45	3	20	59	4. 855903

A Table

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A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	*Sign* 7. Long. ♀ à 1 ✳ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	4	5	23	45	3	20	59	4.	855903
1	4	6	24	35	3	21	34	4.	855927
2	4	7	25	25	3	22	6	4.	855952
3	4	8	26	15	3	22	33	4.	855978
4	4	9	27	14	3	22	57	4.	856005
5	4	10	27	53	3	23	17	4.	856934
6	4	11	28	42	3	23	33	4.	856064
7	4	12	29	30	3	23	46	4.	856095
8	4	13	30	17	3	23	54	4.	856128
9	4	14	31	3	3	23	59	4.	856161
10	4	15	31	50	3	24	0	4.	856196
11	4	16	32	35	3	23	57	4.	856232
12	4	17	33	21	3	23	50	4.	856270
13	4	18	34	5	3	23	40	4.	856308
14	4	19	34	48	3	23	25	4.	856348
15	4	20	35	32	3	23	7	4.	856389
16	4	21	36	14	3	22	45	4.	856431
17	4	22	36	55	3	22	20	4.	856474
18	4	23	37	37	3	21	50	4.	856518
19	4	24	38	16	3	21	17	4.	856563
20	4	25	38	55	3	20	40	4.	856610
21	4	26	39	34	3	19	59	4.	856657
22	4	27	40	12	3	19	15	4.	856705
23	4	28	40	48	3	18	27	4.	856754
24	4	29	41	25	3	17	35	4.	856804
25	5	0	42	0	3	16	40	4.	856856
26	5	1	42	34	3	15	41	4.	856909
27	5	2	43	8	3	14	38	4.	856962
28	5	3	43	41	3	13	31	4.	857016
29	5	4	44	13	3	12	22	4.	857071
30	5	5	44	44	3	11	8	4.	857126

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	*Sign.* 8. Long. ♀ à 1 ✳ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	5	5	44	44	2	11	8	4.	857126
1	5	6	45	13	3	9	51	4.	857183
2	5	7	45	42	3	8	31	4.	857241
3	5	8	46	10	3	7	7	4.	857299
4	5	9	46	37	3	5	39	4.	857358
5	5	10	47	3	3	4	8	4.	857418
6	5	11	47	28	3	2	34	4.	857478
7	5	12	47	52	3	0	57	4.	857539
8	5	13	48	15	2	59	16	4.	857600
9	5	14	48	37	2	57	32	4.	857662
10	5	15	48	58	2	55	44	4.	857725
11	5	16	49	18	2	53	54	4.	857788
12	5	17	49	37	2	52	0	4.	857852
13	5	18	49	54	2	50	3	4.	857917
14	5	19	50	11	2	48	3	4.	857982
15	5	20	50	26	2	46	0	4.	858047
16	5	21	50	41	2	43	53	4.	858112
17	5	22	50	54	2	41	44	4.	858178
18	5	23	51	6	2	39	32	4.	858244
19	5	24	51	18	2	37	17	4.	858310
20	5	25	51	28	2	34	59	4.	858377
21	5	26	51	37	2	32	39	4.	858444
22	5	27	51	44	2	30	15	4.	858511
23	5	28	51	50	2	27	49	4.	858578
24	5	29	51	57	2	25	20	4.	858646
25	6	0	52	1	2	22	49	4.	858713
26	6	1	52	4	2	20	15	4.	858780
27	6	2	52	7	2	17	38	4.	858848
28	6	3	52	7	2	14	59	4.	858915
29	6	4	52	7	2	12	13	4.	858983
30	6	5	52	6	2	9	34	4.	859050

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	Sign. 9. Long. ♀ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	6	5	52	6	2	9	34	4. 859050
1	6	6	52	4	2	6	48	4. 859117
2	6	7	52	0	2	4	0	4. 859184
3	6	8	51	57	2	1	9	4. 859251
4	6	9	51	51	1	58	16	4. 859318
5	6	10	51	44	1	55	21	4. 859384
6	6	11	51	37	1	52	25	4. 859451
7	6	12	51	27	1	49	26	4. 859517
8	6	13	51	17	1	46	25	4. 859582
9	6	14	51	6	1	43	22	4. 859648
10	6	15	50	54	1	40	17	4. 859712
11	6	16	50	41	1	37	11	4. 859776
12	6	17	50	27	1	34	3	4. 859840
13	6	18	50	12	1	30	53	4. 859903
14	6	19	49	56	1	27	42	4. 859966
15	6	20	49	38	1	24	29	4. 860029
16	6	21	49	19	1	21	15	4. 860091
17	6	22	49	0	1	17	59	4. 860152
18	6	23	48	40	1	14	42	4. 860212
19	6	24	48	19	1	11	23	4. 860272
20	6	25	47	56	1	8	4	4. 860331
21	6	26	47	34	1	4	43	4. 860390
22	6	27	47	10	1	1	21	4. 860448
23	6	28	46	44	0	57	58	4. 860505
24	6	29	46	18	0	54	34	4. 860561
25	7	0	45	50	0	51	9	4. 860617
26	7	1	45	22	0	47	43	4. 860671
27	7	2	44	54	0	44	16	4. 860725
28	7	3	44	24	0	40	49	4. 860778
29	7	4	43	53	0	37	20	4. 860830
30	7	5	43	21	0	33	52	4. 860881

A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	Sign 10. Long. ♀ à 1 ✱ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	7	5	43	21	0	33	52	4. 860881
1	7	6	42	49	0	30	22	4. 860931
2	7	7	42	16	0	26	53	4. 860981
3	7	8	41	42	0	23	22	4. 861030
4	7	9	41	17	0	19	52	4. 861077
5	7	10	40	32	0	16	21	4. 861123
6	7	11	39	56	0	12	50	4. 861169
7	7	12	39	19	0	9	18	4. 861213
8	7	13	38	41	0	5	47	4. 861256
9	7	14	38	2	0	2	15	4. 861299
10	7	15	37	24	Sou.	1	16	4. 861340
11	7	16	36	44	0	4	48	4. 861380
12	7	17	36	3	0	8	19	4. 861420
13	7	18	35	22	0	11	50	4. 861458
14	7	19	34	41	0	15	21	4. 861495
15	7	20	33	58	0	18	52	4. 861530
16	7	21	33	15	0	22	22	4. 861565
17	7	22	32	32	0	25	52	4. 861599
18	7	23	31	48	0	29	21	4. 861631
19	7	24	31	3	0	32	50	4. 861663
20	7	25	30	18	0	36	18	4. 861693
21	7	26	29	33	0	39	46	4. 861722
22	7	27	28	47	0	43	12	4. 861750
23	7	28	28	2	0	46	38	4. 861777
24	7	29	27	15	0	50	3	4. 861802
25	8	0	26	27	0	53	27	4. 861827
26	8	1	25	40	0	56	51	4. 861851
27	8	2	24	51	1	0	13	4. 861873
28	8	3	24	3	1	3	34	4. 861894
29	8	4	23	14	1	6	54	4. 861914
30	8	5	22	25	1	10	12	4. 861932

A Table

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A Table of the Heliocentrick Place of *Venus*.

Mid. Anom.	Sign. 11.								
	Long. ♀ à 1 ✳ ♈				Inc. South.			Dif. à ☉ Curt.	
°	s	°	′	″	°	′	″	Logarithm.	
0	8	5	22	25	1	10	12	4.	861932
1	8	6	21	46	1	13	30	4.	861950
2	8	7	20	47	1	16	46	4.	861966
3	8	8	19	57	1	20	0	4.	861981
4	8	9	19	7	1	23	13	4.	8619,5
5	8	10	18	17	1	26	25	I.	862007
6	8	11	17	26	1	29	35	4.	862019
7	8	12	16	36	1	32	44	4.	862029
8	8	13	15	45	1	35	51	4.	862039
9	8	14	14	54	1	38	56	4.	862048
10	8	15	14	3	1	41	59	4.	862055
11	8	16	13	12	1	45	1	4.	862061
12	8	17	12	20	1	48	1	4.	862067
13	8	18	11	29	1	50	58	4.	862071
14	8	19	10	38	1	53	54	4.	862074
15	8	20	9	46	1	56	48	4.	862075
16	8	21	8	54	1	59	40	4.	862076
17	8	22	8	3	2	2	29	4.	862076
18	8	23	7	12	2	5	16	4.	862075
19	8	24	6	20	2	8	2	4.	862072
20	8	25	5	28	2	10	54	4.	862069
21	8	26	4	37	2	13	25	4.	862064
22	8	37	3	46	2	16	3	4.	862059
23	8	18	2	55	2	18	39	4.	862054
24	8	29	2	4	2	21	12	4.	862047
25	9	0	1	13	2	23	42	4.	862038
26	9	1	0	22	2	26	11	4.	862029
27	9	1	59	32	2	28	37	4.	862019
28	9	2	58	41	2	31	0	4.	862009
29	9	3	57	51	2	33	20	4.	861997
30	9	4	57	1	2	35	37	4.	861985

A Table of the mean Motion of *Mercury* from the *Aphelion*.

Years from Christ	Anomaly ☿			
	s	°	′	″
1	3	1	32	0
1501	3	9	2	0
1581	5	7	2	0
1601	5	21	32	0
1621	6	6	2	0
1641	6	20	32	0
1661	7	5	2	0
1681	7	19	32	0
1701	8	4	2	0
1721	8	18	32	0
1741	9	3	2	0
1761	9	17	32	0
1781	10	2	2	0
1801	10	16	32	0
1901	0	29	2	0
2001	3	11	32	0
Years	Anom. Mot.			
	s	°	′	″
20	0	14	30	0
40	0	29	0	0
60	1	13	30	0
80	1	28	0	0
100	2	12	30	0
200	4	25	0	0
300	7	7	30	0
400	9	20	0	0
500	0	2	30	0
600	2	15	0	0
700	4	27	30	0
800	7	10	0	0
900	9	23	30	0
1000	0	5	0	0
2000	0	10	0	0
3000	0	15	0	0
4000	0	20	0	0
5000	0	25	0	0
6000	[illegible]	0	0	0

Years	Anom. Mot.			
	s	°	′	″
1	1	23	42	7
2	3	17	24	14
3	5	11	6	21
4	7	8	54	0
5	9	2	36	7
6	10	26	18	14
7	0	20	0	21
8	2	17	48	0
9	4	11	30	7
10	6	5	12	14
11	7	28	54	21
12	9	26	42	0
13	11	20	24	7
14	1	14	6	14
15	3	7	48	21
16	5	5	36	0
17	6	29	18	7
18	8	23	0	14
19	10	16	42	21
20	0	14	30	0
Months	Anom. Mot.			
	s	°	′	″
January	0	0	0	0
February	4	6	51	44
March	8	1	26	52
April	0	8	18	36
May	4	11	4	48
June	8	17	56	33
July	0	20	42	45
August	4	27	34	29
September	9	4	26	14
October	1	7	12	26
November	5	14	4	10
December.	9	16	50	2

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

A Table

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A Table of the mean Motion of *Mercury* from the *Aphelion*.

Days	Anom. Mot. s	°	'	''	H.	Anom. Mot. °	'	''	H.	Anom. Mot. °	'	''
1	0	4	5	32	H.	°	'	''	H.	°	'	''
2	0	8	11	5	'	'	''	'''	'	'	''	'''
3	0	12	16	37	1	0	10	14	31	5	17	9
4	0	16	22	10	2	0	20	28	32	5	27	23
5	0	20	27	42	3	0	30	42	33	5	37	37
6	0	24	33	14	4	0	40	55	34	5	47	51
7	0	28	38	47	5	0	51	9	35	5	58	5
8	1	2	44	19	6	1	1	23	36	6	8	19
9	1	6	49	52	7	1	11	37	37	6	18	32
10	1	10	55	24	8	1	21	51	38	6	28	46
11	1	15	0	56	9	1	32	5	39	6	39	0
12	1	19	6	29	10	1	42	18	40	6	49	14
13	1	23	12	1	11	1	52	32	41	6	59	28
14	1	27	17	34	12	2	2	46	42	7	9	42
15	2	1	23	6	13	2	13	0	43	7	19	46
16	2	5	28	38	14	2	23	14	44	7	30	9
17	2	9	34	11	15	2	33	28	45	7	40	23
18	2	13	39	43	16	2	43	42	46	7	50	37
19	2	17	45	16	17	2	53	55	47	8	0	51
20	2	21	50	48	18	3	4	9	48	8	11	5
21	2	25	56	20	19	3	14	23	49	8	21	19
22	3	0	14	53	20	3	24	37	50	8	31	32
23	3	4	7	25	21	3	34	51	51	8	41	46
24	3	8	12	58	22	3	45	5	52	8	52	0
25	3	12	18	30	23	3	55	19	53	9	2	14
26	3	16	24	2	24	4	5	32	54	9	12	28
27	3	20	29	35	25	4	15	46	55	9	22	42
28	3	24	35	7	26	4	26	0	56	9	32	56
29	3	28	40	40	27	4	36	14	57	9	43	9
30	4	2	46	12	28	4	46	28	58	9	53	23
31	4	6	51	44	29	4	56	42	59	10	3	37
32	4	10	57	17	30	5	6	55	60	10	13	51

	s	°	'	''
Long. Aph. ☿ à 1 ✱ ♈	7	13	48	0
Long. ☊ ☿ à 1 ✱ ♈	0	15	42	0
Inclin. Orb. ☿		6	54	0

Dist. Mid. ☿ à ☉ —— 38710

Eccentricity —— 7970

A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom. °	Long. ☿ à 1 ✱ ♈ s	°	'	''	Inc. North. °	'	''	Dis. à ☉ Curt. Logarithm.
0	7	13	37	38	3	14	38	4. 668435
1	7	14	17	50	3	18	54	4. 668395
2	7	14	58	4	3	23	9	4. 668340
3	7	15	38	18	3	27	22	4. 668269
4	7	16	18	34	3	31	34	4. 668184
5	7	16	58	49	3	35	43	4. 668082
6	7	17	39	6	3	39	51	4. 667963
7	7	18	19	24	3	43	58	4. 667829
8	7	18	59	45	3	48	2	4. 667678
9	7	19	40	6	3	52	5	4. 667512
10	7	20	20	29	3	56	6	4. 667330
11	7	21	0	54	4	0	6	4. 667132
12	7	21	41	21	4	4	3	4. 666918
13	7	22	21	51	4	7	59	4. 666687
14	7	23	2	23	4	11	53	4. 666441
15	7	23	42	58	4	15	45	4. 666180
16	7	24	23	35	4	19	34	4. 665904
17	7	25	4	14	4	23	22	4. 665610
18	7	25	44	58	4	27	9	4. 665301
19	7	26	25	44	4	30	53	4. 664976
20	7	27	6	34	4	34	35	4. 664636
21	7	27	47	27	4	38	15	4. 664280
22	7	28	28	25	4	41	53	4. 663908
23	7	29	9	26	4	45	29	4. 663522
24	7	29	50	31	4	49	3	4. 663119
25	8	0	31	40	4	52	34	4. 662700
26	8	1	12	54	4	59	4	4. 662266
27	8	1	54	12	4	59	31	4. 661817
28	8	2	35	35	5	2	56	4. 661351
29	8	3	17	3	5	6	19	4. 660870
30	8	3	58	36	5	9	40	4. 660373

A Table

A Table of the Heliocentrick Place of *Mercury*.

Sign. 1.

Mid. Anom.	Long. ☿ à 1 ✱ ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	8	3	58	36	5	9	40	4. 660373
1	8	4	40	16	5	12	58	4. 659860
2	8	5	22	1	5	16	14	4. 659332
3	8	6	3	51	5	19	27	4. 658789
4	8	6	45	47	5	22	38	4. 658231
5	8	7	27	50	5	25	47	4. 657656
6	8	8	9	56	5	28	53	4. 657066
7	8	8	52	15	5	31	57	4. 656459
8	8	9	34	37	5	34	58	4. 655838
9	8	10	17	6	5	37	57	4. 655201
10	8	10	59	41	5	40	53	4. 654549
11	8	11	42	24	5	43	46	4. 653882
12	8	12	25	15	5	46	37	4. 653199
13	8	13	8	15	5	49	25	4. 652500
14	8	13	51	22	5	52	10	4. 651787
15	8	14	34	37	5	54	52	4. 651059
16	8	15	18	1	5	57	32	4. 650314
17	8	16	1	33	6	0	8	4. 649555
18	8	16	45	14	6	2	41	4. 648780
19	8	17	29	4	6	5	12	4. 647989
20	8	18	13	4	6	7	40	4. 647183
21	8	18	57	15	6	10	4	4. 646363
22	8	19	41	35	6	12	25	4. 645526
23	8	20	26	5	6	14	44	4. 644674
24	8	21	10	45	6	16	58	4. 643808
25	8	21	55	36	6	19	10	4. 642925
26	8	22	40	37	6	21	18	4. 642028
27	8	23	25	50	6	23	23	4. 641115
28	8	24	11	14	6	25	25	4. 640187
29	8	24	56	51	6	27	22	4. 639244
30	8	25	42	39	6	29	17	4. 638286

A Table of the Heliocentrick Place of *Mercury*.

Sign 2.

Mid. Anom.	Long. ☿ à 1 ✱ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	8	25	42	39	6	29	17	4. 638286
1	8	26	28	39	6	31	7	4. 637312
2	8	27	14	51	6	32	54	4. 636323
3	8	28	1	17	6	34	37	4. 635320
4	8	28	47	57	6	36	17	4. 634303
5	8	29	34	39	6	37	52	4. 633270
6	9	0	21	54	6	39	24	4. 632221
7	9	1	9	14	6	40	51	4. 631158
8	9	1	56	48	6	42	14	4. 630081
9	9	2	44	37	6	43	33	4. 628988
10	9	3	32	40	6	44	48	4. 627880
11	9	4	21	0	6	45	59	4. 626757
12	9	5	9	33	6	47	5	4. 625620
13	9	5	58	22	6	48	6	4. 624469
14	9	6	47	29	6	49	3	4. 623302
15	9	7	36	51	6	49	55	4. 622121
16	9	8	26	30	6	50	43	4. 620926
17	9	9	16	26	6	51	25	4. 619717
18	9	10	6	39	6	52	3	4. 618492
19	9	10	57	10	6	52	36	4. 617253
20	9	11	48	0	6	53	3	4. 616001
21	9	12	39	7	6	53	25	4. 614734
22	9	13	30	34	6	53	42	4. 613454
23	9	14	22	20	6	53	53	4. 612159
24	9	15	14	24	6	53	59	4. 610851
25	9	16	6	49	6	53	59	4. 609529
26	9	16	59	33	6	53	54	4. 608194
27	9	17	52	38	6	53	42	4. 606845
28	9	18	46	5	6	53	25	4. 605482
29	9	19	39	52	6	53	1	4. 604107
30	9	20	34	1	6	52	31	4. 602718

A Table

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A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	Sign 3. Long. ☿ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	9	20	34	1	6	52	31	4. 602718
1	9	21	28	31	6	51	55	4. 601318
2	9	22	23	25	6	51	12	4. 599905
3	9	23	18	40	6	50	23	4. 598478
4	9	24	14	18	6	49	27	4. 597040
5	9	25	10	20	6	48	25	4. 595590
6	9	26	6	45	6	47	15	4. 594129
7	9	27	3	34	6	45	58	4. 592655
8	9	28	0	47	6	44	34	4. 591170
9	9	28	58	26	6	43	2	4. 589674
10	9	29	56	30	6	41	24	4. 588166
11	10	0	54	59	6	39	37	4. 586648
12	10	1	54	54	6	37	43	4. 585119
13	10	2	53	14	6	35	41	4. 583581
14	10	3	53	1	6	33	31	4. 582034
15	10	4	53	16	6	31	12	4. 580478
16	10	5	53	56	6	28	46	4. 578912
17	10	6	55	5	6	26	11	4. 577338
18	10	7	56	42	6	23	27	4. 575755
19	10	8	58	46	6	20	35	4. 574164
20	10	10	1	19	6	17	34	4. 572565
21	10	11	4	21	6	14	24	4. 570960
22	10	12	7	53	6	11	5	4. 569348
23	10	13	11	54	6	7	36	4. 567730
24	10	14	16	24	6	3	59	4. 566107
25	10	15	21	24	6	0	12	4. 564479
26	10	16	26	54	5	56	15	4. 562845
27	10	17	32	55	5	52	9	4. 561207
28	10	18	39	27	5	47	51	4. 559567
29	10	19	46	30	5	43	26	4. 557924
30	10	20	54	4	5	38	50	4. 556279

A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	Sign. 4. Long. ☿ à 1 * ♈				Inc. South.			Dif. à ☉ Curt. Logarithm.
°	s	°	′	″	°	′	″	
0	10	20	54	4	5	38	50	4. 556279
1	10	22	2	10	5	34	4	4. 554631
2	10	23	10	48	5	29	7	4. 552984
3	10	24	19	58	5	24	1	4. 551335
4	10	25	29	39	5	18	44	4. 549687
5	10	26	39	53	5	13	16	4. 548040
6	10	27	50	40	5	7	38	4. 546395
7	10	29	1	58	5	1	49	4. 544752
8	11	0	13	49	4	55	50	4. 543114
9	11	1	26	14	4	49	40	4. 541479
10	11	2	39	12	4	43	19	4. 539849
11	11	3	52	42	4	36	48	4. 538226
12	11	5	6	46	4	30	6	4. 536608
13	11	6	21	23	4	23	13	4. 534999
14	11	7	36	32	4	16	10	4. 533397
15	11	8	52	15	4	8	56	4. 531805
16	11	10	8	31	4	1	31	4. 530225
17	11	11	25	20	3	53	56	4. 528655
18	11	12	42	42	3	46	11	4. 527097
19	11	14	0	38	3	38	15	4. 525553
20	11	15	19	5	3	30	8	4. 524023
21	11	16	38	5	3	21	52	4. 522509
22	11	17	57	38	3	13	26	4. 521011
23	11	19	17	42	3	4	50	4. 519531
24	11	20	38	18	2	56	4	4. 518069
25	11	21	59	26	2	47	9	4. 516626
26	11	23	21	5	2	38	4	4. 515205
27	11	24	43	16	2	28	51	4. 513806
28	11	26	5	58	2	19	29	4. 512430
29	11	27	29	9	2	9	58	4. 511079
30	11	28	52	50	2	0	20	4. 509752

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A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	Sign. 5. Long. ☿ à ♈				Inc. South.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	11	28	52	50	2	0	20	4. 509752
1	0	0	17	0	1	50	33	4. 508451
2	0	1	41	39	1	40	39	4. 507179
3	0	3	6	47	1	30	38	4. 505935
4	0	4	32	22	1	20	31	4. 504721
5	0	5	58	25	1	10	16	4. 503537
6	0	7	24	54	0	59	56	4. 502386
7	0	8	51	49	0	49	31	4. 501268
8	0	10	19	9	0	39	1	4. 500185
9	0	11	46	55	0	28	26	4. 499137
10	0	13	15	3	0	17	47	4. 498126
11	0	14	43	35	0	7	4	4. 497152
12	0	16	12	30	Nor. 3		41	4. 496217
13	0	17	41	45	0	14	29	4. 495321
14	0	19	11	21	0	25	19	4. 494467
15	0	20	41	16	0	36	10	4. 493655
16	0	22	11	30	0	47	2	4. 492885
17	0	23	42	2	0	57	54	4. 492158
18	0	25	12	50	1	8	45	4. 491476
19	0	26	43	54	1	19	35	4. 490840
20	0	28	15	13	1	30	24	4. 490248
21	0	29	46	45	1	41	10	4. 489702
22	1	1	18	30	1	51	54	4. 489204
23	1	2	50	26	2	2	33	4. 488755
24	1	4	22	32	2	13	9	4. 488354
25	1	5	54	47	2	23	39	4. 488003
26	1	7	27	13	2	34	4	4. 487702
27	1	8	59	41	2	44	23	4. 487451
28	1	10	32	16	2	54	36	4. 487252
29	1	12	4	55	3	4	41	4. 487104
30	1	13	37	38	3	14	38	4. 487008

A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	Sign. 6. Long. ☿ à ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	1	13	37	38	3	14	38	4. 487008
1	1	15	10	23	3	24	27	4. 486962
2	1	16	43	8	3	34	7	4. 486969
3	1	18	15	52	3	43	36	4. 487029
4	1	19	48	35	3	52	56	4. 487140
5	1	21	21	14	4	2	5	4. 487304
6	1	22	53	48	4	11	3	4. 487521
7	1	24	26	17	4	19	50	4. 487789
8	1	25	58	40	4	28	24	4. 488109
9	1	27	30	55	4	36	46	4. 488481
10	1	29	3	0	4	44	55	4. 488905
11	2	0	34	53	4	52	51	4. 489378
12	2	2	6	36	5	0	33	4. 489901
13	2	3	38	6	5	8	1	4. 490474
14	2	5	9	21	5	15	15	4. 491097
15	2	6	40	21	5	22	14	4. 491768
16	2	8	11	5	5	28	58	4. 492488
17	2	9	41	32	5	35	27	4. 493254
18	2	11	11	38	5	41	42	4. 494068
19	2	12	41	26	5	47	40	4. 494928
20	2	14	10	54	5	53	23	4. 495833
21	2	15	40	0	5	58	51	4. 496782
22	2	17	8	43	6	4	3	4. 497773
23	2	18	37	2	6	8	58	4. 498807
24	2	20	4	58	6	13	38	4. 499882
25	2	21	32	28	6	18	3	4. 500997
26	2	22	59	32	6	22	11	4. 502161
27	2	24	26	8	6	26	3	4. 503342
28	2	25	52	17	6	29	40	4. 504569
29	2	27	17	57	6	33	1	4. 505832
30	2	28	43	10	6	36	7	4. 507129

A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	Sign 7. Long. ☿ à I ✱ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	3	28	43	10	6	36	7	4.	507129
1	3	0	7	52	6	38	57	4.	508458
2	3	1	32	3	6	41	32	4.	509819
3	3	2	55	46	6	43	51	4.	511209
4	3	4	18	56	6	45	56	4.	512629
5	3	5	41	33	6	47	46	4.	514078
6	3	7	3	38	6	49	21	4.	515553
7	3	8	25	9	6	50	42	4.	517052
8	3	9	46	9	6	51	48	4.	518576
9	3	11	6	34	6	52	41	4.	520121
10	3	12	26	25	6	53	20	4.	521688
11	3	13	45	44	6	53	46	4.	523276
12	3	15	4	28	6	53	59	4.	524882
13	3	16	22	36	6	53	58	4.	526505
14	3	17	40	10	6	53	45	4.	528144
15	3	18	57	10	6	53	20	4.	529798
16	3	20	13	35	6	52	43	4.	531467
17	3	21	29	23	6	51	54	4.	533148
18	3	22	44	37	6	50	54	4.	534841
19	3	23	59	16	6	49	43	4.	536543
20	3	25	13	19	6	48	21	4.	538255
21	3	26	26	48	6	46	48	4.	539975
22	3	27	39	42	6	45	6	4.	541702
23	3	28	52	1	6	43	13	4.	543434
24	4	0	3	45	6	41	11	4.	545172
25	4	1	14	55	6	38	59	4.	546914
26	4	2	25	30	6	36	39	4.	548659
27	4	3	35	30	6	34	9	4.	550406
28	4	4	44	56	6	31	32	4.	552154
29	4	5	53	48	6	28	46	4.	553902
30	4	7	2	8	6	25	52	4.	555650

A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	Sign. 8. Long. ☿ à I ✱ ♈				Inc. North.			Dif. à ☉ Curt. Logarithm.	
°	s	°	′	″	°	′	″		
0	4	7	2	8	6	25	52	4.	555650
1	4	8	9	53	6	22	51	4.	557396
2	4	9	17	4	6	19	43	4.	559139
3	4	10	23	44	6	16	27	4.	560881
4	4	11	29	49	6	13	5	4.	562618
5	4	12	35	23	6	9	36	4.	564352
6	4	13	40	25	6	6	1	4.	566080
7	4	14	44	54	6	2	20	4.	567801
8	4	15	48	52	5	58	33	4.	569516
9	4	16	52	21	5	54	41	4.	571225
10	4	17	55	17	5	50	43	4.	572926
11	4	18	57	44	5	46	41	4.	574619
12	4	19	59	59	5	42	33	4.	576302
13	4	21	1	5	5	38	21	4.	577977
14	4	22	2	2	5	34	4	4.	579641
15	4	23	2	30	5	29	44	4.	581295
16	4	24	2	31	5	25	19	4.	582939
17	4	25	2	3	5	20	50	4.	584570
18	4	26	1	5	5	16	18	4.	586191
19	4	26	59	42	5	11	42	4.	587801
20	4	27	57	52	5	7	3	4.	589398
21	4	28	55	35	5	2	21	4.	590983
22	4	29	52	52	4	57	36	4.	592555
23	5	0	49	44	4	52	48	4.	594113
24	5	1	46	9	4	47	57	4.	595658
25	5	2	42	9	4	43	4	4.	597188
26	5	3	37	47	4	38	8	4.	598705
27	5	4	32	57	4	33	10	4.	600207
28	5	5	27	48	4	28	11	4.	601696
29	5	6	22	14	4	23	9	4.	603169
30	5	7	16	16	4	18	5	4.	604628

A Table

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A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	*Sign.* 9.							
	Long. ♀ à 1 ✱ ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	5	7	16	16	4	18	5	4. 604628
1	5	8	9	56	4	13	0	4. 606072
2	5	9	3	14	4	7	53	4. 607500
3	5	9	56	10	4	2	44	4. 608914
4	5	10	48	45	3	57	34	4. 610311
5	5	11	40	58	3	52	23	4. 611693
6	5	12	32	51	3	47	10	4. 613059
7	5	13	24	24	3	41	57	4. 614408
8	5	14	15	38	3	36	42	4. 615743
9	5	15	6	31	3	31	27	4. 617060
10	5	15	57	6	3	26	10	4. 618362
11	5	16	47	23	3	20	53	4. 619647
12	5	17	37	21	3	15	36	4. 620916
13	5	18	27	0	3	10	17	4. 622168
14	5	19	16	22	3	4	58	4. 623404
15	5	20	5	27	2	59	39	4. 624623
16	5	20	54	15	2	54	19	4. 625825
17	5	21	42	47	2	48	59	4. 627011
18	5	22	31	3	2	43	39	4. 628180
19	5	23	19	3	2	38	18	4. 629332
20	5	24	6	48	2	32	57	4. 630468
21	5	24	54	17	2	27	36	4. 631587
22	5	25	41	31	2	22	16	4. 632688
23	5	26	28	31	2	16	55	4. 633772
24	5	27	15	17	2	11	34	4. 634841
25	5	28	1	48	2	6	13	4. 635892
26	5	28	48	6	2	0	52	4. 636927
27	5	29	34	12	1	55	32	4. 637943
28	6	0	20	4	1	50	12	4. 638943
29	6	1	5	43	1	44	52	4. 639927
30	6	1	51	11	1	39	32	4. 640894

A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	*Sign.* 10.							
	Long. ♀ à 1 ✱ ♈				Inc. North.			Dif. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	6	1	51	11	1	39	32	4. 640894
1	6	2	36	26	1	34	13	4. 641844
2	6	3	21	30	1	28	54	4. 642777
3	6	4	6	22	1	23	35	4. 643693
4	6	4	51	3	1	18	17	4. 644592
5	6	5	35	33	1	13	0	4. 645474
6	6	6	19	53	1	7	43	4. 646340
7	6	7	4	1	1	2	26	4. 647188
8	6	7	48	0	0	57	10	4. 648019
9	6	8	31	50	0	51	55	4. 648834
10	6	9	15	31	0	46	40	4. 649632
11	6	9	59	1	0	41	26	4. 650412
12	6	10	42	23	0	36	13	4. 651177
13	6	11	25	35	0	31	0	4. 651924
14	6	12	8	39	0	25	48	4. 652655
15	6	12	51	35	0	20	37	4. 653369
16	6	13	34	23	0	15	26	4. 654066
17	6	14	17	3	0	10	17	4. 654745
18	6	14	59	36	0	5	8	4. 655410
19	6	15	42	2	Sou.	0	0	4. 656057
20	6	16	24	20	0	5	7	4. 656688
21	6	17	6	30	0	10	13	4. 657301
22	6	17	48	35	0	15	19	4. 657899
23	6	18	30	33	0	20	23	4. 658479
24	6	19	12	26	0	25	27	4. 659044
25	6	19	54	12	0	30	29	4. 659592
26	6	20	35	52	0	35	31	4. 660123
27	6	21	17	27	0	40	32	4. 660637
28	6	21	58	56	0	45	31	4. 661134
29	6	22	40	20	0	50	30	4. 661615
30	6	23	21	40	0	55	27	4. 662081

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A Table of the Heliocentrick Place of *Mercury*.

Mid. Anom.	Sign II. Long. ☿ à 1 * ♈				Inc. South.			Dis. à ☉ Curt.
°	s	°	′	″	°	′	″	Logarithm.
0	6	23	21	40	1	55	27	4. 662081
1	6	24	2	54	1	0	24	4. 662529
2	6	24	44	4	1	5	19	4. 662961
3	6	25	25	9	1	10	13	4. 663376
4	6	26	6	10	1	15	6	4. 663775
5	6	26	47	6	1	19	58	4. 664157
6	6	27	28	0	1	24	49	4. 664524
7	6	28	8	49	1	29	39	4. 664873
8	6	28	49	35	1	34	27	4. 665206
9	6	29	30	18	1	39	14	4. 665523
10	7	0	10	58	1	44	0	4. 665824
11	7	0	51	34	1	48	45	4. 666109
12	7	1	32	8	1	53	29	4. 666377
13	7	2	12	40	1	58	11	4. 666629
14	7	2	53	8	2	2	52	4. 666865
15	7	3	33	34	2	7	32	4. 667084
16	7	4	13	59	2	12	10	4. 667287
17	7	4	54	22	2	16	47	4. 667474
18	7	5	34	44	2	21	23	4. 667646
19	7	6	15	4	2	25	57	4. 667800
20	7	6	55	21	2	30	30	4. 667939
21	7	7	35	37	2	35	1	4. 668060
22	7	8	15	53	2	39	31	4. 668166
23	7	8	56	9	2	44	0	4. 668257
24	7	9	36	22	2	48	27	4. 668330
25	7	10	16	35	2	52	53	4. 668388
26	7	10	56	48	2	57	17	4. 668429
27	7	11	37	1	3	1	39	4. 668453
28	7	12	17	13	3	6	0	4. 668463
29	7	12	57	26	3	10	20	4. 668456
30	7	13	37	38	3	14	38	4. 668435

The

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 *Prælect. Astronom.*

1. That there is this great Difference between an Eclipse of the Sun and of the Moon: That a 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 Position 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 Solar 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 since the Earth's *Disk* is much greater than the Disk of its Shadow seen 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 visible any where, as happen when the Moon is interposed between that particular Place and the Sun: 'Tis easily seen, that in particular Places *Lunar* 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 *Perigæum*, and the Moon in her *Apogæum*, 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 all round about it.

4. The Moon is never eclipsed by the very Shadow of the Earth it self, but only by that of the Earth's Atmosphere. This was a Proposition perfectly unknown to the Ancients, but is sufficiently apparent and manifest from the Consideration of Refraction.

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 self 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 Altitude, 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 Eclíptick, making with it an Angle of at least five Degrees; and also 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 Syzygies.* 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 sought, 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 subduct 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, *&c* Then will the Day, with its annexed Hours, Minutes, Seconds, *&c.* of the mean Time of the Syzygy sought, 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.

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 six Signs; but on the Right, if it be in the six 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 Minutes 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 six 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,

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.º 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 Ecliptick, 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 results, will be the Sun's correct Place in the Ecliptick for the Time given. An Example will make all this plain.

 Suppose

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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 *Flamstead'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 distance 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 3s. 7°. 6'. 50''.

Make a little Table, and write all things down thus:

What is the Sun's Place *Oct.* 25. 1h. 5'. 30''. p. m.
In the apparent Time *A. D.* 1668 ?

	Sun's Motion.				Perihelion's Motion.				
	S.	°	'	"	S.	°	'	"	
1661.	9	20	25	46	3	6	35	0	
7.	11	29	18	48			5	50	
Bissect. *Oct.* 26.	9	24	42	30				41	
Hour 1.			2	28					
Min. 5.				12	3	6	42	31	Sum of all, and the Place of the Perihelion.
Seconds 30.				1					
Sum of all	34	14	29	45					
Deduct	24	for 2 Circles.							

	S.	°	'	"	
Remains	7	14	29	45	For the Sun's mean Motion.
Deduct	3	6	41	31	Being the Place of the Perihelion.
Remains	4	7	48	14	Which is the *mean Anomaly*.
Again from	7	14	29	45	The mean Motion.
Subduct		1	32	1	The proper Equation found as above.
Remains	7	12	57	44	The Sun's Place.
Subtract again				40	The proportionable Parts to be subtracted, as above shewn.
Remains	7	12	57	04	For the Sun's corrected Place.

And thus may the Sun's Place be truly calculated for any Time assign'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 *Perihelia*.

2. Besides, the Motions of the Moon her self and of the *Apogaeum*, (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 versâ*.

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 'tis 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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mined, causes a very considerable Difficulty in Lunar Calculations.

5. The Motion of the *Apsis* 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 succeed 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 Equation, 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.

These 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 Anomaly*, both the proper Parts of their corresponding Equation, and the *Absolute Equation* thence arising, 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* Time.

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 ascending 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 Anomaly* 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 six Signs than the mean Motion of the Moon, let those Numbers be added to; but if it be greater by six 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 *true* 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, reserving the Difference for other Astronomical Uses.

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 soon 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 greatest 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 Moon'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; but only such a Place of her, as is supposed to be without 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.

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Equation. Which Equation if it be added to, 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.* The 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 corresponding to such Reduction or Excess: And say 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 Reduction, shall give a *Reduction true and perfect,* 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.

9. And this Longitude of the Moon being obtained, you must thus proceed to seek her Latitude. From the *Table of the Moon's Latitude,* which not only shews 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 pursued 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 assigned. 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 'tis *less* than the Horary Motion belonging to the greater Eccentricity, or *substracted* 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 Parallaxes,* and *apparent Diameters* will be so too, the Reason of both being one and the same.

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The Calculation of Eclipses.

IN 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. *Whiston*) 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 the Sun.

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 terminating in a Point.

4. 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 Deficiencies 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 visible 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 calculate *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 Lunar. 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 Degrees. And first in Order,

To calculate an Eclipse of the Moon.

YOU 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 seek for the *Conjunction*, the remaining Numbers alone, or with the Addition of six 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, Minutes, Seconds, &c.* for then the Day with its Hours, Minutes, Seconds, &c. so 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, &c. 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 Syzgies.*

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.

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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 ſay by the Rule of Three, As the *Motion* of one Hour, is to that one Hour, or to 60 Minutes 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 ſince 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 ſlower, but when 'tis at a *mean* in the middle. (2.) The Interval between the *mean* and *true* Syzygy, ſeldom exceeds 12 Hours, never 14, as by Aſtronomical 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 (as above directed) correſponding thereunto, together with the Moon's true Latitude from the Ecliptick agreeable to the Moment of the true Syzygy, 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 adjectitious, 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 *leaſt 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, where 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 Difference of their Centres, and this *half 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 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 Phænomena 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 plain

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plain from the Diagram of *Hipparchus (vid. Whiston 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 Semidiameter 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 Terrestrial Shadow.

3. Next substract the apparent Semidiameter of the Moon, from that of the Shadow: And if the Difference be *equal* to the *said least Central Distance*, there will be a *total Eclipse of the Moon*; but *sine 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 Moon's Diameter is supposed to be 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 *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 therefore will be found; as also, its Equal, the *Angle of the Exit*. But since 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 Semidiameters* 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 Eclipse being known, you will have the Angle of *Incidence* and *Immersion*.

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 Semidiameters of the Shadow and of the Moon, to the *Semi-mora*, or half the Duration of the Eclipse.

8. *To find the Duration of the absolute Darkness 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 express'd in Time; say, As the Horary Motion of the Moon from the Sun, is to an Hour or 60 Minutes in Time :: so 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 Eclipse.*

From or to the middle Moment of the Eclipse, take or add the Semi-duration, and you must have the Beginning 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 Parallaxes and Refractions. *An Example follows.*

A Calcu-

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

		Mid. Motion ☾				Apogæum.				Retrogr. Node.				
		S.	°	′	″	S.	°	′	″	S.	°	′	″	
Radix	1701	10	15	19	50	11	8	18	20	4	27	24	20	
Years since	6	2	9	28	55	8	4	5	44	3	26	1	29	
April, Days	5	5	21	45	27	0	10	35	2	0	5	1	51	
Hours	13	0	7	8	14	0	0	3	37	0	0	1	43	
Minutes	46	0	0	25	15	0	0	0	13	3	0	0	6	
Mean Motion	Sum	6	24	7	41	7	23	2	56	4	1	5	9	Take this from the upper Number there remains.
										0	26	19	11	
Sun mean Anomaly		9	17	43	41									
Parts Physical	Subtr.	0	0	10	53	0	26	14	57	0	26	14	57	
Middle Place correct		6	23	56	48	Sun's true Place.				Sun's true Place.				Sun's true Place.
Apogæum Subtr.		7	14	42	23									
Mean Anomaly		11	9	14	25	5	3	12	1	11	26	14	57	Sun's Distance
Equation add		0	2	21	0	Annual Argum.				Sun's Dif. fr. Node				from the Node.
Equated Place in the Orbit		6	26	17	48									
True Place of the Sun			26	14	57		8	20	33		0	0	5	Equation add.
Moon's Distance from the Sun		6	0	2	51	Equation Subtr.				Equation add.				
Variation add		0	0	0	1									
True Place in the Orbit		6	26	17	49									
Node Subtr.		0	26	19	16									
Argument of Latitude		5	29	58	53									
Reduction add		0	0	0	0									
True Place in the Ecliptick		6	26	17	49									
True North Latitude		0	0	0	8									
Former Equation add				7	15									
Latter Equation substract				7	39									
The Dif. is Equation now add				0	24									

	S.	°	′	″
The true Place of the Apogæum	7	14	42	23
Node	0	26	19	16
Inclination of the Limit		5	18	0
The greatest Eccentricity	66850			
True	62131			
Mean	55237			
Difference	0·6894			
Difference between the mean and the greatest.	11613			

Wherefore the apparent Times of the Eclipse will be thus,

Beginning	11	42	42
Middle	13	40	9
End	15	37	36

	′	″
The Horary Motion of the Moon	29	56
Of the Sun	2	26
Horary Motion of the Moon from the Sun	27	30

As. 1650″. 60′ : : 172. $6\frac{1}{4}$. Wherefore the Difference of Time to be subducted, is $6\frac{1}{4}$.
And therefore the middle of the Eclipse will be 13 h. 39′. 45″

	′	″
The Moon's Horizontal Parallax	54′.	48″.
The Sun's add		10
Sum	54	58
The Sun's Semidiameter Subtr.	16	01
Remains Semidiameter Shadow	38	57
Moon's Semidiameter	14	52
Sum	53	49

Then say 27.5 : 60′ : : 53, 8 : 117 $\frac{12}{}$ = 1h.57.$\frac{1}{2}$. Wherefore the Duration of the Eclipse, is 3h. 55′.

Beginning	11h,	42m.	18″
End	15h.	37m.	12″.

To

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To Calculate the Eclipse of the Sun.

IN order to which, let it be premised, 1. That 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 *Eclipse 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 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 plain that the Centre of the Moon, being in the Plane of the Ecliptick, directly interposed betwen the Centres of the Sun and Earth, will occasion a Central Eclipse of the Sun, to such 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 Nodes*, but a little Distance from it; then the Centre of the Moon's Shadow will not describe the Ecliptick, nor any *great* Circle on the Earth, but a *lesser 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 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 Incidence.

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. *Flamsted* and Mr. *Halley*, to avoid this tedious and precarious way of Parallactick Calculation, and of delineating a Solar Eclipse by Scale and Compass. See *Flamsted's Doctrine of the Sphere, in Sir Jonas More's Mathematicks*. Vol. I.

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

1. FROM the Moon's Horizontal Parallax, substract 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 Eclipse arises.

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 *less* 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 out 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 below.

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

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

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 Latitude, to the Cosine of the Angle of the total Immersion.

And since 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; And,

As Radius to the Sine of the Angle of Immersion of the Centre : : so is the *Semidiameter of the Disk*, to the Motion of half the Duration of Central 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 middle 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 Consideration of the Difference of Meridians or Longitudes of Places, may easily be accommodated to any other Place.

And thus may the general *Phænomena* 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 Eclipse, 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 Eclipse 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 Phænomena 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 proper 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 Calculation.

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 connects 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; so 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 aforesaid 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

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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 Body.

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 Penumbra*, note the Hours of your Meridian, with the Quarters, Minutes, &c. (if there be occasion) corresponding to the *Phænomena* of the Eclipse, found as 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 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 *Rectilinear 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, 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 opened still at the same Distance, and now carried 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 *Doctrine of the Sphere in Sir* Jona. Moor's *Math.* Vol. I.

For the Calculation of the Eclipses of the Satellites of *Jupiter*, See *Jupiter* in Vol. II.

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 D.	Latitude M.	Diff. of Merid. H.	Diff. of Merid. M.	Diff. of Longit. D.	Diff. of Longit. M.	
Acapulco in *Mexico*	17	30	7	05	106	15	W
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	07	2	12	33	00	E
* *Amiens* in *France*	49	54	0	09	2	15	E
* *Amsterdam*	52	21	0	19	4	45	E
* *Antwerp*	51	10	0	17	4	15	E
* *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	41	26	0	10	2	30	E
* *Batavia*	6 S	15	6	43	100	45	E
* *Bayon*	43	29	0	06	1	30	W
Bengal	21	56	6	21	95	15	E
Bergen in *Norway*	61	00	0	32	8	00	E
* *Bononia* in *Italy*	44	30	0	47	11	45	E
* *Boston* in *New-England*	42	25	4	42½	70	37	W

Places Names.	Latitude D.	Latitude M.	Diff. of Merid. H.	Diff. of Merid. M.	Diff. of Longit. D.	Diff. of Longit. M.	
* *Brest* in *France*	48	23	0	18	4	30	W
* *Bourdeaux*	44	50	0	02	0	30	W
Cadiz in *Spain*	36	16	0	30	7	30	W
* *Calis* in *France*	50	57	0	07	1	45	E
Camboia in *India*	10	20	7	12	108	00	E
* *Canea* in *Crete*	35	29	1	36½	24	07	E
Candia	35	18	1	41	25	15	E
* *Cape Bon Esperance*	34 S	15	1	19	19	45	E
* *Cape Comerin*	8	00	5	13	78	15	E
* *Cape Virde* at the *Isle of Goree*	14	43	1	09	17	51	W
* *Cayenne West-Indies*	4	56	3	26	15	30	W
* *Cayro*	30	04	2	17	34	15	E
Ceylon	7	50	5	33	83	15	E
* *Chensan China*	30	00	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	E
Corvo Insula	40	03	2	06	31	30	W
Cracow Poland	50	10	1	18	19	30	E
Cusco in *Peru*	12 S	25	4	55	73	45	W
* *Dantzick* in *Poland*	54	22	1	16	19	00	E
* *Diep* in *Normandy*	49	56	0	04	1	00	E
* *Dublin* in *Ireland*	53	12	0	28	7	00	W
* *Dunkirk Flanders*	51	01	0	09	2	15	E
Durazzo in *Dalmatia*	41	58	1	21	20	15	E
* *Edinborough* in *Scotland*	55	57	0	12	3	00	W
* *Embden*	53	05	0	30	7	30	E
Fero Insula	28	05	1	13	18	15	W
Fez	33	10	0	24	6	00	W
* *Florentia*	43	41	0	47	11	45	E
Frankford on the *Main*	50	04	0	33	8	45	E
Geneva	46	22	0	26	6	30	E
Genoa	44	27	0	39	9	45	E
* *Ghent*	51	01	0	15	3	45	E
Greenwich at the Observatory	51	28½	0	00	0	00	
Goa in *India*	15	30	4	55	73	45	E
* *Goes* in *Zealand*	51	30	0	16	4	00	E
* *Guataloupa*	14	00	4	09½	62	20	W
* *Grenoble*	45	16	0	24	6	00	E
* *Hamburgh*	53	41	0	42	10	30	E
Havre de Grace	49	30	0	00½	0	07	E
Heidelburgh	49	20	0	36	9	00	E
Hoaignan in *China*	33	35	7	56	119	00	E
* *Jamaica Port Royal*	17	40	5	04	76	00	W
Ingolstad	48	40	0	46	11	37	E
* *Inspruck*	47	15	0	47	11	45	E
* *Kebreck New France*	47	00	4	40	70	00	W
* *Koningsberg* in *Prussia*	54	43	1	22	20	30	E
Leghorn	43	18	0	51	12	45	E
Liege	50	40	0	24	6	00	E
* *Leipsick*	51	19	0	53	13	15	E
Lima Peru	12 S	20	5	24	81	00	W
* *Lintz Austria*	48	16	1	00	15	00	E
* *Lions France*	45	45	0	20	5	00	E
* *Lisbon Portugal*	38	50	0	42	10	30	W
* LONDON	51	32	0	0½	0	05	E
* *Macao China*	22	13	7	44	116	30	E
Madagascar Bay of Terra del Gada	19 S	29	2	58	44	00	W

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A Table of the Latitudes and Longitudes, &c.

Places Names.	Latitud. D.	M.	Dift. of Merid. H.	M.	Diff. of Longit. D.	M.	
Madrid Spain	40	10	0	13	3	15	W
* *Majorca*	39	35	0	10	2	30	E
* *Malacca India*	2	42	6	40	100	00	E
* *Martinico Island*	14	44	4	04	61	00	W
* *Marseiles*	43	20	0	21½	5	22	E
Messina in *Sicily*	38	21	1	06	16	30	E
* *Mexico*	20	06	6	49	102	10	W
Munchen Bavaria	48	58	0	47	11	45	E
* *Montpelier*	43	36	0	15	3	45	E
* *Muscow*	55	34	2	35	38	45	E
* *Namur*	50	25	0	20	5	00	E
Nangasack Japan	32	53	8	31	127	45	E
* *Nancy Lorrain*	48	39	0	27	6	45	E
* *Nants*	47	13	0	06½	1	36	W
Naples	41	05	1	03	15	45	E
* *Narbon*	43	15	0	09	2	15	E
Narsinga	18	15	5	34	83	30	E
* *Nice Provence*	43	38	0	29	7	15	E
* *Ningpo* or *Liampo China*	29	58	8	01	120	15	E
* *Noremberg*	49	29	0	49	12	15	E
Olinda Brasile or *Pernambuck*	7 S	48	2	20	35	00	W
* *Oxford*	51	44½	9	05	1	15	W
Ozaca Japan	35	05	8	52	133	00	E
* *Padua*	45	31	0	45	11	15	E
* *Paris*	48	50	0	09	2	15	E
* *Pekin China*	39	55	7	51	117	45	E
* *Poudicherri*	11	54	5	21	80	15	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
* *Rhodes*	36	42	2	12	33	00	E
* *Rochel*	46	10	0	05½	1	20	W
Rome	41	51	0	52	13	00	E
* *Rostock*	54	10	0	51	12	45	E
* *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	1	49	27	15	E
Spahan Persia	36	14	4	20	65	00	E
Stockholm Sweden	58	50	1	10	17	30	E
Syracusa Sicily	37	04	1	01	15	15	E
Tangier	35	55	0	25	6	15	W
Tidore	00	36	6	37	99	15	E
Toledo Spain	39	46	0	14	3	30	W
* *Thoulon France*	43	06	0	23	5	45	E
* *Tripoly* in *Barbary*	32	54	0	52	13	00	E
* *Tubing Germany*	48	34	0	37	9	15	E
* *Valentia Spain*	39	30	0	03	0	45	E
Venice	45	18	0	50	12	30	E
* *Vienna*	48	22	1	09	17	15	E
Upsal	59	00	1	12	18	00	E
* *Uraniburg*	55	54	0	51	12	45	E
* *Utrecht*	52	05	0	20	5	00	E
* *Wirtemberg Saxony*	51	53	0	52	13	80	E
Wolfenbuttle	52	11	0	44	11	00	E
York	54	00	0	04	1	00	W

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-

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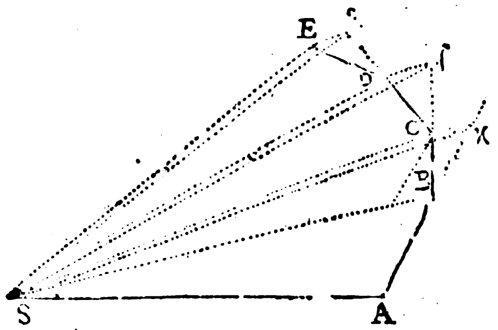
ASTRONOMY, in order to prepare the Way for the right understanding of this noble Science, as it now stands in the Writings of the modern Astronomers, who have revived and demonstrated the *Ancient Pythagorean System of the World:* And besides those necessary Precognita of the Doctrine of the Sphere, *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 *Mechanical* 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 immoveable 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

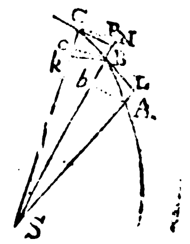


that drawing the Rays AS, BS, xS to the immoveable Center S, the Areas ASB and BSx described, would be equal: But when the Body comes to B, let a Force in S attract the same, and by one single but strong Impulse, make the Body deviate from the right Line Bx, and move in the right Line BC; draw xC Parallel to BS, interfecting BC 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 ASB; join SC and the Triangle SBC, because of the Parallels 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*.

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 Tangent 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.*

CONSECTARY I.

If a Body or Planet revolving in the Curve ABC, be attracted by a Central Force in S, or gravitate towards 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 $SAb = \frac{1}{2} SA \times Ab$, and the Triangle SBC is $= \frac{1}{2} SB \times Bc$; therefore it is, $\frac{1}{2} SA : \frac{1}{2} SB :: SA : SB :: Bc : Ab$; that is, the infinitely little Arches Ab, Bc, are Proportional to the Radii SA, 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 A move to B, or b, its Circular Velocity is measured by the Arch of the Circle Ab describe on the Center of Attraction S, and the Circular Velocity of a Body moving from B to C is measured by the Circular Arch BC.

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 Centrifugus* may be express'd 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.

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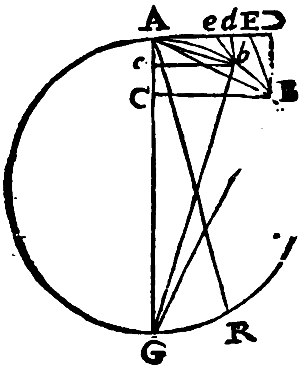
DEFIN. V.

Solicitatio Paracentrica Gravitatis vel Levitatis, or the *Paracentric Solicitation* of Gravity or Levity, is exprefs'd by the right Line AL, drawn from the Point A, Parallel to the Ray SB (infinitely near SA) until it interfect the Tangent BL.

LEMMA I.

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 ABG in A, then DAB is the Angle of Contact; Let AB be an infinitely little Arch, AB the Chord, and AC the versed Sign thereof, I fay AC or BD is as the Square of AB; that is, if another infintiely 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, $ABq : Abq :: AC \times AG : Ac \times AG :: AC : Ac :: BD : bd$.

Now when the Points B, b, are infinitely near the Point A, then the Chords AB, Ab, are equal to the Arches AB, Ab, and consequently the Versed Sines AC, Ac, or the Subtenfes of the Angle of Contact BD, bd, are in a duplicate Ratio of the conterminal Arches AB, Ab.

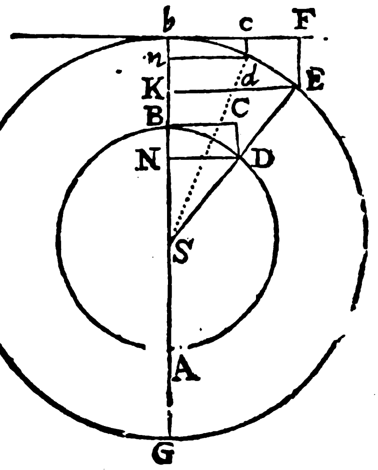
And if the Lines BE, be, fubtend the Angle of Contact DAB, and be Parallel to any Line (lefs than the Diameter AG) drawn within the Circle, as AR, then the Lines BE, be, will be as the Squares of the conterminal Arches AB, Ab, for $BD : bd :: BE : be :: ABq : Abq$.

COROLLARY.

The Subtenfes of the Angles of Contact of Curves, whofe Curvature in the Point of Contact is the fame with that of fome Circle (or when the Difference between them is incomparably little) are in a duplicate Ratio of the conterminal Arches.

LEMMA II.

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



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

Then it is, $bK : BN :: Sb : SB$.

And $bn : bK :: bdq : bEq$.

But $bE = \frac{Sb}{SB} BD$.

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

That is, $bn : BN :: \frac{bdq}{Sb} : \frac{BDq}{SB}$.

And fuppofing. $\}$ $bd = BD$

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

PROP. II.

The Conatus Centrifugi (*or* Vires Centripetæ) *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 verfed Sine of the Angle of Circulation, and the verfed Sines of Arches infinitely little are in a duplicate Ratio of the Chords of thofe Arches; that is, in a duplicate Ratio of the Arches themfelves, and the Velocities (the times being fuppofed equal) are as the Arches, therefore the *Conatus Centrifugi* are in a duplicate Ratio of the Velocities.

CONSEC-

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CONSECTARY I.

If two Bodies B, b, revolve in unequal Circles, ABD, GbE, and describe the Areas SBD, Sbd; then the *Conatus Centrifugi* (or *Vires Centripetæ*) 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 Centrifugi* 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 $bn : BN :: \frac{bdq}{Sb} : \frac{BDq}{SB}$ will become $bn : BN :: \frac{SBq}{Sb} : \frac{Sbq}{SB} :: \overline{SB}^3 : \overline{SB}|^3$, that is, the *Conatus Centrifugi* are reciprocally in a triplicate Ratio of the Radii.

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 BD, bd in equal Times, then the periodic Time of b will be to the peroidic Time of B, as $\frac{Sb}{bd}$ is to $\frac{SB}{BD}$; because the Times are directly as the Spaces and reciprocally as the Velocities; and because $bn : BN$ ($:: dc : DC$) $:: \frac{bdq}{Sb} : \frac{BDq}{SB} :: \frac{SB}{BDq} : \frac{Sb}{bdq} ::$ (Multiplying by $SB \times Sb$) $\frac{SB \times SBq}{BDq} : \frac{SB \times Sbq}{bdq}$. Therefore the *Vires Centripetæ* 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 $bn : BN :: \frac{Sb \times SBq}{BDq} : \frac{SB \times Sbq}{bdq}$ :: (by substitution) $Sb \times SB : Sb \times SB$; that is, the *Vires Centripetæ* 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 $\frac{Sbq}{bdq} : \frac{SBq}{BDq} :: Sbq : SBq$, then it will be $bn : BN :: \frac{Sb \times SBq}{BDq} : \frac{SB \times Sbq}{bdq}$ :: (by substitution) $Sb \times SBq : SB \times Sbq :: SB : Sb$; that is, the *Vires Centripetæ* (or *Conatus Centrifugi*) are reciprocally as the Radii; and because (in this Supposition) $SBq \times \frac{Sbq}{bdq} = Sbq \times \frac{SBq}{BDq}$, therefore $BD = bd$; that is, the Velocities are equal; *Et vice versa.*

CONSECTARY VII.

If the Squares of the periodic Times be as the Cubes of the Radii, that is, if $\frac{Sbq}{bdq} : \frac{SBq}{BDq} :: \overline{Sb}|^3 : \overline{SB}|^3$. Then it will be $bn : BN :: \frac{Sb \times SBq}{BDq} : \frac{SB \times Sbq}{bdq} :: SB \times \overline{SB}^3 : SB \times \overline{Sb}^3 :: SBq : Sbq$; that is, the *Vires Centripetæ* are reciprocally in a duplicate Ratio of the Radii; and because $\frac{SB}{bdq} = \frac{Sb}{BDq}$, therefore $\sqrt{SB} : \sqrt{Sb} :: bd, BD$; that is, the Velocities are reciprocally in a subduplicate Ratio of the Radii: *Et vice versa.*

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.

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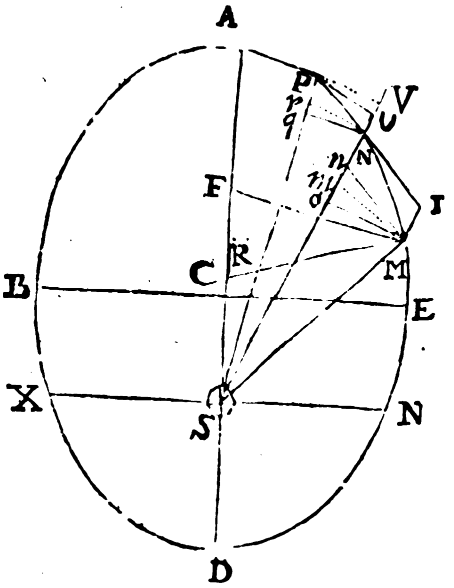
PROP. III.

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 Action 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 Action of Gravity.*

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



the Base SN is common to both) the Altitudes Pv, Mo are equal; take $Nn = LM$, and draw Mn parallel to LN; then the Triangles PNv, Mno will be equal and similar, and $PN = Mn$, and $Nv = on$; 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 $= (Nv).no + Vv$; and Nm is $= Nn + no = om$, therefore $NV - Nm = Vv + mo - Nn =$ to the differentio-differential, or infinitely little Increment or Decrement of the Paracentric Velocity, $= 2mo - Nn$ (because Vv and mo, 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* ($2mo$) 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.

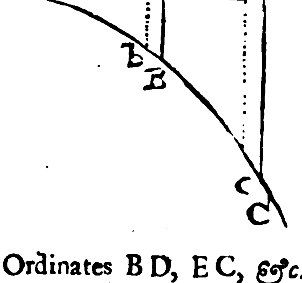
The Circular Velocities are in a Ratio compounded of the Rationes of the Angles and Radii, jointly; therefore the Angles are in a Ration compounded of the direct Ratio of the Circular Velocities, and the reciprocal Ratio of the Radii: But because in equal Times the Areas are equal, (*Conf.* 2. *Prop.*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

And such are the apparent Diurnal Motions of the Planets observ'd 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 B D, E C, &c. proportional to the Velocities of the heavy Body, at the end of the Times represented by A D, and A E, and describe the Curve A B C. Now because the Space which a Body describes, is proportional to the Time of Description, and the Velocity jointly;

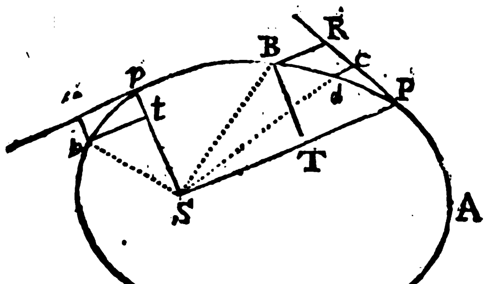
it

it is evident, that the Space which the heavy Body describes in the Moment of Time $D d$, is proportional to the Rectangle $D b$; and the Space which the same heavy Body describes in the Moment of Time $E e$, is proportional to the Rectangle $E e$: Whence the Space which the Body describes in the Time $A D$, is to the Space it describes in the Time $A E$, as the Curvilineal Space $A D B$, is to the Curvilineal Space $A E C$, but when the Body begins to descend, the Ordinates $D B$, $E C$ are indefinitely near the Point A; in which Case the trilineal Figures $A D B$, $A E C$ become rectilineal similar Triangles, the indefinitely little Portions $A B$, $B C$ 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 $A B D$: Area $A E C :: A D q : A E q$; therefore the Spaces which a heavy Body describes in the Beginning of its Descent, are in a duplicate Ratio of the Times. *Q. E. D.*

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 $P B$, 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 $P S B$, $P S d$; (*Lemma* 3.) 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 Arch $P B$, is to the Square of the Time it takes to describe the Arch $p b$; again, because $P d$ and $p b$ are suppos'd to be describ'd in equal Times, therefore $d c$ is to $b r$, as the *Vis Centripeta* in P is to the *Vis Centripeta* in p; whence it is evident that $B R$ is to $b r$ in a Ratio compounded of the Rationes of the Squares of the Times in which the Arches $P B$, $p b$ are describ'd, and of the *Vis Centripeta* in P to the *Vis Centripeta* in p; that is, (because the Times of describing the Arches $P B$, $p b$, are proportional to the Triangles $P S B$, $p S b$, or to the Rectangles $S P \times B T$, $S p \times b t$.)

$$B R : b r :: V \times S P q \times B T q : v \times S p q \times b t q.$$

And by division $\frac{B R}{S P q \times B T q} : \frac{b r}{S p q \times b t q} :: V : v.$

Or $\frac{S p q \times b t q}{B R} : \frac{S P q \times B T q}{B R} :: V : v.$

That is, the *Vis Centripeta* in P is as the Solid $\frac{S P q \times B T q}{B R}$ inversely.

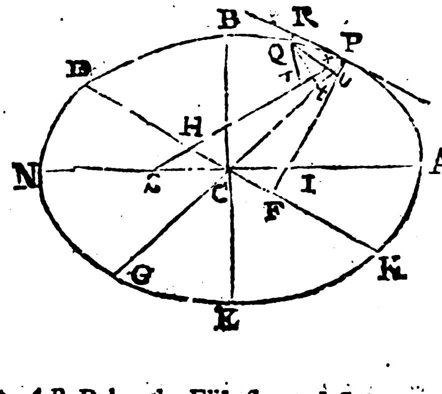
This may be more briefly demonstrated thus: If the Times be equal, $B R$ is as the *Vis Centripeta*; and if the *Vis Centripeta* be given, then $B R$ (*Prop.* 1. *Lem.* 3.) is as the Square of the Times; and if neither the Times nor the *Vis Centripeta* be equal, then $B R$ is (supposing $V =$ to the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

COROLLARY.

Hence if any Figure, as $A P p$, be given, and the Point S, to which the *Vis Centripeta* 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 Centripeta*, which is reciprocally as the said Solid, may be found.

PROP. VI. *Problem* II.

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



Let $A B D$ be the Ellipsis, and S the *Focus* to which the *Vis Centripeta* tends. Draw the Axis

$A N$;

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AN; and AN, the Conjugate Diameter BE; draw the Line PR touching the Curve in any Point (P) and draw the Diameter PG, the Conjugate-Diameter DK, PF perpendicular to DK, and Qv parallel to PR: Draw SP interfecting DK in H, and interfecting Qv in x; and draw QR parallel to SP. Then (*Hayes, Art.* 51.) $PH = AC$; draw QT perpendicular to SP; and fuppofe the Parameter of the Axis $\left(\frac{2\,BCq}{AC}\right) = L$. Then,

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

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

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

And becaufe Qvq is $= Qxq$, when Q is infinitely near P. Therefore,

$Qxq\,(= Qvq) : QTq ::$ (by fimilar Triangles) $HPq\,(= ACq) : PFq ::$ (*Hayes, Art.* 6c.) $CDq : CBq$.

And multiplying the refpective Terms of thefe Analogies into one another, there will arife this;

$L \times QR : QTq :: L \times AC \times CPq : Gv \times CBq \times CP$.

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 $2\,PC = Gv$.

Whence $L \times QR = QTq$.

And multiplying both fides of the Equation by $\frac{SPq}{QR}$, we fhall have $L \times SPq = \frac{SPq \times QTq}{QR}$. (*Cor. Prop.* V.) Therefore the *Vis Centripeta* is reciprocally as $L \times SPq$; and becaufe L is a determinate Quantity, therefore the *Vis Centripeta* is reciprocally as the Square of (SP) the Diftance of the Body in P from the Centre of Attraction S. *Q. E. I.*

COROLLARY I.

The Parament of the Axis (L) is equal to $\frac{QTq}{QR}$.

COROLLARY II.

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

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 Ellipfis APN will become a ftreight 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 Ellipfis, or) Centre of Attraction S be given; and if the other Focus I be at an infinite Diftance from S, then the Ellipfis NPA will degenerate into a Parabola, and the *Vis Centripeta* in P will be as the Square of the Diftance NP inverfively.

COROLLARY V.

The fame things being fuppos'd, if the Focus I be at more than an infinite Diftance from S; that is, if it fall on the contrary Side of N in refpect 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 Diftance from the Focus S.

COROLLARY VI.

If the Focus I and the Vertex A be given; and if the Centre of Attraction S be fuppos'd at an infinite Diftance from I, then the Curve AP will be a Parabola, and the *Vis Centripeta* will be the fame in every Point of the Curve; and contrarily, if a Body moving at firft in a ftreight Line, be attracted to a Centre at an infinite Diftance from the fame, 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 Diftance from the Vertex.

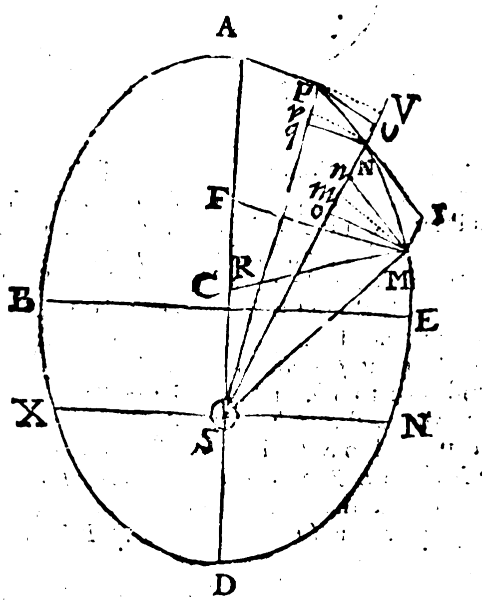
SCHOLIUM.

It may be obferv'd that the Paracentric Solicitation of Gravity, *and the* Vis Centripeta, *are Terms fignifying the fame thing.*

PROP. VII.

The Solicitation of Gravity, or Vis Centripeta *of a Planet, is to the* Conatus Centrifugus *of the fame Planet, as its prefent Diftance from the Sun is to* $\frac{1}{2}$ *the Parameter of the Planetary Ellipfis.*

Suppofe $SM = D$, and $L =$ to the Parameter of the Axis; and let $t \times L$ be a conftant Plane equal to twice the Elementary Triangle



MSN: Then the Arch Mm is $= \frac{t \times L}{D}$, and Mmq is $= \frac{t^2 \times L^2}{D^2}$, and $mo = \frac{Mmq}{2\,SM} = \frac{t^2 \times L^2}{D^3} =$ to the *Conatus Centrifugus*.

Again,

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Again, the Solicitation of Gravity is as D^2 inversely, or as $\overline{Mm}|^2$, 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 $\frac{t \times L^2}{2 D^3}$, or as D is to $\frac{1}{4} D$; and because $\frac{1}{4} L$ is an invariable Quantity, the Rationes of the Solicitation of Gravity to the *Conatus Centrifugus* 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 SW 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 Centrifugus*, as D is to $\frac{1}{4} L$; and the Solicitation of Gravity is to twice the *Conatus Centrifugus*, 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 Centrifugus*: 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.

COROLLARY.

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 $\frac{1}{4}$ part of the Parameter of the Axis; and in the Ellipsis, the Distance of a Planet from the Focus, is always greater than $\frac{1}{4}$ part of the Parameter of the Axis. Therefore, &c.

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.

COROLLARY.

Hence in the Point W (in which an Ordinate to the Axis drawn through the Focus S, intersects the Ellipsis) the *Impetus* which a Planet hath acquired since 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 Planet, describing any Arch of its Orbit, acquires, is to the *Impetus* acquir'd in a Semi-revolution, as the Angle of apparent Motion is to two right Angles; the *Impetus* here meant is that impress'd by Gravity or Attraction, simply consider'd by themselves, the contrary *Impetus* arising from the *Conatus Centrifugus* not being considered.

PROP. X.

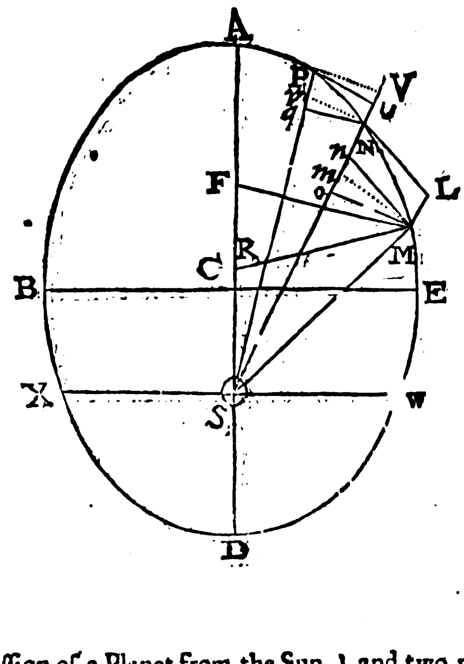
To explain the Motion of a Planet through the whole Revolution; and to shew how a Planet approaches to, and again recedes from the Sun, Alternis Vicibus.

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 Distance, *viz.* in the Aphelion A, the Solicitation of Gravity is greater than twice the *Conatus Centrifugus*, (because SA, the Distance of the Aphelion from the Sun, is greater than $\frac{1}{2}$ the Parameter SW) 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 Centrifugus*; 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 $\frac{1}{2}$ 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 $\frac{1}{2}$ the Parameter of the Orbit; and consequently, all the while the Planet is in describing the Portion of the Orbit WDX, 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, precisely 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* towards *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 destroying 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 consequently mutually destroy each other: And thus the Planet returns to *A*, from whence it departed, and begins and finishes new Revolutions successively, and without Interruption.

CONSECTARY I.

Hence we have six 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 *S B* or *S E* is $= \frac{1}{2}$ the transverse Axis *A D*, 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 II.

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 *A* to *D*, and the Impetus acquir'd from *A* to *W* is = 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 *W S D* are right Angles.

CONSECTARY III.

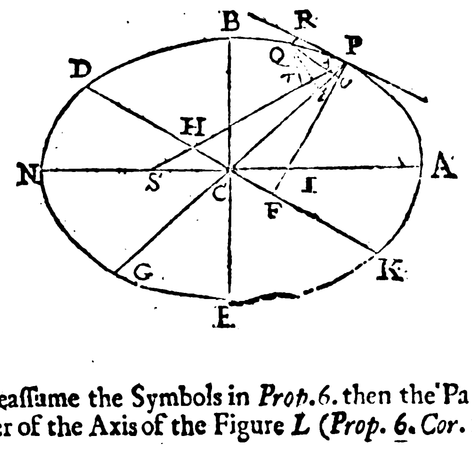
Hence to determine the Species of the Planetary Ellipsis; the Focus of the Ellipsis *S* is given; and the Point *A* where the Planet is when the Sun begins to attract it, being supposed at the greatest Distance of the Planet from the Sun, the remoter Vertex of the Ellipsis is also given, and the proportion 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 same Point *A* being known; the principal Parameter of the Orbit *W X*, or an Ordinate applied to the Axis in the Focus *S*, may be found. For *S A* (given) is to *S W* ($= \frac{1}{2}$ the Parameter of the Orbit) as the Force of Attraction in *A* is to twice the *Conatus Centrifugus*, and if $\frac{1}{4}$ 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 *S D*; therefore *A D* 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 nearer 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 Attraction) 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 said Point is the Perihelion.

PROP. XI.

If several Bodies revolve 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 Parameter of the Axis of the Figure *L* (*Prop.* 6. *Cor.* 1.)

is $= \frac{QTq}{QR}$, when the Point Q is infinitely neat P, and if the Times be equal, then QR is directly as the *Vis Centripeta*, or reciprocally as (the Square of the Distance) SPq; therefore L is as $QTq \times SPq$; that is, the *Latus Rectum* (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 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* N° 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.

Books on this Subject of Astronomy of more immediate 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 1 Vol. of Mathem.
N. Mercator's Astronomy, *Lat. Lond.* 1676. 8*vo.*
Gassendus's Astronomy.
Bishop *Ward*'s Astronomy.
Tacquet's Astronomy, in his *Opera Math.*
Halley's Catalogue of the *Southern* Stars. *Oxon* in 4*to.*
An Essay concerning the Causes of the Celestial Motions, in the *Leipsick* Acts of *Feb.* 1689. by G. G. *Leibnitz.*
Kepleri Epitome Astronomiæ Copernicanæ.
Wing's *Harmonicon Cæleste.*
Street's *Astronomia Carolina.*
Jer. Horrocci Op. Posthuma.
Bayeri Uranometria.
Bulliald Astronom. Philolaica.
Hugenii Systema Saturnianum.
Whiston's *Prælectiones Astronomicæ.*

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.* I. under this Word, it appears to be plainly impossible to account for so great a Rarefaction and Condensation as is discovered to be in the Atmospherical Air, without the Supposition of the Particles of Matter being endued with a *Repelling* 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 Earth's Surface. See *Phil. Transf. N.* 187. It seems a *very hard 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 such as are found guilty of some Crime or Offence, especially Felony or Treason: But a Man is also said to be attainted of *Disseisin. West.* 1. *c.* 24. and 36. and 3. *Ed.* 1. A Man is attainted two Ways; by *Appearance* 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 himself 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 *Utlary*, and is where a Person flieth 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 sort dependeth upon another. *v. gr.* There is a Lord, Mesne and Tenant. The Tenant holdeth of the Mesne by a Penny, the Mesne holdeth over by two Pence. The Mesne releaseth to 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 *Attendant* 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 Design 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 Attraction* is stronger in a *small* Loadstone, in proportion to its Weight, than in a *larger*: For the Particles of small 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 *Attraction* 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-

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ure or Curvature of the Line which the Ray describes in the place of its Refraction, to the Curvature or Flexure of the Line which the said projected Body describes. That is, supposing the Inclination of the Ray, to the refracting Surface be the same with that of the Horizon. And from this Proposition he Calculates that the *Attraction* of the Rays of Light is above 1000000000000000 a Thousand Millions of Millions of Times greater 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 point 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 themselves.

'Tis very probable therefore that the *small 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 Phænomena in Nature*. 'Tis very well known that some Bodies do thus act on one another by the *Attractions* of *Gravity*, *Magnetism* 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*, *Magnetism* and *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 such 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 Heat, from other things. 'Tis much the same thing with *Oil of Vitriol*, which till it is Saturated with it, attracts the Moisture of the Air in very considerable Quantity, and afterwards parts with it with great Difficulty. And when Oyl of Vitriol and Water beiug mingled together in the same Vessel, grow so hot, 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 Impetuosioty, and consequently attract or gravitate towards one another with an accelerated Motion. Thus also when *Aqua fortis*, Spirit of *Vitriol* or *Nitre*, or any other corrosive *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 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 Balsam 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 *Wine*, 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 *Brimstone* 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 six 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 Rest (and 'tis the same thing also in all Fermentations, &c.) may be and are put into most violent Motions, by some Principle of very great Force and Activity, which yet doth not discover 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

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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 go the *Copper* (*see 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 Menstruums 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 liquid 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 Attraction* 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 *Mechanicks*, where *Attraction* 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 *inflecting* 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; aud the same Force which in Reflection serves to *repel* the Ray, now serves to *emit* it.

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 soon 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 *elastical*, *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 *reserved Rent in Corn* paid to Religious Houses by their Tenants or Farmers.

AVOIR DU POIS, in *French* signifies 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 1 Pound *Avoir du pois* was exactly 14 Ounces, 11 Peny-Weights, 15 ½ Grains *Troy*: And he saith, he can find no Law for the Introduction of this Weight, nor at what Time it came into Use, which it seems to have done only by Custom. *See* Weights *in* Vol. I.

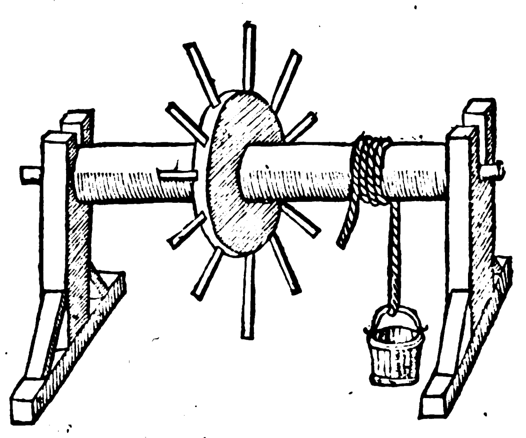
AURELIA, is a Term used by the *Natural Historians* for the first apparent Change of the *Eruca* of any Insect: 'Tis the same with what some Writers call *Nympha*.

AURISCALPIUM is an Instrument to clean the Ears.

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 towards 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 Description in *Vol.* I.



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 *Æquilibrium*.

From the Fabrick of the Engine, 'tis plain, that the Weight *W* is 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.

Wherefore

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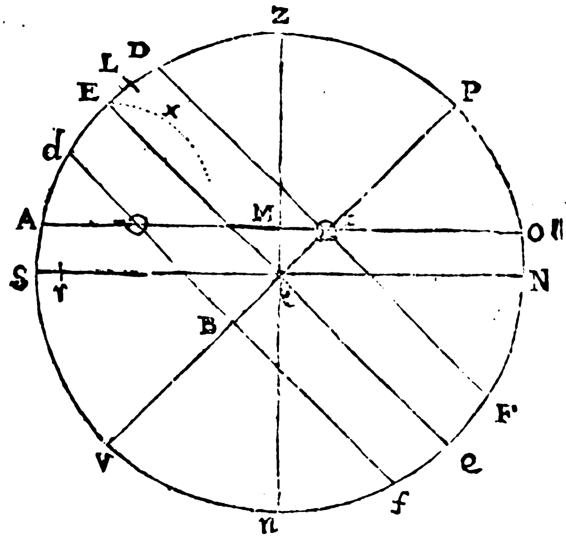
Wherefore if the Weight be to the Power, as the Perimeter of the *Peritrochium* is to the *Perimeter* of the Axis, then will the Velocity of the Power to that of the Weight, be as the Weight to the Power; and consequently the Moment of the Power will be equal to that of the Weight. Wherefore 'tis plain, that the greater the Perimeter or outermost Wall, the longer the Stick or Lever D C: 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 ayde* 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 abateth and entereth the same Day, and dispossesseth the Heir.

ASIAMENTA, *Easements*, in Grants of Conveyance and Demise did include any Liberty of Passage, High-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 P E Z 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, so shall P be the Pole of the World: and set it also from the Zenith in Z to E, and draw E C Q for the Equinoctial, draw also P U for its Axis. Then from the Chords set the Sun's Declinrtian from E 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 D F, or *d f*: 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 Intersects, the Parallel of Declination will be the Representation of the Sun's Place, as at ⊙ 1 in Summer, or ⊙ 2 in Summer. Fit then the Sector to the Radius A M, and M O, or M ⊙ 1, or M ⊙ 2 shall 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 C S, on which Point *r*, as a Center, with the Extent M O 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 give you the Degrees of the Azimuth.

BABYLONISH *Hours.* The *Babylonians, Persians,* and *Syrians, &c.* accounted their 24 Hours of the natural Day to begin from Sun-rising, and to continue till the Sun setting of the next Day. Wherefore Hours thus accounted, and thus put in (as is common) among the Furniture of Dials, are in Dialling called the *Babylonish 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 save 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 unslit 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 belonging 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 *Bargainor* to the *Bargainee.* The Author of the new Terms of the Law saith, 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 Heirs*; and though there be no *Livery & Seisin* made by the Vender, so it be by Deed, indorsed, sealed, 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 Cistern, which abates the Force of the Perpendicular Pressure, or the usual Gravity of the erect Column of Air, equal in Base to the Orifice of the Tube.

BAROMETER *Portable,* is one that can be safely 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 some 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 Outside 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 Tube in 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 therefore the Tube secured from having its Top broken off.

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 solely 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, Camden* refers to *Henry* 3. 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 such 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 chosen at each Port, and at the two Ancient Towns of *Winchelsea* and *Rye.*

BARON is also used for the Husband in Relation to the Wife; which two in Law, are called *Baron and Feme.*

The

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

Ever since 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 sloping Edge of a *Chissel*, 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 Batchelours.* 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 Numbers.

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 *Astragal* is thus carved.

A *Bead plain* is sometimes set also on the Edge of each *Fascia* of an *Architrave*. Its Convexity is usually about a Quarter of a Circle, and differs from a *Boultine* only in not being so large. A 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 ½ 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 Posts.

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 Bayliff 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 set 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*, or *Donatives*.

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 Jurisdiction 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 *Institution* or *Induction*, and without any Examination 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, saith *Watson.* 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 a Writ directed 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 a Value, on this or that particular Man.

BENEVOLENCE 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 *Besantine* was the Value of two Shillings, and the Gold

was

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was of the Weight of a Ducket, as *Chaucer* seems to represent. *Kennet's Glossary.*

BENEFICIUM *Cedendarum Actionum*, is the Right which one Surety hath who is sued for the whole Debt, to force the Creditor by Exception to assign over his Action 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 sue 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 sluggish, 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*, *&c.* 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 short of the End of their Trains. Those of the Hawk Kind which are of a Nature more cowardly and sluggish, or else *indocile*, are neglected by our Falconers, 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 Paradise*, 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 sort 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 sized, and most common, *Parrots* and *Popinjays*; and the least sort *Parrakeets*; and all this Kind make use of their Beak in climbing, and move the upper Jaw.

Land-Birds that have their Bill and Claws more strait, 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 *Ostrich*, the *Cassowary*, and the *Dodo*. The *middle siz'd* Kind are divided by their Bills into such as have *large*, *thick*, *strong*, and *long* ones; some of which feed promiscuously on Flesh, 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 Insects; or *hard beaked*, which have thick and hard Bills, and feed mostly on Seeds,

Water-fowl, are either such as *frequent Waters and watry Places to seek their Food*; and these are all *cloven-footed*, and generally have long 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 *lesser* which are either *Piscivorous*, feeding on Fish, as the *Heron*, *Spoon-bill*, *Stork*, &c. or *Mudsuckers* and *Insectivorous*: 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-shank*, &c. and a third sort have short Bills, as the *Lapwing* and *Plover*. Those are reckoned short Bills which exceed not an Inch and $\frac{1}{2}$; middle siz'd are between two Inches $\frac{1}{2}$ and $1\frac{1}{2}$; 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 footed*, but most are *whole footed*: And of these some few have very *long Legs*, as the *Flammant*, the *Avosetta*, and *Corrira*, (see *Willoughby*, *Part* 2. §. 2) but mostly they are *short leg'd*: Of which some few have but three Toes on each Foot, as the *Penguin*, *Razor-bill*, &c. but generally they have four Toes on each Foot; and these either all connected together by intervening Membranes, as in the *Pelican*, *Soland Goose*, &c. or more usually with the *back Toe loose*: 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 sort some are *serrate*, as in the *Diver-kind*, and some not *toothed*, as in the *Puffin*; or *sharp pointed* or *straighter*, of which sort some have long Wings, as the *Gull* Kind; and some *shorter*, as those Diving Birds called *Douckers*. Those with *broad Bills* may be divided into the *Goose* 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 short 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 Bishop, 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 Eslire*,

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Eslire, or Leave to elect to the Dean and Chapter, nominating the Person whom he thinks fit to have chosen. The Dean and Chapter are obliged within twenty Days after the Receipt of this *Conge de Eslire* to make the Election, which being accepted by the Person 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 Consecrate him. The Archbishop 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 Bishop 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 Bishop Elect; 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 Consecration, 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 Consecration the Bishop hath a Right to his Temporalties, but he cannot sue for them till his Consecration be certified by the Archbishop; but the King may grant the Bishop 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 *Isaac 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 Particles, 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 *Black*, and yet may perhaps reflect it variously to and fro within them so long, till it happen to be stifled 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 *Putrefaction*, by dividing the Particles of Substances, turn them *Black*: Why small Quantities of black Substances impart their Colour very freely and intensely 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 of others. Hence also it appears, why Glass ground very elaborately with Sand on a Copper Plate, till it be well polished, 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 Observation, 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 reflected 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 Mass 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-works.

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, &c. Hence,

BORDLODE was the Farm or Quantity of Food which they paid by this Tenure: And the small Estates so held, called

BORDLANDS, which therefore are such Demeasnes as Lords kept in their Hands, for the Maintenance of the Board or Table. *Kennet*'s *Glossary*.

BOTANY,

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BOTANY or *Botanicks*. Books on this Subject; Mr. *Ray*'s *Historia Plantar.* 3 Vol. Fol. His *Synopsis Stirpium Anglican.* in 8vo. *Basis Botanica. Auth. D. Christ. Ludovico Welschio*, Lipſ. 1697. 12°. *Morison*'s *Præludia Botanica*, Lond. 1669. His *Universal Herbal.* Dr. *Plukenet*'s *Phytographia*, *Tournefort*'s *Method of Plants*, 2 Vol. 4to. both in *French* and *Latin*.

Plantar. Umbellif. Distributio Nova, per Tabulas Cognationis & Affinitatis, ex libr. Naturæ Observata Detecta, Auth. R. Morison, Oxonii, Fol. 1672.

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Cowlei Angli sex libri Plantar. Poemate Latino conscripti. Lond. 8vo.

Quadripartitum Botanicum Simonis Pauli, Med. Reg. in Dania. Argentorat. in 4to. *Almagestrum Botanicum*, by Dr. *Plukenet*. Lond. 1696. Fol. *Dr.* Sloan's *Catalogus Plantar. quæ in Insula Jamaica Sponte proveniunt.* Lond, 1696. 8vo. *Icones & Descriptiones Rarior. Plantar. Siciliæ*, &c. *per* Paulum Boccone. 1674.

Leon Thurneisseri Hist.ria Plantar. Berlini. 1578. Fol.

Johnson's *Herbal.* Fol.

Parkinson's *Herbal* Fol.

Rivinus de Re Herbacca. 2 Vol. Fol.

Theophrasti Historia Plantar.

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

Fabius Columna de Stirp. Rarior. Cognitione. 2 Vol. 4to.

Hortus Indicus Malabaricus.

1. *Boccone Icones & Descriptiones Plantar. Italiæ Galliæ*, &c.

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

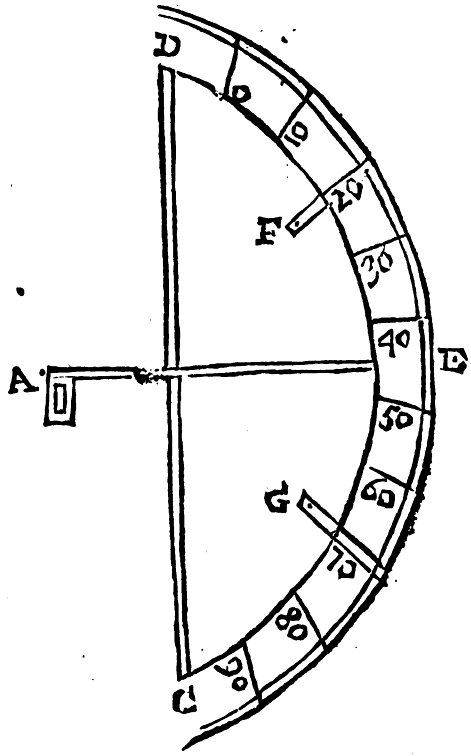
BOULTINE in Architecture is the Workmens Term for a Convex Moulding, whoſe Convexity is juſt ¼ of a Circle: 'Tis plac'd next below the *Plinth*, in the *Tuſcan* and *Doric* Capital.

BOW is an Inſtrumeut 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 D E C is the Arch, A E 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 A B 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 obſerved, you muſt wait and make Obſervation as oft as you think fit, 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 sought.

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 rise up on each Side of the Mortar, and serve 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 some are called *Joyner's 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 hast, 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 easily incorporable. Then they put about 7 ℔ of Calamine into a melting Pot, holding about a Gallon, and uppermost about 5 ℔ 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 ℔ of Crude Calamine produces 30 ℔ burnt or calcined. They use *Brass Shruff* sometimes instead of so much Copper; but that cannot always be procur'd 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 ℔ of Lead is usually put into 100 ℔ of *Pot-Metal*, but about 6 ℔ is sufficient to put into a 100 ℔ of *Gun Metal*.

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

The Manufacture 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 2&c.

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 consisting 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 Lactiferi*, 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 Net-work of the bigger Fibres. Through it pass the *Tubuli Lactiferi*, 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 sixth Pair of the Brain.

The Use of the Breasts is to separate the Milk for the Nourishment of the *Fœtus*. The Arteries which terminate in the Glands, which compose the Substance of the Breasts, bring the Blood pregnate with a Chyle 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 Lactiferi* 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* II. granted, among other Things, to the Tenants of the Honour of *Wallingford*,

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ford, Oxon, That they should be *Quieti de Bredewite.*

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 15 Pound; so that 100 will weigh 1500, and 1000 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 Notch 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 several Counties or Places. 14. *Place Bricks* are such as are made in a Place made on Purpose for them near the Building they are to be used in. 15. *Statute* or *small common Bricks:* These ought to be 9 Inches long, 4 ½ broad, and 2 ½ thick; 100 of these usually weighs 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, &c. 30 or 32, if true Measure, will pave a Yard Square, and 330 will pave a Square of 100 Foot, laid flat; 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, Furze Straw, Heath, Brake or Fern Faggots, having first 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 burnt usually in abont 48 Hours. But now-a-days about *London*, they usually burn Bricks in *Clamps*, which are built of the Bricks to be burnt, something 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 Difference 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 Sea-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 Dictionary.*

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 Communication one with another.

BRIGADE *Major*, is an Officer appointed by the Brigadeer to assist 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 dressing *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 fit 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 great

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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, *&c.* 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 express their Thickness in the Draught.

The Walls also must be well wrought and *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 slacking 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 fly 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, and then 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 Torsels for Mantle Trees, or Lintels for Windows, Templets for Girders, *&c.* let it be always laid in *Loam*, 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 Pitch, to preserve them from the Mortar.

BULL, perhaps from Βουλὴ *Consilium*, is an Instrument so called, granted by the Bishop of *Rome*, and sealed with a Seal of Lead, containing in it his Arbitrary Decrees, Command, or other Actions. 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 void. *Matt. Paris*, *A. D.* 1237. describes the Seal of the Bull to be a Cross in the middle, with St. *Paul* on the Right, and St. *Peter* on the left Hand.

BURNING *Glasses*. In *Philos. Transact. 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 ½ 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 Reflexions, 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 3 Minutes time will be melted quite through. 4. A Plate of Iron or Steel is presently red hot, and soon 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 sort 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-sheards, in a little time melt into Glass, as also doth Pumice 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 *August* and *September.*

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.

Mr. *Tschirnhaus* 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

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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' Academie des Sciences, Anne* 1699.

The *Linum Vivum* or *Asbeſtos* would be vitrified by this Glaſs, even in *January*, in about 10 Minutes Time: *Vid. Act. 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, conſiſting of ſeven Concave Glaſſes, and ſo placed, as that all their Foci join in one Phyſical Point. Each Glaſs is about 11 $\frac{1}{2}$ 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 $\frac{1}{2}$ Inches. The Central Glaſs lies about an Inch lower or farther in than the reſt. The common Focus is about 22 $\frac{1}{2}$ Inches diſtant, and of about $\frac{1}{2}$ 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, *&c.* are ſometimes called *Butments*.

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CADE, in the Book of Rates is us'd for a certain determinate Number of some kinds of Fish; 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 common High-ways, Cause-ways and Roads; as

CALCEARUM *Operationes*, were the Work and Labour of this Kind done by the inferior servile 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 Lectures*, 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. *Neiwintis*'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, &c. and are very proper where-ever is occasion for long Beams, being much stronger than flat Beams of the same size; for being laid with the hollow Side downwards, and having good Butments at the Ends, they serve 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 their *Local Statutes*, and therefrom were called *Regula*, and *Canon* their Rule.

CANON in Musick; *Ptolemy* rejecting the Aristoxenian Way of measuring the *Intervals* in Musick by the Magnitude of a *Tone* (which they suppose to be formed by the Difference between a *Diapente* and *Diatessaron*) 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. *Ptolemy* therefore 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 *SesquioEtave*; 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 shews how 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*, *Ptolemy* and his Followers have been called *Canonici*, as those of *Aristoxenus* were called *Musici*.

There is a Tract call'd *Sectio Canonis* attributed, but falsly, to *Euclid*; and which you will find at the End of his Works, in the *Oxford* Edition. G. L.

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 *Press-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 $\frac{1}{24}$ 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 seems 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* consisting of four distinct *Petala* in each Flower, and which bear their Seeds in short *Capsulæ*; by which they are distinguish'd from the *Siliquosæ*, which bear their Seed in *long Cases* or *Capsulæ 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 Thickness of the Trunnions, for $\frac{2}{3}$ of them are let into the Carriage, and the other End is fastened 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 Architecture, 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 endow'd with a Motion about different Points, as common Centres, which Points were placed at equal Distances: so as that the Matter round them compos'd different *Vortices*, 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 these he calls the *Matter* of his *second Element*.

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But the very small Particles which, by the aforesaid Motions, were ground and rubb'd off from the first Particles of Matter, and driven violently 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 *second 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 *System* 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*. And 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 sooner 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 *Vortex* produced by the Revolution of a Sphere about its Axis, must be propagated *in infinitum*, if nothing hinder it: And therefore, since 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 absurd and contrary to that Constancy, Limitation and Uniformity which is observed in the *Phænomena* 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 lessening some Part of their Motion, which never being restored, these Parts must still move slower and slower by Degrees, till at last all the Motion will be quite destroyed.

3. 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 *Princip.* 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 solid 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.

And *First* he shews, That all Bodies, which in a Fluid describe a *Curve-line*, are moved by that Fluid, for of themselves they would describe

ſcribe right Lines, and nothing (he ſaith) 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 neceſſarily 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 ſince 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 excuſſory 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 Hypotheſis.

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 Circulation is not continued from *Mercury* to *Saturn*, but is interrupted, and reaches only from the *Perihelion* of *Mercury* to his *Aphelion*, 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 Chaſms 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* θυρεοειδὴς 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 ſubſervient 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 practiſed by *Michael Angelo* and *Raphael Urbin*, *&c.* 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, *&c.*

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 ſecure Way.

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 ſame 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.

CARUCATE, from *Caruca*, and the *French Carui*, a Plough, was the Ancient *Plough Land*; and ſignified 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.

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CASE-HARDENING, is a Way of making the Outside of Iron hard. And 'tis used sometimes by File-Cutters, when they make Course Files for Cheapness; and formerly most *Rasps* were *Case-hardened*. 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 $\frac{1}{4}$, some $\frac{1}{6}$ of a Circle in Compass.

CASSINE, in the Military Language, is a Farm House, where a Number of Soldiers 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. Dr. *Kennet*.

CASTING *of Drapery*, is a Term in Painting, signifying 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* saith it ought to be $\frac{1}{4}$ of the whole Height of the whole Building.

CAVETTO, in Architecture, is a hollow Moulding of about $\frac{1}{6}$ or $\frac{1}{4}$ of a Circle in Compass.

CAUKING, in Architecture, signifies Dovetailing across.

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*.

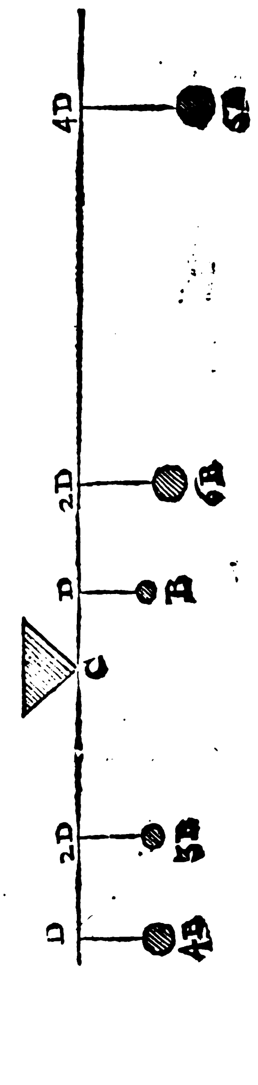
CEMENT, in Architecture, is a strong binding Mortar. 'Tis used to cement Bricks together for some Kinds of Moulding; to make a *Block of Bricks* for the carving of *Scrolls*, *Capitals*, *&c.* 'Tis of two Sorts: The *hot Cement*, which is common, is made by putting to a Pound of Rozin and a Quarter of 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, *&c.* for about $\frac{1}{4}$ of an Hour, stirring it all the while; then let it stand 4 or 5 Minutes, and 'tis fit for Use.

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; the next Morning put it into a *Tray*, *&c.* With the Cheese and Milk, put half a Pound of very fine powdered and sifted 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 Use: If 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 Centre 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 Consideration of the *Centre of Gravity* is one of the Noblest Speculations in Geometry; and since 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 Suspen-

Suſpenſion, then they will be in Æquilibrio, 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 *Æquilibrio*, 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 $6\,B$ is $= 6\,B \times 2\,D$ ($2\,D$ I ſay, for the Velocities are as the Diſtances from C) $= 12\,B\,D$.

3. And if the Moment and Weight (or 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 $\frac{12\,B\,D}{6\,B} = 2\,D$.

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 Rectangles on one Side, be equal to the Sum of all thoſe on the other, the Weights or Bodies will be in Æquilibrio: if they are not equal, that Side will preponderate, whoſe Sum is the greater. Thus, *v. gr.* the Sum of all the Rectangles 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 Rectangles 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 $-\,15\,B\,D$, and the Sum of all the Weights $19\,B\,D$; 'tis plain, if you divide the former by the latter, the Quotient $\frac{15}{19}\,D$ 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 $\frac{33}{12}\,D$ 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 $A\,B$ be ſuſpended at A, and ſuppoſe it divided into an infinite Number of heavy Points; 'tis then plain, that the farther any Point is from A, the more it will gravitate; and the *Moment* of each Point will be a Rectangle under its Diſtance from A, multiplied by its ſelf or Unity: Wherefore the Moment of all the Points muſt be equal to the Sum of all the ſaid Rectangles; and therefore if the *whole Moment* be divided by the *whole Gravity* of all the Points, or by the Gravity of the whole Line $A\,B$, the Quotient (by *Princip.* 3. and 6.) will be equal to the Diſtance of a certain Point from A, at which, if all the Points be ſuſpended, their *Moment* will be the ſame as it is now; that is, that Point ſhall be the *Common Centre of Gravity* of the Line $A\,B$.

8. If a *Line*, *Plane*, or *Solid*, be biſſected 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; 'tis 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 ſuſpended to the ſame Arm of a Balance common to them all: And let the Point of Suſpenſion be as in A, at the End 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 ſolid Triangles or Triangular Priſms it will be in the middle Point of the *Diameter of Gravity*: And that *Diameter* is found by the common Interſection of two Planes, each of which biſſects 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 Gravity 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 Gravi-

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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 consequently only one single 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 considered 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 Rectangles 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 *Centripetal*, 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 suffer more Violence of Attraction, and consequently 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 composed of an Infinity of Arks of infinitely small Circles, all described by different Radii; and so, that where the Curve hath 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 off 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 consequently the Effect be every where equal to the absolute 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.* 80. for the Year 1700.

CENTRUM *Phonicum*,
CENTRUM *Phonacampticum* } See *Echo*.

CENTRY-BOX, the same with the *Guerite*; only the former is of Wood, and the latter of Stone. It is made to save 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 Letæ*.

CERUSSE. In *Phil. Transf. N.* 137. there is this Account of the way of making *Cerusse*. Pigs of clean and soft Lead are cast into thin Plates, a Yard long and six 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. These Flakes 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 set by them, without any possible Distinction of Disadvantage, yield few, small, or none at all. Sometimes the Pots are taken up all dry, and sometimes

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times they prove best; sometimes they are taken up wet. The Plates that cover the Pots yield better 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 Benefices becoming void. By the Canon Law, if 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 Facto.* But by Statute, if a Clerk have one Benefice of 8 Pound *per Annum*, or upwards, and takes another of any Value whatsoever with Cure of Souls, and without Dispensation, the former Living is *ipso facto*, void: And this kind of Voidance of a Living is called *Cession.* And what is called *Cession* in other Benefices, is called *Creation* in relation to a Bishoprick; for if an Incumbent be made a Bishop, his Benefice is said to be void by *Creation.*

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 ceaseth or neglecteth so long to perform some Duty belonging to him, as that by this his *Cesse* or *Ceasing*, he incurs the Danger of the Law, and hath, or may have, the Writ *Cessavit* (see *Vol.* I.) brought against him. And where it is said in their Terms, the Tenant *Cesseth* 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, (see *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, Sculpture, *&c.*

CHAMBERLAIN, from the *French Chambellan*, i. e. *Cubicularius vel Praefectus Cubiculi*, is used in divers Senses in our Chronicles, and old Books of Laws and Statutes: As the Lord Great Chamberlain of *England*, Lord Chamberlain of the King's House, the King's Chamberlain, 13 *E.* 1. *c.* 41. 17 *R.* 2. *c.* 16. To whose Office it appertaineth 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 *Wales* 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 Person shall 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 Wine, 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 Judgment; 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 Aequum & Bonum.* And therefore *Stamford*, in his *Prerogative*, *c.* 20. *p.* 65. saith, 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 thei Title of *Lord High Chancellor of* Great-Britain. But there are others that bear this Name of Chancellor, as the

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, *&c.* and hath by the Privy Seal from the King. Power with others, to compound for Forfeitures 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 Usher, 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, Patents, Presentations, Dismission, Licenses to alienate, Injunctions,

ctions, Enrollments, Protections, *Subpœnas*, and of the Affidavits, &c. The Sealer, Chafe-wax, &c.

CHAPEL, is of two sorts; 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 Collegiatorum. 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 sacred 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 Privileges; 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*, *Carlisle*, *Durham*, *Rochester* and *Norwich*; and of such sort are the Chapters of the five 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 six 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 Person, Body Politick, &c. to excuse a Man from being impanelled on a Jury: *Charters of Pardon*, whereby Men are forgiven Felonies, &c.

CHARTER-LAND is such Land as a Man holds by *Charter*, *i. e.* by Deed or Evidence in Writing; and this is otherwise called *Freehold*.

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 Metals.

CHEST-ROPE in a Ship, is the same with the *Guest* or *Gift-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 so 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, signifies 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.

2. The *Paring Chissel* hath a very fine and smooth Edge, and 'tis 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

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holds the *Chissel* 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 Basil; 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* require.

5. The *Gough* is a *Chissel* with a round Edge, one size of which serves to prepare the way for an Augre; and others to cut such Wood as is to be rounded or hollowed, &c.

6. *Socket 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 *Chissels*.

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 Pieces.

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 given.*

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 requir'd, or by the Number of the Sides of the regular Polygon, and the Quotient will be a Number 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; set 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 *Alexander* III. and the Council of *Tours*.

CHRISM was anciently (in times of Popery) a Confection of Oil and sweet Balsam, which was consecrated by the Bishop, and used in Baptism, Confirmation, Extreme Unction, &c.

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*, such Children as die in the Month are called *Chrisoms*.

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 reflected 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 *J. Bap. Riccioli Chronologia Reformata*. 2 Tom. Bonon. 1669.

Guil. Beveregii Institutiones Chronologicæ.
Mar. Boxhornii Chronologia.
Sethi Calvisii Opus Chronologicum.
Alstedii Thesaurus Chronologicus.
Mastini Chronolog. Theses & Tabulæ.
Helvici Chronologia.
Jos. Scaliger de Emendatione Temporum.
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 *Nymphæ*: Though some confine this Word *Chrysalis* to the *Nymphæ* of *Butterflies* and *Moths* only. See *Swammerdam Hist. Insect general.* Sect. 2.

CHURCH-SCOT, Payment or Contribution; by the *Latin* Writers was frequently called *Primitiæ 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.

CHYROGRAPHUM, in the *Saxon* Times, signified any publick Instrument of Conveyance attested by Witnesses: This the *Normans* called *Charta*.

To prevent Frauds and Concealments, they made their Deeds of mutual Covenant in a *Script* and

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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 said Sheet asunder 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---*.

CIMATIUM, CIMATUM, in Architecture, is what our Workmen call an *O - G--* with 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 Construction*: 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 *Ceulen*, *Vieta* and *Hugenius*; 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, saith *Leibnitz*, are erroneously 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 reduc'd 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 $X^x + X$ be $= 30$, and X be sought, it will be found to be 3, because $3 + 3 + 3 = 27 + 3 = 30$.

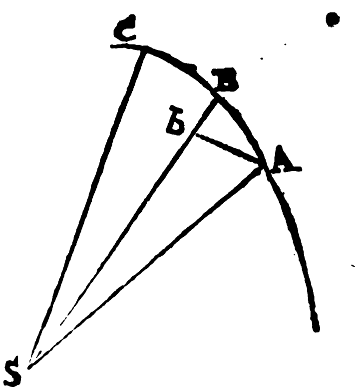
The Algebraical is done by Vulgar, though irrational Vulgar, or by the Roots of common Equations; which for the general Quadrature of the Circle, or its *Sectors*, is indeed impossible.

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.

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 $\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{7} - \frac{1}{11} + \frac{1}{13} - \frac{1}{15} + \frac{1}{17}$, &c. 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 such straight *Lines* as are divided from the Divisions made in the Arch of a Circle; such as *Sines*, *Tangents*, *Secants*, &c. an Account of the Construction of which you have under the Word *Scale* in *Vol.* I.

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 *A b* described on the Centre of Attraction *S*: and the circular Velocity of a Body moving from *B* to *C*, is measur'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 *Moral*, because they do really influence our Actions, and render them more Good or Evil than they would be without such Circumstances. And the Writers of Ethicks sum *them* all up in this one Verse;

Quis, quid, ubi, 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 *Feudal Law* and particular Customs bear sway. In *Naples* and *Sicily* the Constitutions and

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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 *Jus Regium* and Custom. In *Scotland* the Statutes of the *Sederunt*, Part of the *Regia Majestatis*, and their Customs, controul the Civil Law.

CLAMP-NAILS, are such Nails as are used to fasten on Clamps in building and repairing of Ships.

CLAMP'D. 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 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 sink into the Wood, and when drove home, let a Smoothing Plane go over them.

CLENCH-NAILS, are such as will drive without splitting the Boards, and draw without breaking. 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 Geometrick Method to make *Clepysydræ* or *Water-Clocks* with any kind of given Vessels, and with any given Orifices for the Water to issue out at, and according to any given Velocity of the Water's Descent.

CLERK. This Word did anciently signify 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 riveting 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 secure, 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 such as are commonly used for nailing on of *Clouts* (or Plates of Iron) to the Axle-Trees of Carriages; and are 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 inserted into the whole Length of the *Os Coccygis*, laterally.

Its use is to draw that inwards or forwards after the Excretion of hardned *Fæces*, &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 sealed 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.* 3. 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 wash out the Sand of the Tin-Ore into the *Launder*, while it is bruising in the *Coffer* of a *Stamping-Mill*: See *Tin*.

COCHLEA,

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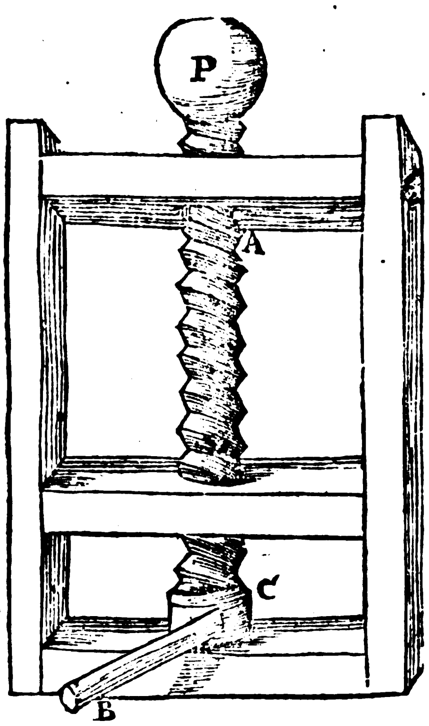
COCHLEA, is one of the Mechanical Powers, consisting of a Cylinder sulcated or hollowed in a Spiral manner, and moving or turning in a Box or Nut, cut so as to answer to it exactly. Now the Power or Force of this Engine may be thus estimated: Suppose in the Figure annexed the Weight *P* to be raised by the Turn of the Male Screw *C A*, by means of the Handle or Lever *B C*. 'Tis plain that in one Revolution of the Cylinder *A C*, 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. Wherefore 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 Distance between any two next adjoining Leaves of the Screw; the Power shall be in *æquilibrio* 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 solemn 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 *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 ½ Foot broad, wherein Tin Ore is broken to Pieces in a stamping Mill. See *Tin*.

COFFERER of the King or Queen's Household, 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 Oversight of other Officers of the House for their good Demeanor and Carriage in their Offices, to all which he pays their Wages. *Vid.* 39. *Eliz. c.* 7.

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*, as 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 cannot touch one another with their whole Surfaces, without supposing that those Particles be either strongly comprest together, or do strongly attract one another. But it doth not seem reasonable to attribute this Cohæsion of the Parts of Matter to any *Pressure* of the *Æther*, as some have imagined; because there is no certain Experiment of the Existence of any such thing as their *Æther*, nor if there were, would it be effectual to solve this Phænomenon, 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 seem to be as much the Law of Nature, as Gravity, *&c.* will fairly account for this hitherto Inexplicable *Phænomenon.* 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 seems 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 *such* produce Bodies of the strictest and firmest Cohesion; others may be terminated partly with Curve, as well as partly with plain Surfaces, and these combined may produce Bodies of a middle Degree of Cohesion; and such as have Surfaces *entirely Curve* may produce Fluids, *&c.* 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 soever: 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 since Light and Bodies act mutually one upon another; and that the Particles of Air endeavour

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to recede one from another (*see 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 small soever.

COLAPTICE, is the Art of Carving or Cutting the Resemblances 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. Transf.* N. 274.) that a Mixture of the greatest Part of all the several Kinds of Salts, in many Liquors is accompanied with a *sensible degree of Coldness*, notwithstanding the violent Fermentations which such Mixtures do sometimes produce. As indeed the Learned and Ingenious Dr. *Slare* had before Experimented (see *Phil. Transf.* 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 such 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 Presentation, and the Arch-deacon gives him *Induction* into it on the Bishops Mandate, as well from the Collation as Institution.

COLLATIONE *Heremitagii*, is a Writ whereby the King confers the keeping of a Hermitage upon a Clerk.

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*, *Wolverhampton*, *Southwel*, *Manchester*, &c. None of these Collegiate Churches are Episcopal Sees or Cathedrals.

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 false; 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 observ'd, that transparent Substances, as Glass, Water, Air, &c. when made very *thin* by being blown into Bubbles, or otherwise formed into Plates, do exhibit various Colours according to their various Thinness, although at a greater Thickness they appear very clear and colourless. About these Sir *Isaac Newton*, in his *Opticks*, *Book* 2. made many excellent Observations serving to illustrate and demonstrate 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 touch; 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 considerably 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 said transparent Spot, till they were compleated into Circles or Rings encompassing 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, shrinking towards the *Whiteness* on either Side of it, till at last they totally vanished into it, and then the Circles in those Parts appeared 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 seem'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 seemed more reddish than the violet

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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 faded, 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 Revolutions 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 found by looking through the Glaſſes. But the Central Spot was now *White*, and the Colours oppoſite to thoſe made by Reflexion in the former Caſes; *i. e.* thoſe Parts of the Glaſs, were now Black, which before were White, *& vice verſa*; and thoſe which were then Red were now Blue; which were then Yellow, were now Violet, *&c.*

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 ſix Lengths of a Chord which ſound the Notes in a ſixth Major *ſol, la, mi, fa, ſol, la.* But that it agrees better with Obſervation to ſay, that the Thickneſs of the Air between the Glaſſes there where the Rings are ſucceſſively made by the Limits of the ſeven 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 Chord, which ſound the Notes in an Eighth, as *ſol, la, fa, ſol, la, mi, fa, ſol*; that is, as the Cube Roots of the Squares of the Numbers 1, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{3}{5}$, $\frac{9}{16}$, $\frac{1}{2}$.

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 fell 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 reflected, and of the Bigneſs of their immediate Spaces: ſo that 'tis plain, *That the Air between the Glaſſes, according to its various Thickneſs, is diſpoſed in ſome Places to reflect, and in others to tranſmit the Light of any one Colour; and in the ſame Place to reflect that of one Colour, where it tranſmits that of another.*

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 *Muſcovy* 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* $\frac{3}{4}$ *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 $\frac{20}{31}$ of the Thickneſs of Air producing the ſame Colours, and the like of

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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, *&c.* 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 considers the Phænomena 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 reflecting 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 Confines of equally refracting Mediums there is no Reflexion.

PROP. II.

The least Particles of almost all Natural Bodies are in some Measure transparent; and the Opacity of those Bodies ariseth from the Multitude of Reflexions 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 Densities; as Water between the tinging Corpuscles with which any Liquor is impregnated; Air between the Aqueous Globules that constitute Clouds or Mists: And for the most part Spaces void of both Air and Water, but yet perhaps not void of all Substance, between the Parts of hard 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 therefore arise from the thinness of the transparent Parts of the Feathers; that is, from the Slenderness 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 some 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 obscure 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 sorts 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;

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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 intermediate Sizes, those Globules, when they become of a convenient Size to reflect 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 considering 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 such a small Particle will at diversely oblique Incidences reflect all sorts 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 imperfect 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 intensely 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 since 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 *Yellows*, 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 Intenseness 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 'tis 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 imperfect 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.

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

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they can constitute Clouds of others Colours. And so this being the first Colour which Vapours begin to reflect, it ought to be the Colour of the finest and most transparent Skies in which Vapours are not arrived to that Grossness requisite to reflect 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, 'tis a Mixture of the Colours of several Orders. Of this last kind he takes the Whiteness of Froth, Paper, Linen, and most white Substances to be; and of the former that of white Metals. For since 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 reflect 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 reflect 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 *less*, 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 Particles 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 Density 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.

Whence 'tis possible, that the Particles may be as little as the Particles of some transparent and volatile Fluids, and yet reflect 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 if they be supposed a little less than is requisite to reflect 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 Positions of the Eye without 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 intensely to other Substances to which they are applied, the minute Particles of these, by reason of their very great Number, easily 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 reflected 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 other.

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 Vibrations

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brations of the Air: *See* Newton's Opticks, *at the End.*

He shews 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 *Striæ* 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 Bodies, as in Flowers, Blood, Metals, *&c.* he concludes, that all other *Hypotheses* of Colours are overthrown, and that nothing besides a *Refraction*, which *is considerable enough to obliquate the Pulse of* Light, is necessary for the Production of Colours.

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 *Treatise of* Combinations *from* Phil. Transf. 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, $a\,a\,a\,a\,b\,b\,b\,c\,c$ is design'd by $a^4\,b^3\,c^2$, and universally p times the Position of c, by $a\,p$, *&c.* 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.

2*dly*, That as often as I shall hereafter mention the *Combination* and *Alternations* of the $p^s\,q^s\,r^s$ or s^s, (which consider'd by themselves are capable of no Variation) I mean, of those things whose Indices they are.

3*dly*, 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 consist, may be design'd.

Lemma I.

If in a right Line, at any Distances, be plac'd any number of Things, $a\,b\,c\,d$, *&c.* the Number of the Intervals, $a\,b$, $b\,c$, $c\,d$, *&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 thereby 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 $m-1$.

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 $a\,b\,c$; 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 $m \times \overline{m-1} \times m\,\overline{m-2} \times \overline{m-3} \times \overline{m-4}$, *&c.* continu'd to m places.

For let $m\,O$ express the Number of the Alternations of m things different each from other; $\overline{m-1}\,O$, of $m-1$ things, and the like.

'Tis evident, that if $m=1$, it will be $m\,O = m$; for there can be but one Order of one thing.

And if m be greater than Unity, then it will be (by *Lem.* 2.) $m\,O = m \times \overline{m-1}\,O = m \times \overline{m-1} \times \overline{m-2}\,O = m \times \overline{m-1} \times \overline{m-2} \times \overline{m-3}\,O =$, *&c.* till we have an Equation consisting of m places; *i. e.* $= m \times \overline{m-1} \times \overline{m-2} \times \overline{m-3} \times$, *&c.* continu'd to m places. *Q. E. D.*

Lemma IV.

If $m\,\omega$ express the Number of the Alternations of m things $a\,p$, $b\,p$, $c\,p$, $d\,p$, $e\,q$, $f\,r$, *&c.* taken m and m; and α the Number of p's, β the Number of q's, γ the Number of r's, it will be,

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$$m\omega = \frac{m - m - 1 \times m - 2 \times m - 3 \times m - 4 \times m \times 5 \times, \text{\&c. continu'd to } m \text{ places.}}{p \times p - 1 \times p - 2 \times, \text{\&c.}\ \alpha \times q \times q - 1 \times, \text{\&c.}\ \beta \times r \times r - 1 \times, \text{\&c.}\ \gamma}$$ each Series continued to p, q, r, &c. 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 suppos'd to compose the several Parts, and consequently the Number of the Alternations of the things composing each Part equal to Unity) $m\omega$ = 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 same Parts; for the things which compose each Part in both Cases, are different from the rest of the things expos'd; *i. e.* by *Lem.* 3.

$$m\omega = \frac{m \times m - 1 \times m - 2 \times m - 3 \times m - 4 \times m - 5 \times, \text{\&c. continued to } m \text{ places.}}{p \times p - 1 \times p - 2 \times, \text{\&c.} \mid \alpha \times q \times q - 1 \times, \text{\&c.} \mid \beta \times r \times r - 1 \times, \text{\&c.} \mid \gamma}$$ each Series continued to p, q, r places respectively. *Q. E. D.*

Lemma V.

The Number of the Combinations of m things $a\ b\ c\ d$, &c. different each from other, taken n and n, is equal to $\frac{m \times m - 1 \times m - 2 \times m - 3 \times, \text{\&c.}}{n \times n - 1 \times n - 2 \times n - 3 \times, \text{\&c.}}$ each Series continued to n places.

For if the things expos'd be divided in two Parts, *viz.* in the *Ratio* of n and $m-n$, 'tis evident that their different Combinations taken n 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 Occurrences are n and $m-n$ = $\frac{m \times m - 1 \times m - 2 \times m - 3 \times, \text{\&c. continu'd to } m \text{ places.}}{n \times n - 1 \times, \text{\&c.} \times m - n \times m - n - 1 \times, \text{\&c.}}$ each Series continued to n and $m - n$ places respectively, (by *Lem.* 4th;) *i. e.* because $n + m - n = m$ $= \frac{m \times m - 1 \times m - 2 \times m - 3, \text{\&c.}}{n \times n - 1 \times n - 2 \times n - 3, \text{\&c.}}$ each Series continued to n places, by *Lem.* 3. Therefore,

Lemma VI.

The Number of the Alternations of m things $a\ b\ c\ d$, &c. different each from other, taken n and n, is $= m \times m - 1 \times m - 2 \times m - 3 \times$, &c. continu'd to n 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 such Indices only (being integer Numbers) whereof no one may exceed the highest 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 Theorem for finding the Combinations and Alternations of m things taken n and n universally; *i. e.* Whether m consist of things all different or not; and whether n be equal to, or less than m.

Theorem.

If n be express'd, according to all the different Forms of Combination which the things expos'd are capable of, and

p = the highest Index	α = the number of p's	in ev'ry form of Combination.
q = the next highest	β = the number of q's	
r = the next highest	γ = the number of r's	
s = the next highest	δ = the number of s's	
&c.		

A	= the Number of all Indices not less than	p.	Which are in the things expos'd.
B		q.	
C		r.	
D		s.	
&c.			

And $b = \alpha + \beta$, $c = b + \gamma$, $d = c + \delta$, &c.

I say the Number of the Combinations of m things taken n and n, in any one Form of Combination, shall be $\frac{A \times A - 1 \times A - 2}{a \times a - 1 \times a - 2} \times$, &c. $\times$ $\frac{B - a \times B - a - 1}{B \times \beta - 1} \times$, &c. $\times \frac{C - b \times C - b - 1}{\gamma \times \gamma - 1} \times$, &c. $\times \frac{D - c \times D - c - 1}{\delta \times \delta - 1}$, &c. continu'd to so many Terms as there are different Indices in the Form of Combination, and each Term to α, β, γ, δ, &c. places respectively, and this Number multiply'd into

$$\frac{n \times n - 1 \times n - 2 \times n - 3 \times n - 4 \times n - 4 \times n - 5 \times n - 6, \text{\&c. continu'd to } n \text{ places.}}{p \times p - 1 \times p - 2 \times, \text{\&c.} \mid \alpha \times q \times q - 1 \times, \text{\&c.} \mid \beta \times 1 \times 1 - 1 \times, \text{\&c.} \mid \gamma \times, \text{\&c.}}$$ each Series continued to p, q, r, &c. places respectively, shall be the Number of their Alternations.

But the Sum of all the Combinations and Alternations which are in every Form of n, shall be the whole Number of 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 $a^p, b^p, c^p, d^p, e^q, f^q, g^q, h^r, i^r$, &c. (the Indices simply consider'd) taken n and n, in a Form wherein are p', q', r', shall be equal to the Number of the Combinations of the p', which are in the things expos'd, taken α and α, multiplied into the Number of the Combinations of the q' taken β and β, 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 C the Number of r': But the Number of the p', which are in every Form of Combination, is $= a$; therefore is $B - \alpha =$ to the Number of q': Also because the Number of ps and q' together, which are in every Form of Combination, wherein there are q', is $= \alpha + \beta = b$; therefore is $C - b =$ 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 α and α, is $= \dfrac{A \times A-1 \times A-2}{\alpha \times \alpha-1 \times \alpha-2}$, &c. continu'd to α places; and the Number of the Combinations of the q', whose Number is $B-\alpha$, taken β and β, is $= \dfrac{B-\alpha \times B-\alpha-1 \times B-\alpha-2}{\beta \times \beta-1 \times \beta-2}$, &c. continu'd to β places; and the Number of the Combinations of the r', whose Number is $C-b$, taken γ and γ, is $= \dfrac{C-b \times C-b-1}{\gamma \times \gamma-1}$, &c. continu'd to γ places. *Q. E. D.*

But every Combination in one and the same 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 Alternatious in any of those Combinations shall be

$$\frac{n \times n-1 \times n-2 \times n-3 \times n-4 \times n-5 \times n-6 \times, \text{ \&c. continu'd to } n \text{ places.}}{p \times p-1 \times p-2 \times, \text{\&c.} \mid \alpha \times q \times q - \times, \text{\&c.} \mid \beta \times t \times r-1 \times, \text{\&c.} \mid \gamma \times}$$

each Series continued to p, q, r, &c. places respectively. *Q. E. D.*

Now to make an Application of this General Rule to those particular Cases which have already been consider'd by others, and which are contain'd in our 3d, 4th, 5th and 6th *Lemma's*, and by us more generally demonstrated; I say,

If $n = m$, there can be but one Form of Combination, and but one Combination in that Form; and therefore the Number of Alternations

$$= \frac{m \times m-1 \times m-2 \times m-3 \times m-4 \times, \text{ \&c. continu'd to } m \text{ places.}}{p \times p-1 \times, \text{\&c.} \mid \alpha \times q \times q-1 \times, \text{\&c.} \mid \beta \times r \times, \text{\&c.} \mid \gamma \times, \text{\&c.}}$$

each Series to p, q, r, &c. places respectively; *i. e.* (if $p = 1$) $= m \times m-1 \times m-2 \times m-3 \times m-4 \times$, &c. continu'd 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 $\alpha = n$, and the whole Number of Combinations $= \dfrac{A \times A-1 \times A-2 \times, \text{\&c.}}{\alpha \times \alpha-1 \times \alpha - \times 2, \text{\&c.}}$ *i. e.* $= \dfrac{m \times m-1 \times m-2 \times, \text{\&c.}}{n \times n-1 \times n-2 \times, \text{\&c.}}$ each Series continued to n places, and therefore the Number of Alternations $= m + m-1 \times m - \times 2$, &c. continued to n places.

But fully to illustrate this Theorem, which, as delivered in general, may seem somewhat too abstracted to be commonly understood, I shall subjoin one short Example.

Example.

Let the things expos'd be $a\ a\ a\ b\ b\ b\ c\ c$, or according to our way of Notation, a^3, b^3, c^2; 'tis requir'd to find the Number of their Combinations and Alternations taken 4 and 4.

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 are capable of, be these,

$$\textit{Viz.} \left\{ \begin{matrix} 3 \cdot 1 \\ 2 \cdot 2 \\ 2 \cdot 1 \cdot 1 \end{matrix} \right\} \text{Then}$$

In the first Form will $p = 3$, $q = 1$, $\alpha = 1$, $\beta = 1$, $A = 2$, $B = 3$.

In the 2d Form will $p = 2$, ———, $\alpha = 2$, ———, $A = 3$, ———.

In the 3d Form will $p = 2$, $q = 1$, $\alpha = 1$; $\beta = 2$, $A = 3$, $B = 3$.

The Number of Combinations in the First Form $= \dfrac{A}{\alpha} \times \dfrac{B-\alpha}{\beta} = \dfrac{2}{1} \times \dfrac{2}{1} = 4$

The Number of Combinations in the Second Form $= \dfrac{A \times A-1}{\alpha \times \alpha-1} = \dfrac{2 \times 2}{2 \times 1} = 3$

The Number of Combinations in the Third Form $= \dfrac{A}{\alpha} \times \dfrac{B-\alpha \times B-\alpha-1}{\beta \times \beta-1} = \dfrac{2 \times 1}{2 \times 1} = 3$

And the whole Number of Combinations $= 10$

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Alſo the Number of Alternations:

$$\text{In the First Form} = 4 \times \frac{n \times \overline{n-1} \times \overline{n-2} \times \overline{n-3}}{\overline{p \times \overline{p-1} \times \overline{p-2}}|^{\alpha} \times q^{\beta}} = 4 \times \frac{4 \times 3 \times 2 \times 1}{3 \times 2 \times 1 | 1 \times} = 4 \times 4 = 16$$

$$\text{In the Second Form} = 3 \times \frac{n \times \overline{n-1} \times \overline{n-2} \times \overline{n-3}}{\overline{p \times \overline{p-1}}^{\alpha}} = 4 \times \frac{4 \times 3 \times 2 \times 1}{2 \times 1 | \quad 2} = 3 \times 6 = 18$$

$$\text{In the Third Form} = 3 \times \frac{n \times \overline{n-1} \times \overline{n-2} \times \overline{n-3}}{\overline{p \times \overline{p-1}}|^{\alpha} \times q^{\beta}} = 3 \times \frac{4 \times 3 \times 2 \times 1}{2 \times 1 | 1 \times 1\,2} = 3 \times 12 = 36$$

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 novo*.

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 given.

Hence may be found the Number of all Numbers, 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 Inſtrument is capable of.

To give an Inſtance of the prodigious Variety that there is in Muſick, I have calculated the Number of Tunes in common Time, conſiſting 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 $\frac{1}{44458.604583}$ of the Number of Tunes: And yet Dr. *Wallis* in 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 operoſe) would be equally attainable by our Theorem.

COMETS. See *Caſſini*'s Diſſertation in the Memoirs of the *French Academy of Sciences*, 1699. In the *Act. Erud. Lipſ.* 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 Cometographia. Geduni, 1668.

——*Ejuſdem Prodromus Cometicus*, 1660.

Eraſmus Bartholinus de Cometis.

Staniſlai Theatrum Cometicum.

Gattus de Cometis.

Jac. Bernouilli Conamen Novi Syſtematis Cometarum.

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 Tempeſts; '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 Cœleſtial 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 *Aſtronomy*, which is now improv'd to ſuch a heighth. But yet amongſt theſe, the Opinion of *Ariſtotle* (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 uncertain Motions of what they eſteemed 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 Comets of his Time, made no Scruple to place them amongſt the Cœleſtial 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

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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 fit 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 Affair, before *A. D.* 1337. 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 observ'd by *Regiomontanus*, 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 ever 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 Observations, 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 Sectors taken at the Centre of the Sun, which he proved to be in the common Focus of these Ellipses) are always proportional to the Times in which the correspondent 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*, 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 mov'd freely through the Planetary Orbs with a Motion not much different from a Rectilinear one; but of what Kind he cou'd not then precisely determine.*

Next, *Hevelius* (a noble Emulator of *Tycho Brahe*) following in *Kelper's* Steps, embraced the same Hypothesis of the *Rectilinear Motion 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 descending, as it were, from an infinite Distance *perpendicularly* 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 founded and commited to the Care of most *excellent Astronomers*, the *apparent* Motion of this Comet was most accurately (perhaps as far as human Skill could go) observ'd by Messieurs *Cassini* and *Flamsteed*.

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 follow from the same Principles; which he abundantly illustrated by the Example of the aforesaid Comet of the Year 1680. 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 prodgious 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 observ'd 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 Posterity, and to last as long as *Astronomy* it self.

The

The Astronomical Elements of the Motions in a Parabolick Orb of all the Comets that have been hitherto duly observ'd

Comt An.	Nodus Ascend.	Inclin. Orbitæ.	Perihelion	Distan. Perihel. a Sole.	Log. Dist. Perihelii a Sol.	Temp. equat. Perihelii.	Perihelion a Node.	
	gr. ′ ″	gr. ′ ″	gr. ′			d. h. ′	gr. ′ ″	
1337	♊24.21. 0	32.11. 0	♉ 7.59. 0	40666	9.609236	*June* 2. 6.25	46.22. 0	Retrog.
1472	♑11.46.20	5.20. 0	♉15.33.30	54273	9.734584	*Feb.* 28.22.23	123.47.10	Retrog.
1531	♉19.25. 0	17.56. 0	♒ 1.39. 0	56700	9.753583	*Aug.* 24.21.18½	107.46. 0	Retrog.
1532	♊20.27. 0	32.36. 0	♋21. 7. 0	50910	9.706803	*Oct.* 19.22.12	30.40. 0	Direct.
1556	♍25.42. 0	32. 6.30	♑ 8.50. 0	46390	9.666424	*Apr.* 21.20. 3.	103. 8. 9	Direct.
1577	♈25.52. 0	74.32.45	♌ 9.22. 0	18342	9.263447	*Oct.* 26.18.45	103.30. 0	Retrog.
1580	♈18.57.20	64.40. 0	♋19. 5.50	59628	9.775450	*Nov.* 28.15.00	90. 8.30	Direct.
1585	♉ 7.42.30	6. 4. 0	♈ 8.51. 0	109358	0.038850	*Sept.* 27.19.20	28.51.30	Direct.
1590	♍15.30.40	29.40.40	♏ 6.54.30	57661	9.760882	*Jan.* 29. 3.45	51.23.50	Retrog.
1596	♒12.12.30	55.12. 0	♏18.16. 0	51293	9.710058	*July* 31.19.55	83.50.30	Retrog.
1607	♉20.21. 0	17. 2. 0	♒ 2.16. 0	58680	9.768490	*Oct.* 16. 3.50	108.05. 0	Retrog.
1618	♊16. 1. 0	37.34. 0	♈ 2.14. 0	37975	9.579498	*Oct.* 29.12.23	73.47. 0	Direct.
1650	♊28.10. 0	79.28. 0	♈28.18.40	84750	9.928140	*Nov.* 2.15.40	59.51.20	Direct.
1661	♊22.30.30	32.35.50	♋25.58.40	44851	9.651772	*Jan.* 16.23.41	33.28.10	Direct.
1664	♊21.14. 0	21.18.30	♌10.41.25	102575½	0.011044	*Nov.* 24.11.52	59.27.25	Retrog.
1665	♐18.02. 0	76. 5. 0	♊11.54.30	10649	9.027309	*Apr.* 14. 5.15½	156. 7.30	Retrog.
1672	♑27.30.30	83.22.10	♉16.59.30	69739	9.843476	*Feb.* 20. 8.37	109.29. 0	Direct.
1677	♏26.49.10	79.03.15	♌17.37. 5	28059	9.448072	*Apr.* 26.00.37½	99.12. 5	Retrog.
1680	♑ 2. 2. 0	60.56. 0	♐22.39.30	00612½	7.787106	*Dec.* 8.00. 6	9.22.30	Direct.
1682	♉21.16.30	17.56. 0	♏ 2.52.45	58328	9.765877	*Sep.* 4.07.39	108.23.45	Retrog.
1683	♍23.23. 0	83.11. 0	♊25.29.30	56020	9.748343	*July* 3. 2.50.	87.53.30	Retrog.
1684	♐28.15. 0	65.48.40	♏28.58. 0	96015	9.982339	*Mai.* 29.10.16	29.23.00	Direct.
1686	♓20.34.40	31.21.40	♊17.00.30	32500	9.511883	*Sept.* 6.14.33	86.25.50	Direct.
1698	♐27.44.10	11.46. 0	♑00.51.15	[illegible]9129	9.839660	*Oct.* 8.16.57	3. 7. 0	Retrog.

This Table needs little Explication, since 'tis plain enough from the Titles what the Numbers mean. Only it may be observ'd, 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.

Med. mot.	Ang. a Perihelio.	Logar. pro dist. a Sole.	Med. mot.	Ang. a Perihelio.	Logar. pro dist. a Sole.	Med. mot.	Ang. a Perihelio.	Logar. pro dist. a Sole	Med. mot.	Ang. a Perihelio.	Logar. pro dist. a Sole.
o	gr. ′ ″		o	gr. ′ ″		o	gr. ′ ″		o	gr. ′ ″	
1	1.31.40	0.000077	31	42.55.06	0.062400	61	69.55.58	0.172914	91	86.20.34	0.274 76
2	3. 3.15	0.000309	32	44. 3.20	0.065838	62	70.36.56	0.176557	92	86.46.20	0.277239
3	4.34.43	0.000694	33	45.1029	0.069319	63	71.17.16	0.180188	93	87.11.43	0.280287
4	6. 6. 0	0.001231	34	46.16.35	0.072839	64	71.56.56	0.183803	94	87.36.45	0.283306
5	7.37. 1	0.001921	35	47.21.36	0.076396	65	72.35.57	0.187404	95	88.01.27	0.286308
6	9. 7.43	0.002759	36	48.25.33	0.079984	66	73.14.15	0.190978	96	88.25.49	0.289293
7	10.38. 2	0.003745	37	49.28.27	0.083600	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	13.37.17	0.006151	39	51.31. 8	0.090910	69	75. 5.38	0.201614	99	89.36.54	0.298122
10	15. 6. 7	0.007564	40	52.30.56	0.094596	70	75.41.35	0.205122	100	90.00.00	0.301030
11	16.34.20	0.009115	41	53.29.44	0.098300	71	76.16.56	0.208612	102	90.45.14	0.306782
12	18. 1.54	0.010798	42	54.27.32	0.102019	72	76.51.43	0.212080	104	91.29.18	0.307469
13	19.28.47	0.012609	43	55.24.21	0.105742	73	77.25.57	0.215529	106	92.12.14	0.318060
14	20.54.54	0.014550	44	56.20.12	0.109490	74	77.59.41	0.218963	108	92.54. 4	6.323587
15	22.20.14	0.016607	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	0.116995	76	79. 5.35	0.225769	112	94.14.40	0.334424
17	25. 8.22	0.021072	47	59. 2. 4	0.120756	77	79.37.45	0.229142	114	94.53.30	0.339736
18	26.31. 8	0.023470	48	59.54.11	0.124518	78	80. 9.23	0.232488	116	95.31.22	0.344979
19	27.52.55	0.025969	49	60.45.25	0.128278	79	80.40.34	0.235809	118	96. 8.22	0.350153
20	29.13.47	0.028570	50	61.35.45	0.132035	80	81.11.16	0.239127	120	96.44.30	0.355262
21	30.33.40	0.031263	51	62.25.14	0.135792	81	81.41.34	0.242416	122	97.19.48	0.360306
22	31.52.32	0.034045	52	63.13.52	0.139544	82	82.11.19	0.245684	124	97.54.17	0.365284
23	33.10.23	0.036916	53	64. 1.40	0.143291	83	82.40.40	0.248933	126	98.28.00	0.370200
24	34.27.12	0.039864	54	64.48.38	0.147029	84	83. 9.34	0.252159	128	99.00.37	0.375052
25	35.42.59	0.042892	55	65.34.50	0.150762	85	83.38. 4	0.255366	130	99.33.11	0.379842
26	36.57.41	0.045982	56	66.20.13	0.154482	86	84. 6. 8	0.258552	132	100. 4.43	0.384576
27	38.11.20	0.049154	57	67.04.50	0.158192	87	84.33.49	0.261720	134	100.35.45	0.389252
28	39.23.54	0.052382	58	67.48.42	0.161890	88	85. 1. 5	0.264865	136	101. 5.48	0.393868
29	40.35.23	0.055668	59	68.31.50	0.165578	89	85.27.58	0.267989	138	101.35.22	0.398428
30	41.15.47	0.059009	60	69.14.16	0.169254	90	85.54.27	0.271092	140	102. 4.19	0.402920

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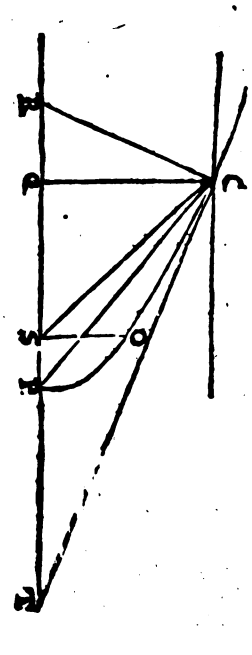
Med. mot.	Ang. a Peribelio.	Logar. pro. dist. a Sole.	Med. mot.	Ang. a Peribelio.	Logar. pro dist. a Sole.	Med. mot.	Ang. a Peribelio.	Logar. pro dist. a Sole	Med. mot.	Ang. a Peribelio.	Logar. pro dist. a Sole.
o	gr. ′ ″		o	gr. ′ ″		o	gr. ′ ″		o	gr. ′ ″	
142	102.32.41	0.407380	204	113.37.25	0.523406	360	117.28. 6	0.708104	820	141.49.24	0.970837
144	103.00.31	0.411784	208	114. 9.52	0.529705	370	128. 2.33	0.716976	840	142.10.00	0.978397
146	103.27.47	0.416132	212	114 41.23	0.535886	380	128.35.38	0.725606	860	142.29.56	0.985771
148	103.54.31	0.420430	216	115.12.02	0.541958	390	129. 7.27	0.734006	880	142.49.10	0.992970
15	104.20.43	0.424676	220	115.41.51	0.547922	400	129.38. 4	0.742186	900	143. 7.48	0.100000
152	104.46.22	0.428866	224	116.10.52	0.553782	410	130. 7.34	0.750160	920	143.25.51	1.006871
154	105.11.33	0.433012	228	116.39. 7	0.559538	420	130.36. 2	0.757930	940	143.43.21	1.013586
156	105.36.16	0.437110	232	117. 6.38	0.565199	430	131. 3.30	0.765516	960	144.00.18	1.020155
158	106.00.32	0.441164	336	117.33.27	0.570762	440	131.30. 2	0.772918	980	144.16.46	1.026583
160	106.24.23	0.445178	240	117.59.35	0.576233	450	131.55.41	0.780148	1000	144.32.46	1.032876
162	106.47.47	0.449144	244	118.25. 5	0.581616	460	132.20.30	0.787216	1500	149.26. 8	1.158188
164	107.10.44	0.453060	248	118.49.57	0.586912	470	132.44.32	0.794122	2000	152.26.15	1.246058
166	107.33.17	0.456936	252	119.14.14	0.592122	480	133.37.50	0.800882	2500	154.32.20	1.313703
168	107.55.27	0.460772	256	119.37.56	0.597252	490	133. 0.25	0.807494	3000	156. 7.27	1.368678
170	108.17.14	0.464208	260	120. 1. 6	0.602301	500	133.52.20	0.813969	3500	157.22.19	1.414974
172	108.38.37	0.468318	264	120.23.44	0.607274	520	134.34.18	0.826522	4000	158.24.36	1.454950
174	108.59.39	0.472030	268	120.45.52	0.612174	540	135.14. 0	0.838600	4500	159.16.36	1.490125
176	109.20.20	0.475705	272	121. 7.30	0.616998	560	135.51.28	0.850187	5000	160. 1.12	1.521521
178	109.40.40	0.479340	276	121.28.39	0.621750	580	136.27. 6	0.861369	5500	160.40. 5	1.549864
180	110.00.40	0.482937	280	121.49.22	0.626438	600	137. 0.57	0.872155	6000	161.14.24	1.575718
182	110.20.20	0.486498	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	110.58.44	0.493512	292	122.48.54	0.640098	660	138.33.21	0.902401	7500	162.37.34	1.641838
188	111.17.28	0.496965	296	123. 7.57	0.644525	680	139. 1.29	0.911866	8000	163.00.23	1.660922
190	111.35.55	0.500484	300	123.26.36	0.648393	700	120.28.25	0.927012	8500	163.21.20	1.678834
192	111.54.05	0.503769	310	124.11.40	0.659559	720	139.54.16	0.929907	9000	163.40.42	1.695708
194	112.11.58	0.507121	320	124.54.36	0.669880	740	140.19. 5	0.938549	9500	163.58.38	1.711662
196	112.29.34	0.510441	330	125.35.34	0.679876	760	140.42.56	0.946951	10000	164.15.20	1.726784
198	112.46.55	0.513729	340	126.14.44	0.689578	780	141. 5.55	0.955124	50000	170.52. 0	2.197960
200	113. 4.00	0.516984	350	126.52.12	0.698970	800	141.28. 3	0.963082	100000	172.45.44	2.399655

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 *Fig.* let *S* be the *Sun*, *P O C* 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 Curve) let fall *C Q* perpendicular to the *Axis P S R*.

Now, any *Area*, as *C O P S*, being given, 'tis requir'd to find the Angle *C S P*, and the Distance *C S*. From the Nature of the *Parabola R Q* is ever $= \frac{1}{2}$ the Parameter of the *Axis*, and consequently if the Parameter be put $= 2$, then $RQ = 1$. Let $CQ = z$; then PQ shall $= \frac{1}{2}zz$, and the Parabolick Segment $COP = \frac{1}{12}zzz$. But the Triangle CSP will $= \frac{1}{4}z$, and so the Mixtilineal *Area* $COPS = \frac{1}{12}z^3 + \frac{1}{4}z = a$, whence $z^3 + 3z = 12a$. Wherefore resolving this Cubical Equation, *z* or the Ordinate *C Q* will be known. Now, let the *Area O P S* be propos'd to be divided into 100 Parts; this *Area* is $\frac{1}{12}$ of



the Square of the Parameter, and consequently 12 *a* is = that Square = 4. If therefore the Roots of these Equations $z^3 + 3z = 0,04 : 0,08 : 0,12 : 0,16$, &c. be successively extracted, there will be obtain'd so many *z* or Ordinates *C Q* respectively, and the *Area S O P* will be divided into 100 Parts. And in like manner is the *Calculus* to be continued beyond the Place *O*. Now the Root of this Equation (since *R Q* is equal 1) is the Tabular Tangent of the Angle *C R Q*, or $\frac{1}{2}$ the Angle *C S P*, and so the Angle *C S P* is given. And *R C*, the Secant of the same Angle *C R Q*, is a mean Proportional between *R Q* or Unity; and *R T*, which is the double of *S C*, as is plain from the *Conicks*. But if *S P* be put = 1, and so the *Latus Rectum* = 4, (as in our Table) then *R T* will be the Distance sought, *viz.* the double of *S C* in the former *Parabola*. After this manner therefore I compos'd the foregoing Table, which serves to represent the Motions of all Comets: For hitherto there has been none observ'd, 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 $\sqrt{2}$ to 1, as appears from *Cor.* 7. *Prop.* 16. *Lib.* 1. of the *Princip. Phil. Nat. Math.* ¶ If therefore a Comet in its *Perihelium* were suppos'd 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 $\sqrt{\frac{8}{9}}$. 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 0.912280 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 less Distance, would* describe similar Quadrants, *are as the Times of the Revolutions in Circles*, that is, in the *Sesquiplicate Ratio* of the Distances: And so the *Diurnal Area's*, estimated in *Centesimal* 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 constant Log.* 9.960128, *and the Complement Arithmetical of the* $\frac{3}{2}$ *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, subtract, if the Time be after the* Perihelium, *the Angle thus found, to or from the Place of the* Perihelium; *or in direct Comets subtract, and in retrograde ones add, 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 Distance 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 1664/5, March *the* 1d, 7h, 00', *P. M.* London. *That is,* 96d, 19h, 8', *after the* Perihelium, *which happened* Novemb. 24°, 11h, 52'.

Log. Dist. Perihel.	0.011044
Log. Sesquialt.	0.016566
Comp. Arith.	9.983434
	9.960128
Log. Temp.	1.985862
Log. Med. Mot.	1.929424
Medius Motus	85.001
Perihel. ♌	10.41.25
Ang. Corresp.	83.38.05
Comet in Orb. ♉	17. 3.20
Ascend. Nod. ♊	21.14.00
Com. a Nodo	34.10.40
Red. ad Eclip.	32.19.05
Com. Helioc. ♉	18.54.55
Incl. Bor.	11.46.50
Log. pro dist.	0.255369
Log Perihel.	0.011044
Co-sin. Incl.	9.990754
Log. dist. Curt.	0.257167
Log. dist. ☉	9.997918
☉ ♓	21.44.45
Com. Visus ♈	29.18.30
Lat. Visa	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.	0.377486
	9.960128
Log. Temp.	1.310723
Log. Med. Mot.	1.648337
Medius Motus	44.498
Perihel. ♊	25.29.30
Ang. Correſp.	23.23.20
Comet. in Orb. ♈	28.42.10
Nod. Deſcend. ♓	23.23.00
Com. a Nodo	35.19.10
Red. ad Eclip.	4.48.30
Com. Helioc. ♓	28.11.30
Incl. Bor.	35. 2.00
Log. pro diſt.	0.111336
Log. Perihel.	9.748343
Co-ſin. Incl.	9.913187
Log. diſt. Curt.	9.772866
Log. diſt. ☉	0.006104
☉ Locus ♌	10.41.25
Com. Viſus ♋	5.11.50
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 ſecond 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°. 11½′. and 28°. 52′. *North* Latitude, which agreed exactly with the Obſervation made at G*reenwich* 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 ⅙ of the Semidiameter of the Sun diſtant from the Surface of it) ſince the *Latus Rectum* is ſo very ſmall, could hardly be contained within the Limits of the General Table, becauſe of the exceſſive Velocity of the *Mean 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 $z^3 + 3z = \frac{3}{1.5}$ of the *mean Motion*) the Tangent of half the Angle from the Perihelion, together with the Log. for the Diſtance 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 Obſervations 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 future 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.

Now it may not be amiſs to put the Reader in mind, That our Five firſt Comets (the Third and Fourth obſerved by *Peter Apian*, the Fifth by *Paulus Fabricius*) as alſo the Tenth ſeen by *Maſtl.n*, 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 diſagreeing with themſelves, and can by no means be reconcil'd with a regular Computation. The Comet which appear'd in the Year 1684, was only taken notice of by *Blanchinus*, who obſerved at *Rome*: And the laſt, which appear'd in the Year 1698, was ſeen only by thoſe at *Paris*, who determined its Courſe in a very uncommon way. This Comet was very obſcure; and although it moved ſwift, and came near enough our Earth, yet we, who were wont to be curious enough in theſe Matters, ſaw nothing of it. For want of Obſervations, I have left out of the foregoing Catalogue, thoſe two remarkable Comets which have appear'd in this our Age, one in *November*, in the Year 1689. the other in *February*, in the Year 1702. For they directing their Courſes 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 requiſite Obſervations, I will willingly fall to work again, and undergo the Fatigue 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 ſuſpect 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 Suppoſition 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 ſince they appear frequently enough, and ſince none of them can be found to move with an Hyperbolick Motion, or a Motion ſwifter than what the Comet 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 vaſtly 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 *Ellipſis*; and the Velocities are in a ſubduplicate *Ratio* of the ſame: Wherefore in every Excentrick 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 *Pa-*

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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 self have seen 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, though 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 themselves 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 observ'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 continue my Life and Health.

In the mean time, those that desire 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 *Isaac 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 *Astronomia 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 Motion 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 *Perigeo*; 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 Affair. 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 sooner 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 Matters.

COMMENDAM. Before the Reformation, it was common for the Ordinary to grant a Sequestration of a Living (especially if in his own Gift, 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 Bishop can't hold any Living in *Commendam* without the Patron's Consent; as *Watson* saith, *c.* 18. *p.* 141. In Case of a *Commendam*, no Institution is necessary; and a Bishop may be Licensed to hold a Living in his own Gift by these Words: *Authoritate sua propria capere, & apprehendere absquere Institutione, Inductione, Collatione*, &c.

COMMISURA *Crassioris Nervi annuli*, is a Medullary Process in the Brain, connecting together the *Corpora Striata*, or the Tips of the *Crura Medullæ oblongatæ.*

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 Inscription, &c.) mark'd out in some ornamental Part of a Building.

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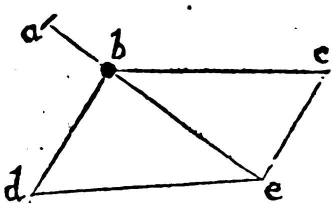
COMPASS: The *Latin* and *Greek* Names used for the *Points of the Compass*, are as follows:

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. Cæcias, Carbas.
E. b. N. Mesocæcias.
EAST. Oriens, Subsolanus.
E. b. S. Hypeurus, Hypereurus.
E. S. E. Vulturnus.
S.E.b.E. Meseurus.
S. E. Euro auster, vulg. Notapeliotes.
S.E. b.S. Hypophænix, Hypereanotus.
S. S. E. Euronotus, *by* Vegetius, Δαλχόνος.
S. b. E. Mesophænix, Meseuronotus.
SOUTH. Auster.
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 Etesiæ, Zephyroboreas.
N.W.b.W. Hypocircius, Mesothracias.
N.N.W. Circius.
N. b. W. Mesocircius.

[*Metius* Lib. V. Doctrin. 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*, so



that it yield to none of them, but continue in *æquilibro:* 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 *b e* represent the Force by which the Body *b* is impelled from *b* to *a*; then will the same right Line *b e* represent also the contrary equal Force, by which it is impelled from *b* to *e*. But by what hath been said before in Composition of Motion, the force *b e* is resolvable into the two Forces acting according to the two Directions, *b d*, and *b c*, 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 *b d*, *b c*, and being equipollent to the Force acting without the Direction *b e*, from *b* to *e*; will be to the Force acting according to the Direction *b e* from *b* to *e*, as *b d*, *b c* to *b d*; and therefore the Forces acting in the Directions *b d*, *b c*, and equipollent to the Force acting in the Direction *b e*, are to the Force acting in the Direction, as *b d*, *b c*, or *d e* to *b e*: That is, if a Body be urged by three different equipollent Powers in the Directions, *b a*, *b d*, 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 Mechanicks, 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 *directly*, and the Simple *Ratio* of the *Radii* of those Circles *Inversly*. 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 Centrifugus*.

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: Quicksilver will stick to Gold, Silver, Tin, Lead, *&c.* and unite with them; but will roll off from Wood, Stone, Glass, *&c.* and Water that will wet Salt and dissolve it, will slip off from Tallow, *&c.* without adhering to it; as it will from a dusty 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 Quicksilver, 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 so near to one another, as to come within the Sphere of one another's Attraction; and why they cannot be brought to do so by shaking, are Enquiries 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 self, without the tedious Number of Lemmas, which some have premised about a Line cut Harmonically; whose Demonstrations alone,

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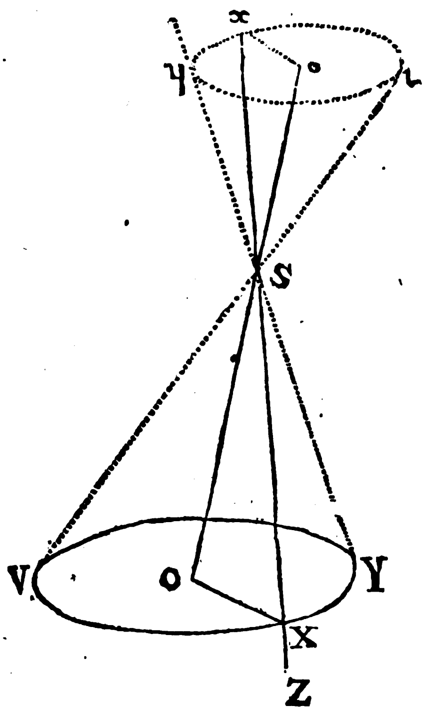
are more than all these Propositions, and not so natural nor easy neither.

DEFINITIONS.

I. If an Infinite right Line, as *x S Z*, having one Part of it, as *S*, fix'd *there* as in an immoveable Point, plac'd above the Plane of the Circle *V X Y*;

Fig. 1.



be supposed to move round the Circumference 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 *Opposite*.

II. The fix'd Point *S*, is called the *Vertex* of *either Surface*.

III. The ⊙ *V X Y*, is called the Base of the *Cone VXYS*; and the ⊙ *u x y S*, the Base of the *Opposite Cone*.

IV. For the Solid contain'd under the Base *V X Y*, and that *Conick Surface* which is generated by the Motion of the Line *S X*, is called a *Cone*.

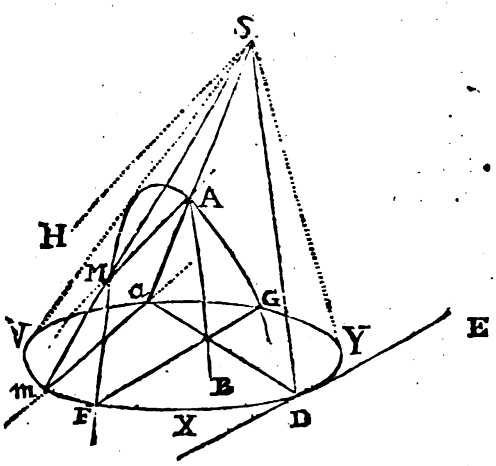
V. The Right Line *S X*, drawn from the *Vertex* to any Point in the Periphery of the Base, is called the *Side* (because 'tis one of the *Sides* of the △, which will be formed by cutting the *Cone* thro' the *Vertex*, and by the *Axis*.)

VI. The Line *S O*, 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, 'tis called a *Scalene Cone*.

VIII. If a *Conick Surface* be cut by a Plane, which doth not pass thro' its *Vertex*, as *F A G*; and which also is not parallel to the Plane of the Base,

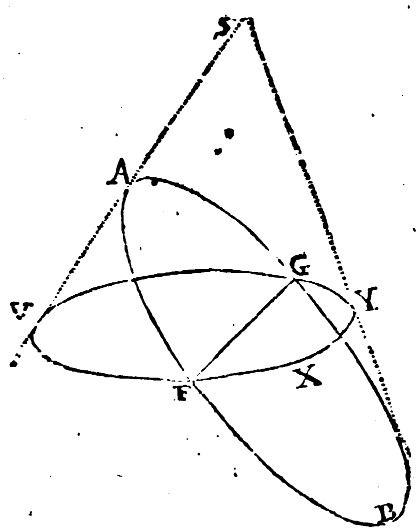
Fig. 2.



(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 *F A G*, with the *Conick Surface*, is called a *Conick Section*.

IX. If thro' the *Vertex S*, a Plane be drawn parallel to any *Conick Section*, the Infinite Right

Fig. 3.



Line *D E*, which is the common *Section* of that Plane, with the Plane of the Base, is called the *Directrix*.

X. *A Conick Section F A G*, is called a *Parabola*, when the *Directrix D E* 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 Section* be produced, it must cut the *opposite Conick Surface*; and *there* will form another *Conick Section*, which is called *Opposite*, and both together are called *Opposite Sections*, or *Opposite Hyperbola's*, as *F A G* and *K N H*, in *Fig.* 4.

XI. If

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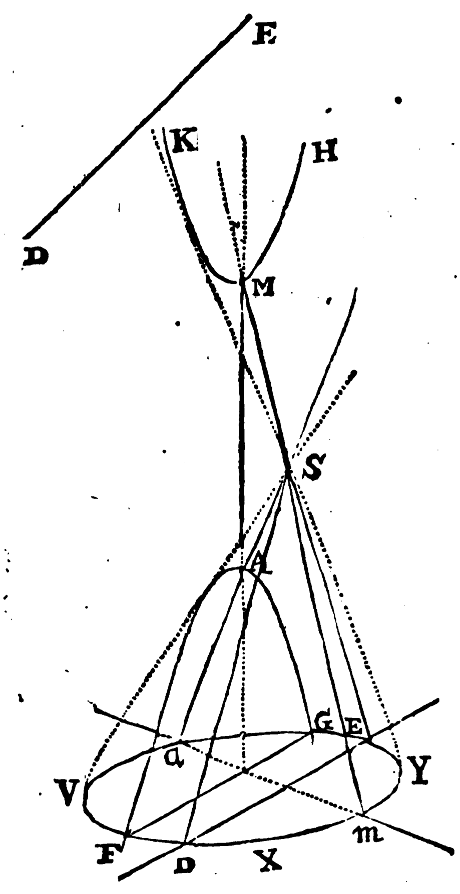
XI. If a Line be drawn in the Plane of any *Conick-Sections*, so that it meet it only in one Point, and being produced both ways, enters not at all into the *Section*, but falls all entirely without, that Line is called a *Tangent* in that Point.

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 S D*, drawn

Fig. 4.



from the Vertex *S* to the Point *D*, where the *Directrix* 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 *S D E* which is parallel to the Sections; and also because all the others cut it in the Point *S*.

The Sides of the Portion *S D V E* form the Points of the Hyperbola *F A G*; 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 *opposite Hyperbola's* are extended infinitely, and can no more return into themselves than the *Parabolick Section*.

Theorem I. PROP. I.

If the *two opposite Conick Surfaces* be cut, by a Plane passing through the *Vertex*, as *S a m* (in *Fig.* 4.) the Intersection of that Plane, with the two Surfaces, will make two Right Lines *S a*, *S m*, 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 *S a m* is supposed to fall *within* the Cone. Wherefore the Sides *S a* and *S m* being produced each way from *S*, must be the two common Sections of the intersecting Plane *S a m*, 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 *a m* 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 *S a m*, be supposed exfinitely extended all round *S*, that Part of it only which is contained within the Legs of the Angle *a S m*, and its Vertical one beyond *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 *S m*, *S a*, and supposing them to determine such a Plane as above, 'tis plain the Line *A M* will fall all within the Legs of the Angle *a S m*, &c.

III. Wherefore any Line passing through the Vertex *S*, and parallel to such a Line as *A M* drawn within the Section, will fall without the *Conick Surface*; and will meet the Plane of the Base produced without the Circumference of the Base of the Cone.

IV. It follows also, (from *Consect.* I.) That any two Points, one in each of the opposite Hyperbola's, (*Fig.* 4.) being joined by a Right Line, as *A M*, that Line will be wholly without and between the opposite Sections; but infinitely produced each way, will be ever after entirely within the *Opposite Hyperbola's*: For drawing through *S* the Lines *S a*, *S m*, 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 compre-

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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 *Consectaries* 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 o u x y, (*see* Fig. 1.) *which is parallel to the Base* O V X Y, *the Section will be a Circle, whose Centre shall be in* o, *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 $o\,u\,x\,y$ in x; the Lines OX and $o\,x$ will be parallel: And the Plane SOX being produced into the opposite Cone beyond S, the Δ's SOX and $S\,o\,x$ 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 $u\,x\,y$ is a Circle.

PROP. III.

If in the Plane of a Parabola, as F A G (Fig. 2.) *you draw from any Point, as* A, *within the Cone, an infinite Right Line, as* A B, *parallel to the Side* S D: *I say, 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 SAB; 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 Circumference 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 Plane to pass along that Line and the Vertex S, as SAM, that will be all of it within the Conick Surface, and can't pass by the Side SD: Whence it follows, that this Plane will form, by its cutting the Surface of the Cone, the two Sides Sa and Sm, (see *Prop.* I.) one of which, Sa, passes through the Point A; and the other, Sm, is by no means parallel to the Plane of the Section; (for by the Nature of it, only the Side SD is so, (see *Def.* X.) Wherefore the Side Sm produced, must cut the Plane of the Parabola in the Point M; through which the Line AM passes, which is formed by the Intersection of the Plane aSm 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, &c.

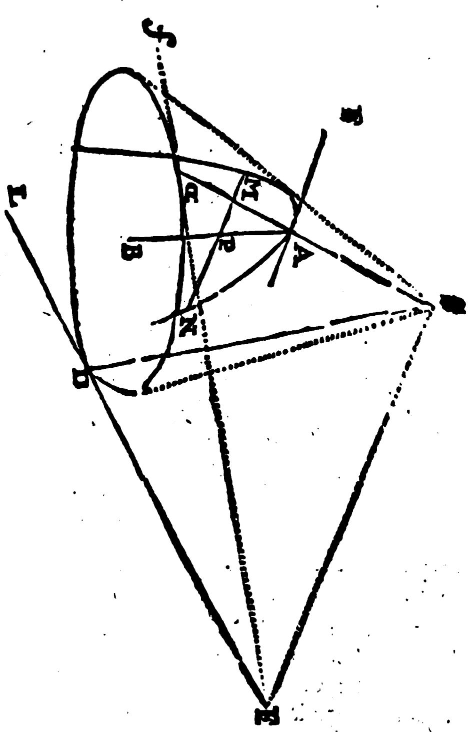
PROP. V. *Probl.* I.

Through a Point given, as A, *in any Conick Section, to draw a Tangent, as* A F, *to the Curve.*

Having drawn through the given Point A, and the Vertex of the Cone, as S, a Right Line, as SA, cutting the Base in a; and then to the Periphery of the Base in the same Point a, a Tangent, as EaF. The Line FA made by the common Section of the Plane SE, af, (produced, if necessary, beyond the Vertex S) with the Plane of the Section, shall be the Tangent required.

For since the Tangent Eaf is entirely without the Base, but only in the Point a, it follows, that the Plane $SEaf$, infinitely produced above or below S, can cut the opposite Conick 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.

Fig. 5.



CONSECTARIES.

I. As there can be but one Tangent to the Periphery of the Base in the Point a, so there can be but

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but one to the Point *A* drawn in any of the Conick Sections.

II. Whence arises the way of drawing a Tangent, as *A F* parallel; a Right Line, as *M N*, given in Position in the Plane of any Conick Section; or in the two opposite Sections.

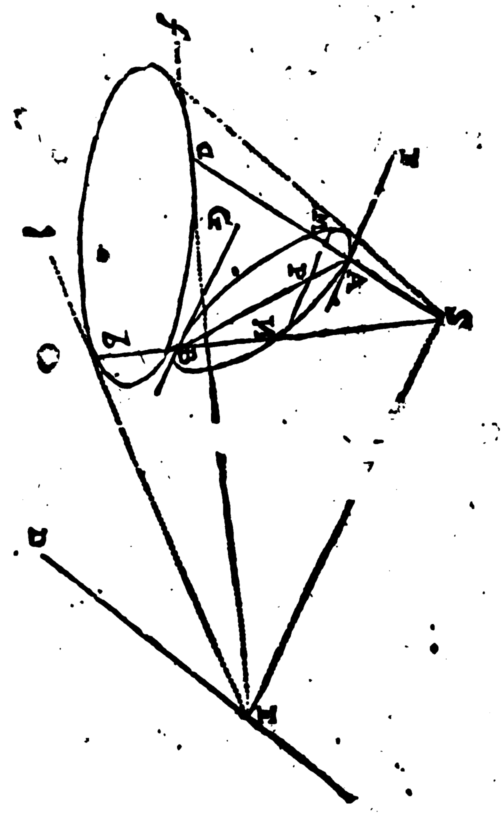
For having drawn through the Vertex *S* a parallel to *M N*, as *S E*, that will either meet with the Directrix in some Point, as *E*, or be parallel to it; because that Line *S E* may be parallel to the Plane of the Section, and consequently may fall in the Plane *S D E*. If it cut it in any Point, 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 E D*; being cut by the Tangent Plane, *S E a f*, must be parallel to one another, as well as *S E* and *M N*.

III. The same things being supposed, as in the preceding Consectary, and *Fig.* 5. it will follow, 1. That in the Parabola this Problem will be impossible, when the Line *M N* is in a parallel Position to the Side *S D*; drawing thro' the Point *D* where 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, two Tangents, as *E a f* and *E D L*, may always be drawn from that Point to the Circumference of that Circle; of which one, *E D L*, will co-incide with the Directrix; and the other, *E a f*, will find by the Intersection of the Plane *S E a f* with that of the Parabola, a Tangent, as *A F*, which shall answer the Problem.

'Tis the same thing when the Line *S E* is parallel 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 *D*; it follows, that a Tangent may be drawn, &c.

2. In the Ellipsis, there may always be drawn two Tangents, *A F*, *G B*, parallel to the Right

Fig. 6.



Line *M N*, given in Position, and consequently to one another.

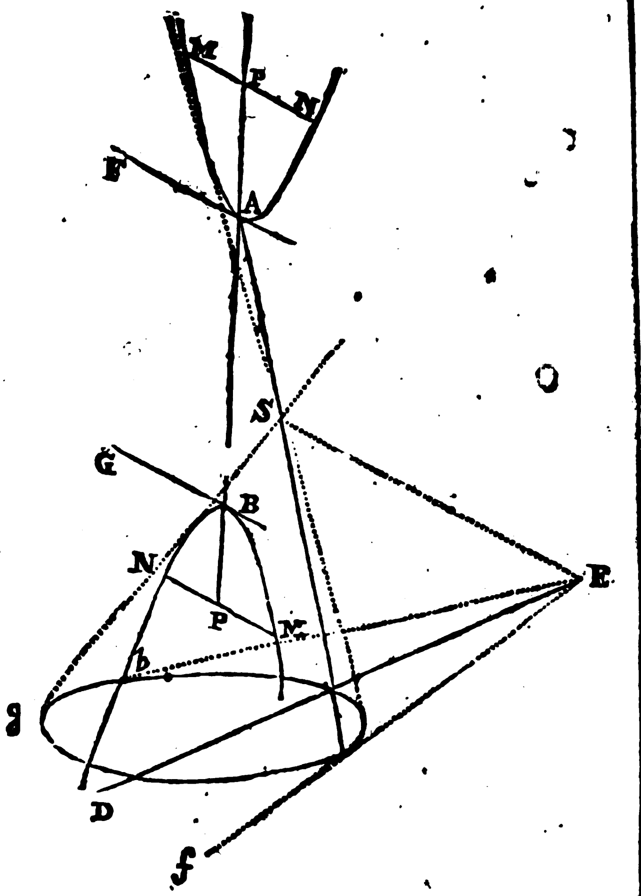
For here all the Points of the Directrix *D E* fall without the Base of the Cone; and therefore you may always draw from the Point *E*, two Tangents, *E a f*, and *E b g* to the Circle of the Base; and these will serve, by the Intersection of the Planes *S E a f*, and *S E b g*, with the Plane of the Section on two Tangents, *A F* and *B G*, which will answer 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

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.



then no Tangent can be drawn to that Point of the Base. But when it falls without, you may always draw two Tangents, A F and A B, 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 Planes S E a f, S E b g, with the Planes of the Sections, two Tangents A F and B G, which will answer the Problem.

And 'tis the same, when the Line S E is parallel 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 parallel 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 a f and E b g, 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 Position (as suppose 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 draw in the Parabola one Tangent, which may be parallel to it; and in the Ellipsis and opposite Hyperbola's, two Tangents, as A F and B G; because the Line S E drawn from the Vertex, parallel to M N, will cut the Plane of the Base produced somewhere without the Circle, or else be parallel to it.

DEFINITIONS.

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 Base, 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 A B, conecting the Points of Contact of the two parallel Tangents, A F and B G, is called a *Diameter*; the Points A and B, its *Extremities*.

XIV. A Line, as M D, drawn thro' any Point, as P, of the Diameter A B 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 A F, 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 P M or P N, 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.

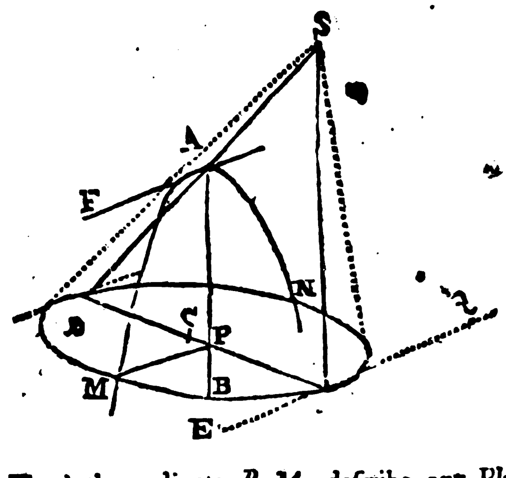
I. From *Def.* 12. it follows, that in the *Parabola* all the *Diameters* must be parallel one to another; because they are all so to the Side S D.

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 Position, as S D is.

PROP. VII. *Problem* II.

A Diameter, as A B, *an Ordinate,* P M, *in any* Conick Section, *to describe the Figure.*

Fig. 8.



Thro' the ordinate P M, describe any Plane whatever, so it be but different from the Plane, A P M,

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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 *A B*; 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 *A P M*, the Parabola *M A N* required.

For having drawn parallel to *M N*, and through the Points *D* and *a*, the Right Lines *E D* and *f a*; 'tis clear, those Lines will be Tangents, because they are parallel to *M P*, which is to *a P*.

But the Place *S D E* passing thro' *S*, the Vertex of the Cone, and thro' the Tangent *D E*, is parallel to the Plane *A P M*; because *S D* parallel *A P*, and *D E* parallel *M P*: Wherefore the Section *M A N*, made by the Plane *A P M* in the Conick Surface, will be a Parabola, whose Diameter is *A B*.

The Tangent Plane also, *S a f*, forms in the Plane *A P M* (by *Prop*. 5.) a Tangent, as *A F*, which is parallel to *M N*, as being the common Section of the two Planes *S a f*, *A P M*, which pass by the Parallels *a f*, *P M*, and consequently (by *Def*. 14.) the Right Line *P M*, is an Ordinate to the Diameter *A B*.

2. When the Section is to be an *Ellipsis* or *Hyperbola*.

Draw thro' the Point *a b*, 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

Fig. 9.

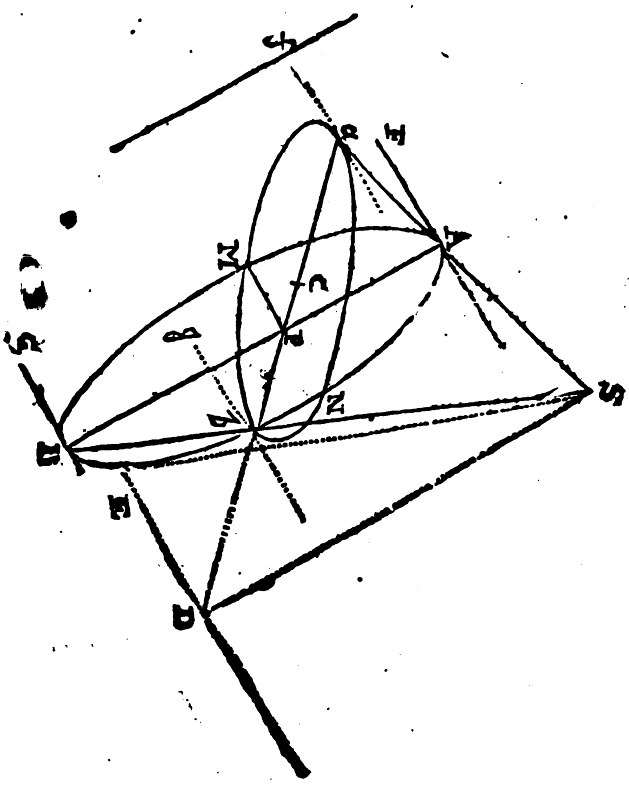
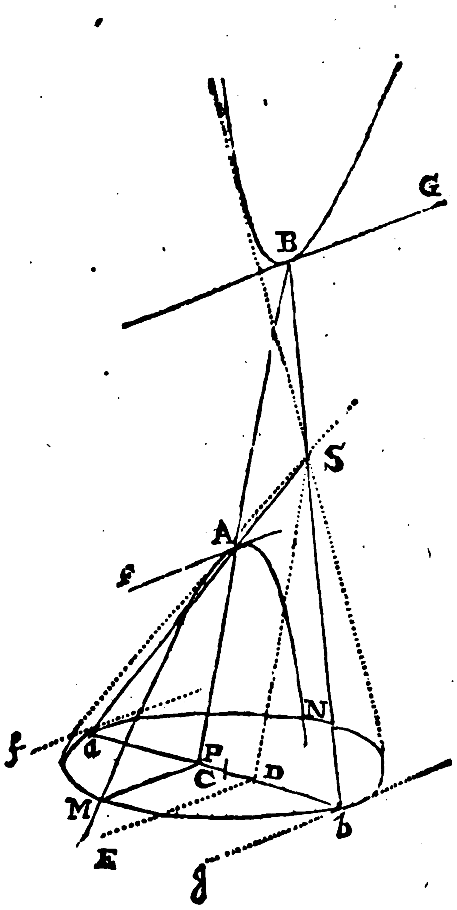


Fig. 19.



Vertex may be that Point *S*, and its Base the Circle *a M b N*. Then, I say, that the Plane *A P M* shall form, in this Conick Surface, the Section *M A N* required.

For drawing *S D* parallel to the Diameter of the Section *A B*, 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*, *a f*, and *b g* to *P M*: Then 'tis apparent, that the Plane *S D E* shall be parallel to *A P M*; and that *D E* (by *Def*. 9.) shall be the *Directrix*.

But in the *Ellipsis*, the Point *D* falls without the Diameter *a b* produced beyond the ☉, 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 *Ellipsis*, and in the latter, an *Hyperbola*.

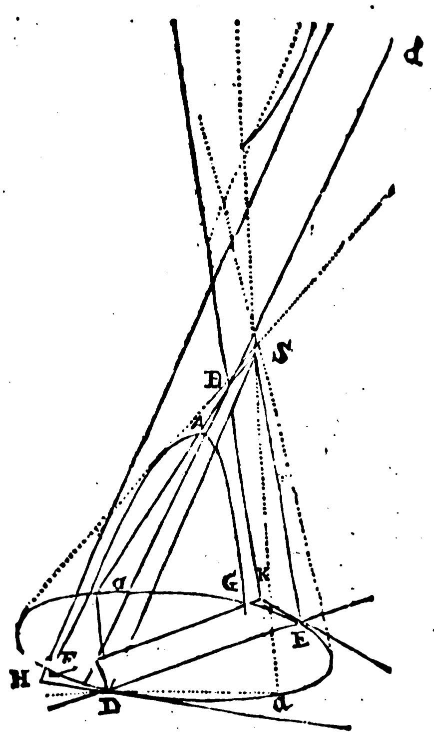
The Tangent *A F* passing thro' *A*, the Extremity of the Diameter *A B*; being the common Section of the Tangent Plane *S a f*, and the Intersecting Plane *A P M*, which passes thro' the Parallel *a f* and *P M*, will be parallel to the Ordinate *P M*; and for the same Reason also, the Tangent *B G* will be parallel to *P M*, for that is the common Section of the Tangent Plane *S b g*, and the Secant Plane *A M P*, which pass by the two Parallels *b g* and *P M*, shall be parallel to *P M*. Wherefore the Line *A B* (by *Def*. 13, 14.) is a *Diameter*, whose Ordinate is *P M*.

It may happen in the *Ellipsis*, that the Line *A a* and *b B* may be parallel to one another; but there can be but only one Point in the Line *a b* 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, *S D H* and *S E K*; which shall cut the Surface of the Cone in the Right Line *C H* and *C K* infinitely produced: Then are those Lines, *C H* and *C K*, called *Assymptotes*.

CONSECTARY I.

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, *S D H*, can have nothing common with the opposite Conick Surfaces, but the Side *S D*, because the Points of the Tangent *D H* fall without the Periphery of the Base of the Cone, but only *D*. But the Plane *S D E* passing thro' the Vertex *S*, and the Directrix *D E*, being parallel to the Planes of the opposite Sections; the common Sections, *S D* and *C H* of those Planes, with the same Plane *S D H*, must be parallel to one another: And therefore the *Assymptote 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 *Assymptotes C K*: But as two *Assymptotes C H*, *C K*, are formed by the Plane *S D H*, *S E K*, 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, since the Lines *B A* and *S D* 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 passes 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*, *S D*, will form in the two Conick Surfaces, two Sides; of which, one is *S D*, and the other the Side *S a*, which must necessarily cut the Line *B A*, in some Point, as *A*; because it lies in the Plane which passes thro' the Parallels *S D*, *A B*; 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 Hyperbolæ. And since the Line *B A* being infinitely produced on the Side of the Point *A*, falls entirely in the Plane *D S a*, contained between the Sides *D S*, *S a*; therefore the Point *A* will be in the Hyperbola *F A G*, and in the vertically opposite one *A S D*, when it belongs to the opposite Hyperbola: 'Tis apparent, it must always fall within *one* of the two Conick Surfaces; and consequently 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 *C B* becomes, the more or farther the Point *A* will get into that Space, and this still more and more, till *C B* 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.

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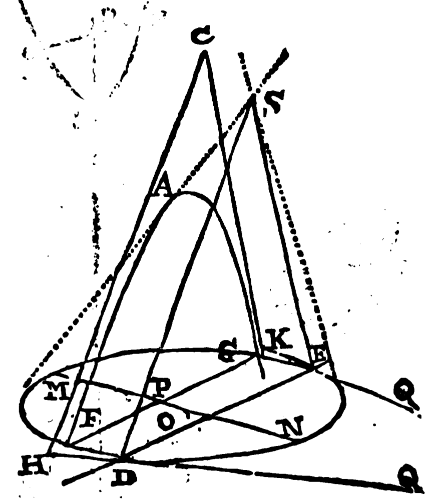
PROP. VIII. Problem.

C H and C K, the Assymptotes of an Hyperbola, F A G, 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

Fig. 12.



(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 Contact *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 bissected in the Point *P*, by the Diameter *MN*, which is perpendicular to it. Wherefore since $PH = PK$ (by the Construction) FH must be $= GK$, and $GH = FK$; and consequently $GH \times HF = FK \times KG$.

2. From the Circle also it follows, That $GH \times HF = \overline{HD}^2$, and $FK \times KG = \overline{KE}^2$; and consequently $HD = KE$.

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.

'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* 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, as* 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.

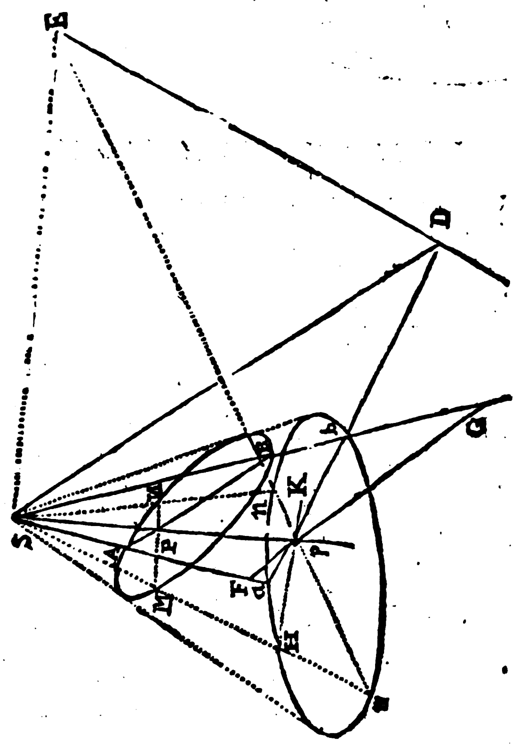
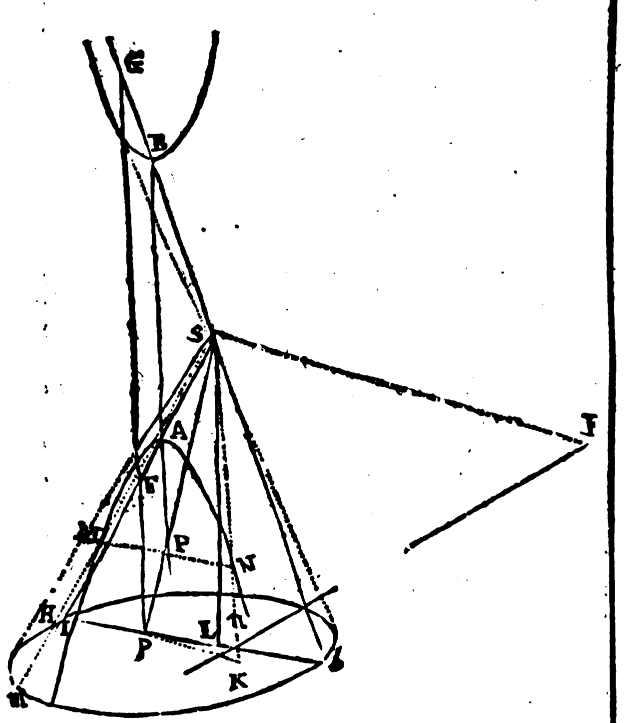


Fig. 14.

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^2 SP^2 :: ▭ APB, ▭ FpG. Alſo the ▭ MPA, ▭ APB :: ▭ HpK ▭ Fpg: But the Ratio of the ▭ HpK to ▭ FpG, is compounded of two Ratio's of $Hp \times pK$ to $mp \times pn$; and of $mp \times pn$; or by the Property of the Circle, $ap \times pb$ to $Fp \times pG$.

But becauſe of the ſimilar Triangles, Hpm, SEm, and Kpn, SEn: It will be Hp, mp :: $SEmE$, and pK, pn :: SE, En.

And then multiplying the Antecedents and Conſequents of thoſe Ratio's, $Hp \times pK$, $mp \times pn$ :: SE^2 $mE \times En$.

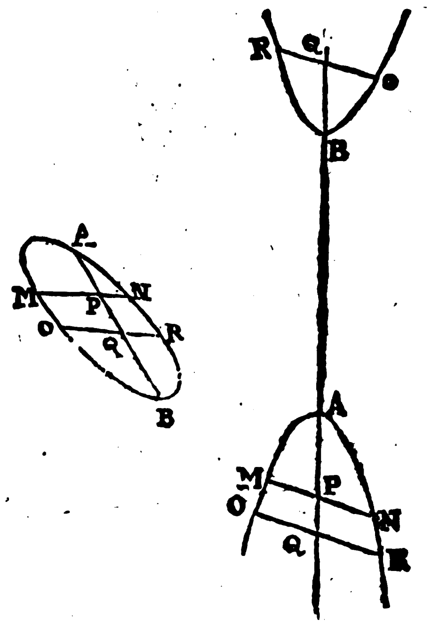
It may be proved alſo from the Similarity of the Triangles Fpa, SDa, and Gpb, SDb: That $ap \times pb$, $Fp \times pG$ :: $aD \times Db : SD^2$.

'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 Rectangle 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.

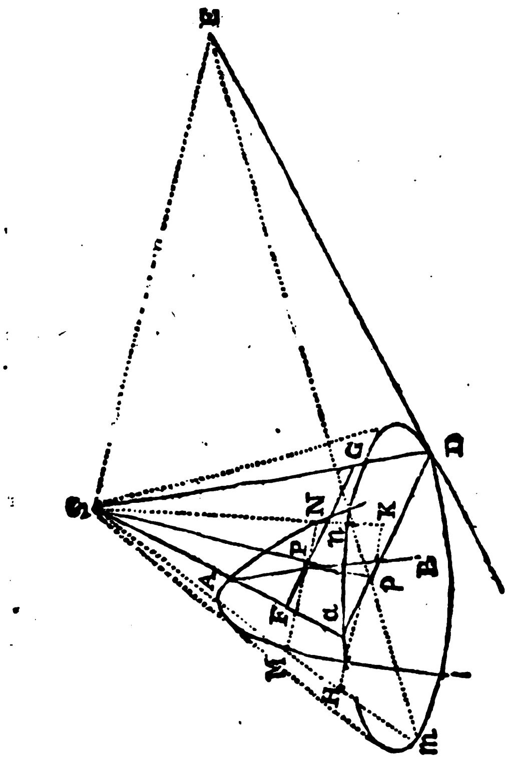
If thro' any Point, as A, *of a Parabola or Hyperbola* M A N, *a Right Line, as* A B *be drawn parallel to the Side of the Cone* S D; *(that is, being drawn in the Parabola thro' the Point* D, *where the Directrix touches the Baſe; and in the Hyperbola thro' one of the two Points where the Directrix 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 × 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.

DEMON-

DEMONSTRATION.

Thro' the Parallel SE, MN, suppose a Plane to be drawn, that will form with the Base of the Cone, the Right Line $E\,n\,m$, in the Conick Surface, the Sides SMm, SNn, and in the Plane SDa; 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.

Fig. 17.



This being suppos'd, the Similar Triangles SPM, SpH, SPN, SPK, SPE, Spa, SPG, SPD will give us these Propositions.

$\square\, MPN$, $\square\, HpK :: SP^2\, Sp^2 :: \square\, FPG$, $\square\, apD$; or (by the Property of the Circle) $\square\, mpn$.

Also the $\square\, MPN$, $FPG :: Hpk$, mpn.

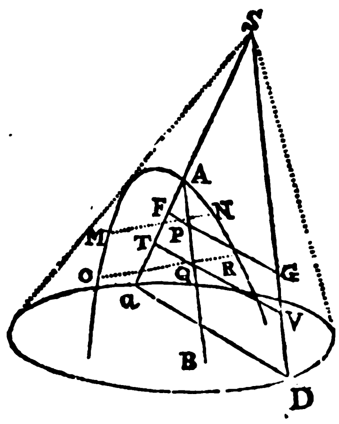
But the Ratio of $\square\, Hpk$ to the $\square\, mpn$, is compounded of the two Ratio's of Hp to pm, and of pk to pn: That is, (because of the Similar Triangles, Hpm, SEm, and Kpn, SEN) of the two *Ratio's* of SE to Em, and of SE to En; and consequently HpK, mpn, or MPN, $FPG :: SE^2\, \square\, mEn$.

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 $\square\, FPG$ in a given Ratio. *Q. E. D.*

CONSECTARY.

Hence 'tis 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 Parallel to one of the Assymptotes, as AB, be drawn, and that thro' any two Points, $a\,P\,Q$, in that Line AB, two Parallels, MN, OR, be drawn and terminated by that Section, or by the opposite Sections; it will always be $\square\, MPN$, $\square\, OQR :: AP$, AQ.

Fig. 18.



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 Righr Lines FG, TV, parallel to Da: 'Tis plain, in the precedent Proposition, that $\square\, MPN$, $FPG :: OQR$, TQV; and then alternately, $\square\, MPN$, OQR, $:: FPG$, TQV. But the Parts PG, QV, are equal to one another; because the Lines AB, SD, are parallel: And moreover, $\square\, MPN$, OQR, $:: FP$, TQ, $:: AP$, AQ; by reason of the Similar Triangles, APF, and AQT. Wherefore $\square\, MPN$, must be to $\square\, OQR :: AP$, 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 consider 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.

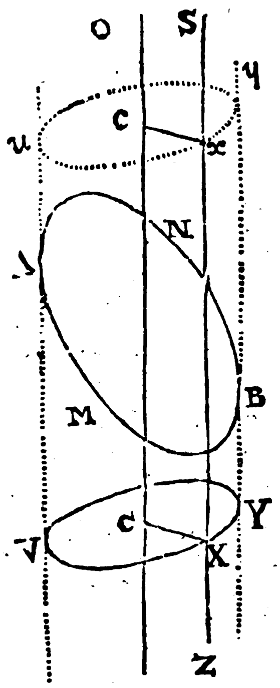
Of

Of the Ellipsis *in Particular.*

DEFINITIONS.

XVII. If an Infinite Right Line, as *S z*, which is without the Plane of the Circle *V X Y*, be moved with one of its Points *X*, quite round the Circumference 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*.

Fig. 19.



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 *V X Y*, is called the *Base*.

XX. The Infinite Line *C O*, drawn from the Centre of the Base *C*, and parallel to the Sides, is called the *Axis*.

XXI. The Infinite Solid, comprehended under the Base *V X Y*, 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 *A M B N*, formed by the Intersection of that Plane with the *Cylindrick Surface*, is called a *Cylindrick Section*.

PROP. XI.

If a Cylinder *be cut by a Plane, (see* Fig. 147.) *as* u x y, *parallel to the Plane of its Base* V X Y; *the Section* u x y, *shall be a Circle, whose Centre shall be the Point* c, *where that Plane intersects the Axis: and its Radius shall be the Right Line* c x = C X, *the Radius of the Base.*

DEMONSTRATION.

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 *C c*; (by *Def.* 20.) wherefore a Plane may be made to pass through these two Lines, which by its Intersection with the two parallel Planes *C V X Y*; and *c u x y* will form the two Right Lines *C x* and *c x* parallel to one another; and which also might be equal to one another, because they are terminated by the two parallel and equal Lines, *C c* and *X x*.

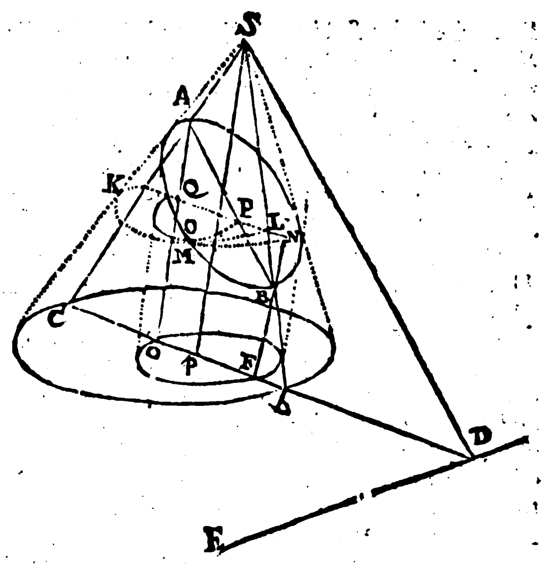
But as this must always be the Case in what Point soever of the Section *u x y*, *x* be taken: It will follow, that the Lines *c x*, drawn from the Point *c*, to all the Points *x*, of the Section *u x y*, are equal to all the *Radii*, *C X*, of the Base; (*i. e.*) the Section *u x y*, must be the Circumference of a Circle, whose Centre is *c*, where the Plane *u x y* cuts the Axis of the Cylinder, and its *Radius* is *c x*, a Line = *C X*, the *Radius* of the *Base*. *Q. E. D.*

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 *a b*, which shall be at Right Angles in the Point *D* with the

Fig. 20.



Directrix D E: Let there be drawn also in the Conick Surface, the Sides *S a*, *S b*, meeting the Plane of the Ellipsis in the Points *A* and *B*, and draw also in the parallel Planes *A M B*, *S D E* the Right Lines *A B*, *S D*.

Then taking *D F*, a mean proportional between *a D* and *D b*; and drawing to *S F*, the Parallels *A G*, *B H*: Let a Circle be described on the Plane of the Base, whose Radius shall be *G H*; and on that Circle let a Cylindrick Surface be formed, whose Sides shall be *A G*, *B H*.

This done, I say, that if through any Point, as *P*, in the Line *A B*, you draw a Parallel to the *Directrix*

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rectrix D E, 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 *Prop.* 2.) whose Centre will be the common Section of that Plane, with the Axis of the Cone; and in the Cylindrick Surface, another Circle, *Q M R*, (by the Precedent) whose Centre will be the common Section of the same Plane *S a b* (by *Def.* 6.) passes thro' the Axis of the Cone; and the Plane A G H B, (which is co-incident with the Plane *S a b*) passes thro' the Cylinder, (by *Def.* 20) and consequently the Lines *K L* and *Q R*, 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 P M, will be the Diameter of the Two Circles; and that Line P O M, shall be Normal to those Diameters, because 'tis parallel to D E, 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 *K L* and *Q R*, (which also must be coincident) are parallel.

Moreover, the Lines *A B*, *S D*, being formed by the Intersection of the same Plane, *S a b*, with two others which are parallel, (and with the Plane *S D E*, and that of the Ellipsis) must be parallel to one another.

Which being well understood, it will follow:

1. That in the Cone, because of the Circle *K M L*, you will have $PM^2 = \square\, KPL$, and because of the Similar Triangles *A P K*, *S D a*, and *P B L*, *S D b*; you will have those Proportions: $AP,\ PK :: SD,\ aD$, and $PB,\ PL :: SD,\ Db$; whence it will follow, $AP \times PB,\ KP \times PL$ (or PM^2) $:: SD^2\ aD \times Db$.

2. In the Cylinder, because of the Circle *Q O R*, $PO^2 = \square\, QPR$, and from the Similar Triangles, *A P Q*, *S D F*, and *P B R*, *S D F*; these Proportions will arise, $AP,\ QP :: SD,\ DF$, and $PB,\ PR :: SD,\ DF$: Whence it will follow, 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 consequently the Points *M* and *O* will be coincident: And because this will always be the Case in what Part soever of the Line *A B*, 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.

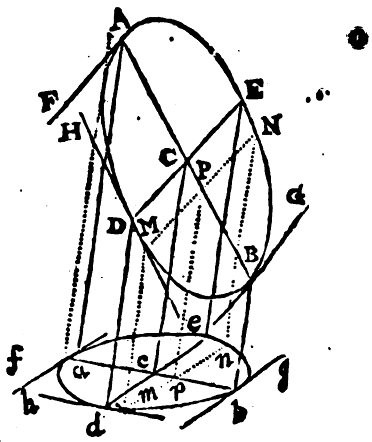
PROP. XIII.

All the Diameters of the Ellipsis pass thro' one only Point: Which is that where the Plane of the Ellipsis cuts or intersects the Axis of the Cylinder, and do there bisect one another: And conversly, all Right Lines passing thro' that Point, and terminated at each End by the Ellipsis, are bisected in that Point, and are also Diameters of the Ellipsis.

They call that Point the *Centre* of the *Ellipsis*.

1. Let *A B* be any Diameter whatsoever; so let *C* be the Point where the Plane of the Ellipsis

Fig. 21.



intersects the Axis of the Cylinder. If you draw the Lines *A a*, *B b*, parallel to the Axis *C c*, 'tis plain (by *Def.* 20.) that they will be the Sides of the Cylindrick Surface; and that the two Planes, *F A a*, *G B b*, passing thro' those Lines, and thro' the Tangents *A F*, *B G*, (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 *A a*, *B b*. From whence it follows, that those two Planes will form in the Plane of the Base, the two Lines *a f*, *b g*, parallel to each other, and Tangents to the Base in the Points *a*, *b*; where the Sides *A a*, *B b*, intersect it.

Now from the Elements of Geometry 'tis plain, that the Line *a b*, which connects the Points of the Contact of the two parallel Tangents; *a f*, *b c*, in any Circle, must pass thro' its Centre *c*. Wherefore the Plane *A a b B* will pass thro' the Axis of the Cylindrick; and the Line *A B*, 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, by reason of the Parallels *A a*, *C c*, *B b*, 'tis plain, that the Diameter of the Ellipsis *A B*, is divided into two equal Parts, or bisected in *C*; because the Diameter of the Circle of the Base *a b*, is bisected in its Centre *c*, which was the first thing to be prov'd.

2. If thro' the Extremities of any Line, as *A B*, passing thro' *C*, where the Plane of the Ellipsis cuts the Axis *C c* of a Cylinder, you draw the *A a*, *B b*, parallel to that Axis, 'tis plain, (from *Def.* 17.) that they will be the Sides of that Cylinder; and that the Plane *A a b B*, must pass thro' its Axis. Whence you see, that the Line *a b*, which is the common Section of the Plane, and of the Plane of the Base, passes thro' *c* the Centre of the Base; and also that it is cut into two equal Parts, the Line *A B* must also be bisected in *C*.

Again, the Tangents *a f*, *b g*, 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, *A c*, *B G*, which shall be Tangents to 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 'tis evident, that through any one Point given in the Plane of an Ellipsis different from its Centre, there can one only Diameter be drawn.

PROP. XIV.

Every Ordinate MPN (*See* Fig. 149.) *of an Ellipsis is bisected in the Point* P, *by the Diameter* AB, *and conversly.*

If a Right Line, as *MPN*, terminated within an Ellipsis, and not passing thro' its Centre *C*, is bisected in the Point by a Diameter, as *AB*, it shall be true Ordinate on each Side of that Diameter.

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 *AabB* 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 Base a Line, as *ab*, 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 consequently the Tangent Planes, *FAa*, *GBb*, will be parallel to the Plane *MmnN*; wherefore the three Lines, formed by those three Planes, by their Intersection with the Plane of the Base, as *af*, *bg*, and *mn*, must also be parallel; and consequently the Line *mn* will be Normal to the Diameter *ab*, and therefore will be bisected by it in the Point *p*; wherefore, because of the Parallels *Mn*, *Pp*, *Nn*, it will follow, that the Line *MN* must also be bisected 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.* 13, 14.) that from the Right Line *MN*, will be an entire Ordinate to that Diameter, and consequently will be bisected 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 *MN*, 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* AB.

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*, *DdeE*, 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 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 *dh*, that will be parallel to *ab*, and the Plane *hdD*, to the Plane *AabB*. 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 shall 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 *Consect. 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 AC^2 : : $\frac{DC^2}{4}$ (or DE^2) $\frac{AC^2}{4}$ (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.

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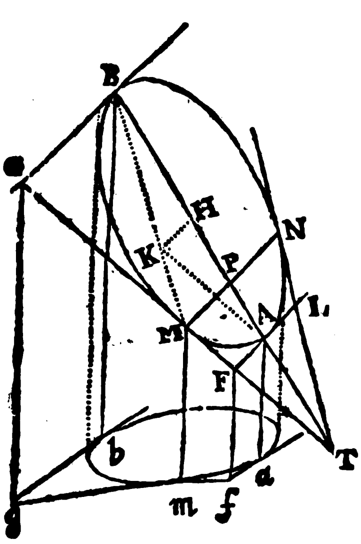
PROP. XVI.

If thro' any Point, as M *in an Ellipsis* A M B, *and Tangent* F M G *be drawn, which in the Points* G F, *shall intersect any two parallel Tangents, as* A B, B G; *I say,* F M, M G : : A F, B G.

For, drawing thro' the Points of Contact, *A*, *B*, *M*, the Sides *A a*, *B b*, *M m*, of the Cylinder; and thro' these Sides, and the Tangents *A F*, *B G*, F G, drawing the Planes *F A a*, G *B b*, *F M m*,

Fig. 22.



or G *M m*: 'Tis plain, that *Ff*, G *o*, 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*, *F A 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 G *o*, 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 *F a*, G *B b*, with that of the Base being parallel: The Parts *f m*, *m o*, 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 *m o* parallel *o b*.

Which being supposed, by reason of the Right Lines *A a*, *Ff*, *M m*, G *o*, *B b*, and *A* F, *B B*, and *a f*, *b o*, which are respectively parallel to one another, you will have,

FM, *M* G : : *f m*. or *f a*, *m o*, or *g b* : : *F A*, G *B*. *Q. E. D.*

CONSECTARIES.

I. If thro' the Points of Contact *A*, *B*, of the two parallel Tangents *A F*, *B* G, a Diameter, as *A B* be drawn, which shall intersect in the Point *T*, another Tangent, as *FM* G; and if an Ordinate, as *M P*, be drawn to that Diameter; 'tis plain, that *AP*, *P B* : : *FM*, *M* G : : *AF*, *B* G : : *AT*, *B T*. And also that *P B* — *A P*, *B P* : : *B T* — *A T*, (or *B A*) *B T*.

II. From hence the following manner of drawing 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 *A B*, to give a Point *M*, let the Right Line *B M* be drawn: And then having drawn the Ordinate *M P* to the Diameter *A B*, and taken in that Diameter towards the Point *P*, a Part, as *P H* = *P A*, draw *H K* parallel to *P M*, which shall intersect the Line *M m K*; thro' which Point, and the other End of the Diameter *A*, drawing *A K*, and then *M T* parallel to it; that Line *M T* shall be the parallel required.

For on account of the Parallels *M P*, *H K*, and *A K*, *M T*; you will have *B P*, *D H*, or *P A* : : *B M*, *M K* : : *T B*, *T A*.

III. If in an Ellipsis there be two Tangents, as *M T*, *N T*, which meet in the Point *T*.

I say, the Diameter *A B*, passing thro' the Point *P*, the middle of the Line *M N*, joining those two Tangents in their Points of Contact; shall pass also thro' *T*, their Point of Intersection.

For, *P N* is an Ordinate to the Diameter *A B*, as well as *P M*; and consequently the (by *Cor.* 1.) Tangents *M T*, *N T*, must so meet or intersect the Diameter in a Point, as *T*; that *P B* — *A P*, *P B* : : *A B*, *B T*, 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 *M N* be drawn, and that it have a third Tangent, as *F A L* parallel to it: I say, that *F A*, *A L*, 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 *A B*: 'Tis plain, the Line *M N* will be an entire Ordinate to that Diameter, because it is parallel to the vertical Tangent *F L*; 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*, *N L*; or will be parallel to them (by *Prop.* 15.) when the Line *M N* is a Diameter.

But 'tis plain in both Cases, that *F L* will be bisected in *A*, by the Diameter *A B*; because *M N* is so bisected in the Point *P*, by the same Diameter.

Of the Parabola *and* Hyperbola, *particularly.*

PROP. XVII.

In the Parabola, *every entire Ordinate (as* M P N*) to a Diameter, as* A B, *is bisected by that Diameter in the Point* P, *and* vice versa.

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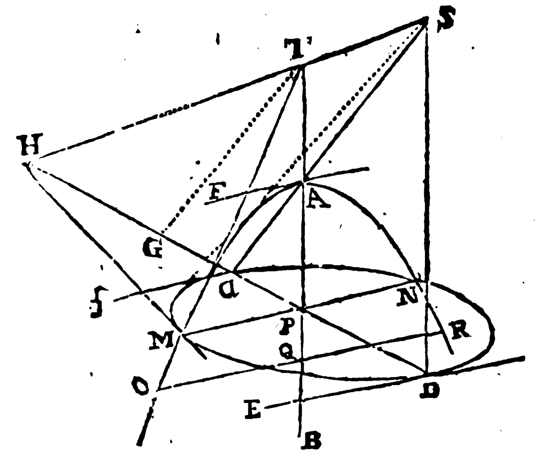
For having made an Elliptick Plane which shall pass thro' the Line MN, that will form with the

Fig. 23.



Tangent Plane SDE, parallel to the parabolick Plane, a Tangent, as DE parallel to MN.

Again, the Plane SAF, drawn thro' S the Vertex of the Cone, and thro' the Tangent AF, which passes thro' A, the Vertex of the Diameter AB, will form in the Elliptick Plane, a Tangent, as fa; and the Line Da jointly, the Points of Contact of the two Tangents DE, af, will pass thro' the Point P, because the Diameter AB is parallel to the Tangent Side SD.

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 MN, and consequently to DE. Whence it appears, that the Line Da (by *Def.* 13.) joining the Points of Contact of the two parallel Tangents DE, af, is a Diameter of the Ellipsis; and also that the Line MN, which is parallel to those 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 thro' the Point and Contact A, a Diameter, as AB, the Line MN will be an Ordinate rightly apply'd (by *Def.* 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 P, Q, of a Diameter AB, two entire Ordinates, MPN, OQR, be drawn; you will always have this Proportion : (by *Consect. 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 *Abcissæ* or intercepted Parts of that Diameter, AP, AQ.

PROP. XVIII.

(*See Fig.* 23.)

If thro' M *any Point in a Parabola, you draw an Ordinate* M P, *to any Diameter* A B, *and also a Tangent* M P, *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 MH, which will cut the Diameter of the Ellipsis uD, in a certain Point as H, thro' which the Line SU passes : And lastly, let the Right Line TG be drawn parallel to SA.

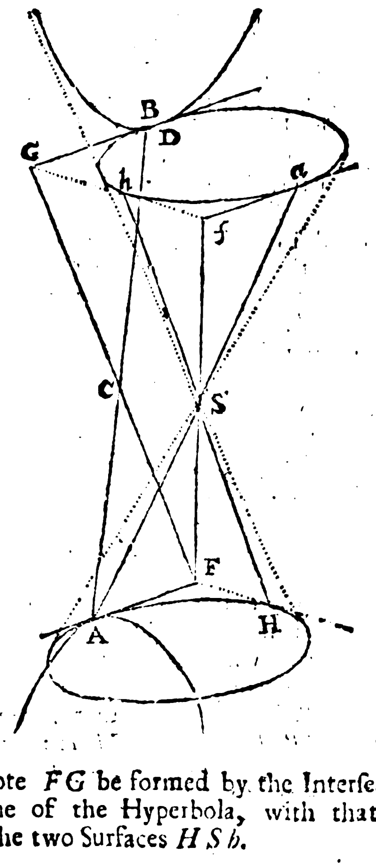
This being well understood, you will have (by *Cor.* 1. *Prop.* 16.) DH, $Ha :: DP$, Pa, and alternately DH, $DP :: Ha$, Pa. But by reason of the parallel Lines AB, SD, and SA, TG: 'Tis plain, that $DH\,DP :: SH\,ST :: Ha\,Ga$; wherefore Ha, $Pa :: Ha$, Ga; and consequently $Pa = Ga$; and therefore $AP = AT$. *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 HSh be one of the two common Sections of a Plane parallel to the Hyperbolick Plane, and the two opposite Conick Surfaces, and let the

Fig. 24.



Assymptote FG be formed by the Intersection of the Plane of the Hyperbola, with that which touches the two Surfaces HSh.

Let

Let there be drawn thro' the parallel Tangents AF, BG, which pass thro' the Ends of the Diameter AB, and intersect the Assymptote FG in 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 FH, Gb, being contained between the two other parallels FG, Hb, will be equal. And the similar Triangles, SHf, Sbf, and SFA, Sfa, will give HF, bf :: Sf, sf :: FA, fa; and also HF, FA :: bf, fa :: (by *Prop.* 16.) to GGB. And hence, because HF, HG; it will follow, that $AF = BG$, and because of the similar Triangles, ACF, BCG; it will follow, that $AC = CB$: That is, the Assymptote FG, bisects the Diameter AB in C.

The same thing may be proved of the other Assymptote, that it shall pass also 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 *Consect* 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 with 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.

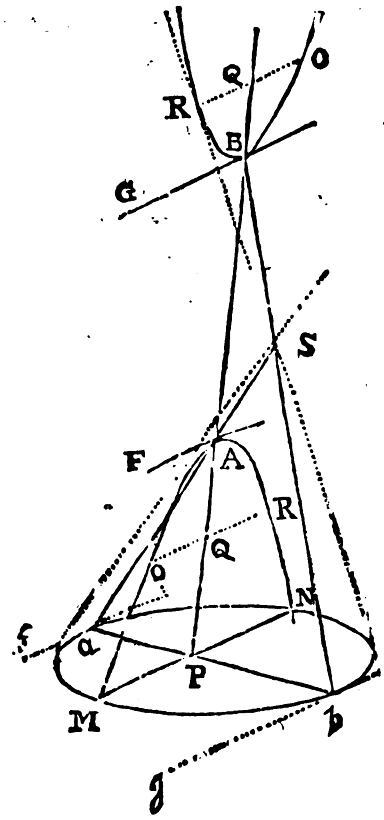
Hence you see that from any Point given within an Hyperbola, there can be but one only Diameter drawn; because no other Line can pass through that Point, and thro' the Centre.

PROP. XX.

In the opposite Hyperbola's, every entire Ordinate MPN, *is bisected in* P, *by its proper Diameter* AB; *and* vice versa.

Having made an Elliptick Plane to pass thro' the Line MN; it will form in the two Tangent Planes, SAF, SBG, the Tangents af, bg.

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 SAB, 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 MN.

For the same Reason, the Tangent bg, which is the common Section of the Elliptick Plane, and of the Tangent Plane SBG, which two Planes do pass thro' the two parallels MN, BG, will be parallel to MN.

The Tangents then, af, bg, 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 MN 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 P by a Diameter AB; it must be an *entire Ordinate*, and rightly applied in that Point.

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CONSECTARY.

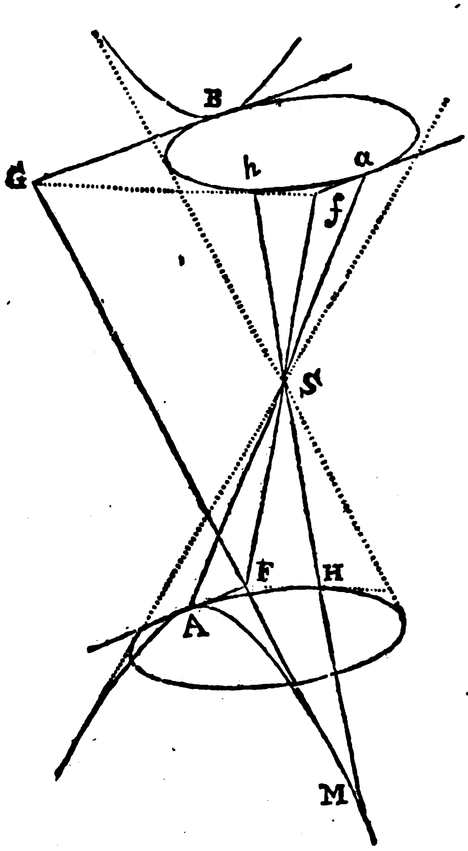
Hence 'tis apparent, that if you rightly apply two entire Ordinates MPN, and OQR, to one and the same Diameter; it will always be (by *Consect. Prop.* 9.) $MP \times PN$, (or PM^2) $OQ \times QR$ (or OQ^2) :: $AP \times PB$, $AQ \times QB$.

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; *I say, that* M F, M G :: A F, B G.

Drawing two elliptick and parallel Planes, which shall pass thro' the Tangents AF, BG, they will form in this Tangent Plane SMG, two Tangents

Fig. 26.



HF, hG, 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 hg in the Point f, where the Line SF cuts the Elliptick Plane.

This being laid down or supposed: The Tangents af, BG, will be parallel, because each is so to the Tangent AF. And therefore (by *Consect.* from *Def.* 15.) you will have BG, Gh :: af, fh, (and because of the similar Triangles Shf, SHF; and Saf, SAF) :: AF, FH: Wherefore BG, AF :: Gh, FH (*i. e.* because of the similar Triangles MGH, MFH) :: MG, FG. *Q. E. D.*

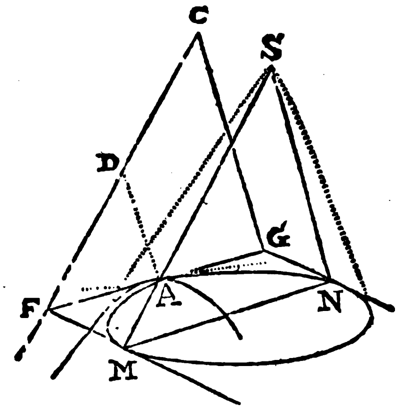
N. B. 'Tis evident, That from this *Prop.* the same Corollaries may be drawn, as are in the Ellipsis (from *Prop.* 16.): And therefore there is no need to expose them at length here.

PROP. XXII.

If a Right Line F G, *terminated between the Assymptotes of an Hyperbola, touch the Curve in a Point at* A, *it will always be bisected 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

Fig. 27.



Def. 16.) in the Sides SM, SN, where the Plane MSN, parallel to the Hyperbolick Plane, intersects 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 *Consect.* 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 CF, CG, are given, a Tangent, as FAG; you need only draw AD parallel to one of the Assymptotes CG, and terminated by the other; and having then taken DF = to CD, draw the Line FAG, 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.

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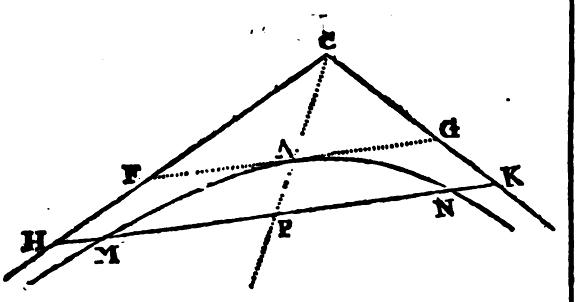
III. If any two Points MN, within an Hyperbola, be joined by a Right Line, as MN, intersecting the Assymptotes in the Points HK: Then

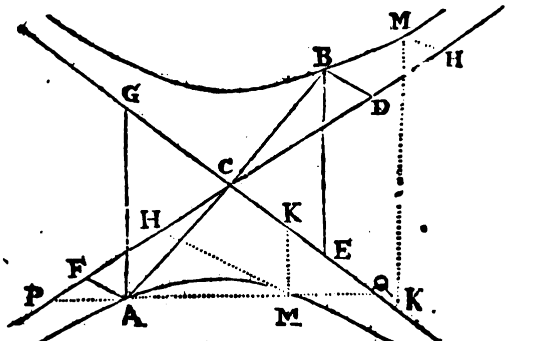
Fig. 28.



will the two Lines MH, NK, being the Parts of MN, lying between the Curve and its Assymptotes, be 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.*

Fig. 29.



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.

For,

1. When the Points AM, fall in one and the same 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 AB, and also the two Right Lines BD, BE, parallel to AF, AG, and terminated by the same Assymptotes; 'tis evident, that the Triangles CAF, CBD, and CAG, CBE, being not only Similar, but also respectively equal one to another, because $CA = CB$, (by *Prop.* 19.) Therefore $BD = AF$, and $BE = AG$, and consequently $BD \times BE = FA \times AG$. But from the former Case, $KM \times MH = DB \times BE$; wherefore now also $FA \times AG = KM \times HM$.

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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 prov'd 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 Circle 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 $\surd : ar$ 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 $2\surd : ra$ and its Periphery $2\surd rae$; and by multiplying the Periphery $2\surd : rea$ into $\frac{1}{2}\surd ra$, 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 by having the Radius 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.

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CONJUGATE *Diameters*, in respect of one another in the Ellipsis, are such as are parallel to Tangents meeting the Curve in each others Vertexes.

Conjugate Sections. See *Sectiones 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 Glossar.*

CONSISTORY, is the Court Christian, or Spiritual Court. This was held formerly in the Name 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 compos'd. 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.

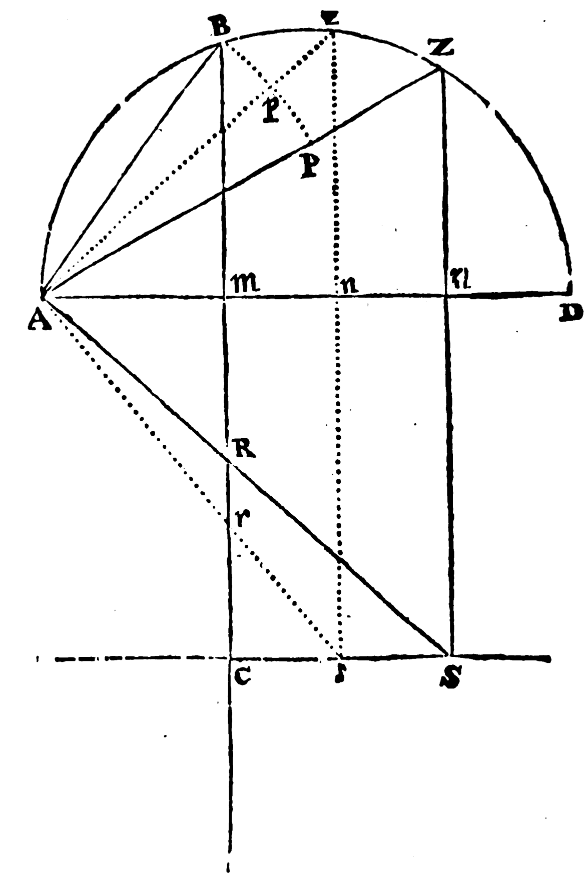
In order to this Method of Construction, I consider each Side of the Equation, as the Product of two Multipliers, the one of two Dimensions, the other of one, (each Term in a Cubick Equation being supposed of three Dimensions.) *E. G.* In this Equation $xxx + pxx = n$; I consider it as in this Form $\overline{xx} \times \overline{x + p} = n = b^2 \times c$, ($b$ being taken at pleasure for any Number whose Square is less than n divided by bb gives c.) Or else in this Form, $\overline{xx + px} \times x = n = b^2 \times c$; 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 x the Multiplier of two Dimensions, and y for x in the other of one Dimension; and then the former Equation will stand thus $zz \times \overline{y + p} = b^2 \times c$; or (the other way,) $\overline{zz + pz} \times y = b^2 \times c$. 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 z) to represent 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 ABD, be a Semi-circle on the Diameter AD, AB and AZ, two Subtenses drawn at pleasure from the end of the Diameter A, from B and Z are drawn the infinite Lines B C and ZS perpendicular to AD, B C 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 $ABq : AZq :: mR : NS$.

Fig. 1.



For (by the Nature of a Circle) $DA \times mA = ABq$, and $DA \times nA = AZq$; then $DA \times mA : DA \times nA :: mA : nA :: mR : nS$; 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 a Cubick Equation reduc'd into the Form above directed) then will mR be equal to the other Multiplier of one Division. So in the first Form above, ($zz \times \overline{y + p} = b^2 \times c$) if $AZ = z$, then is $mR = y + p$, and in the Second Form $\overline{zz + pz} \times y = b^2 \times c$, if $AZ = \sqrt{zz + pz}$, then is $mR = y$, and if $y = z$, then $z = x$ in the given Equation.

Example I.

Suppose I would construct this Cubick Equation $xxx - 4xx = 72$, or $xxx - pxx = n$. I take 16, as a convenient Square Number, (which I call bb) and therewith I divide 72; the Quotient

Quotient is $4\frac{1}{2}$ 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 'tis $zz\times\overline{4-p}=72=16\times4\frac{1}{2}$, 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 m.

I take $4\frac{1}{2}$ ($=c$) off the Scale, and set that Distance with the Compasses from m to C, and thro' C I draw CS parallel to AD.

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 a venture) draw the Chord Az ($=z$) intersecting the Arch Pp in p; so is $Ap=p=4$, and the Line $pz=z-p$ or $z-4$. From z I draw ZS perpendicular to CS, and intersecting it in S, and then the Line AS intersecting MC in r. So is $Mr=y-4$. or $y-p$, (the other Multiplier in the Equation) which being greater than the Line pz (to which it should be equal, it shews that z was taken too little.

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 ($=z-4$) $=MR$ ($=y-4$) consequently $Z=y=x$, z taking from the Scale, is equal to 6, the Root sought.

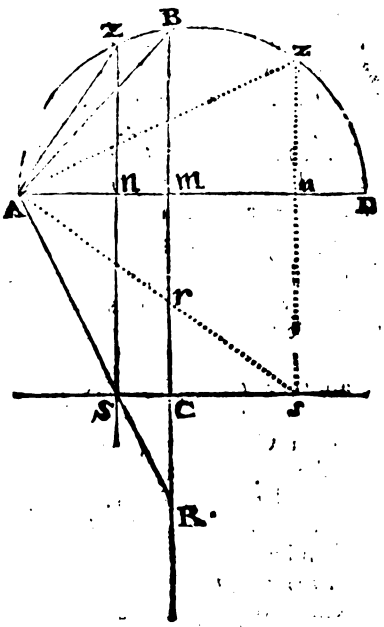
The same Conclusion would follow if I had inverted the Order of proceeding, and had begun with Mr, and thereby found Az (in a first tryal,) for in this Case I must have taken a Line for y (by guess) and made $mr=y-p$, and then having drawn AS intersecting mC in r, and CS in S. Also SZ parallel to BC, 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.

Suppose I would find the Root of this Equation $xxx-3xx+2x=24$. or $xxx-p2x+qqx=n$. I take for bb, 9. by which dividing 24, it gives $C=2\frac{2}{3}$, and then I put the Equation into this Form $\overline{zz-pz+qq}\times\overline{y-bb}\times C$.

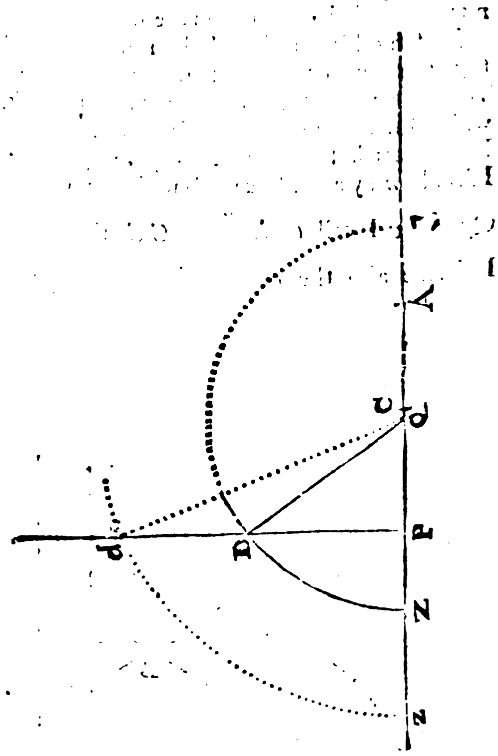
In the Semicircle ABD I draw the Chord $AB=b=3$. BC perpendicular to AD. $mC=C=2\frac{2}{3}$. CS parallel to AD.

Fig. 2.



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,

Fig. 3.



&c. are Lines taken by guess for z. zd, ZD, &c. are Arches of Circles drawn with Centre C and Radius Cz, CZ, &c. So are Pd, PD, &c. $=\sqrt{zz}$

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$\sqrt{zz-pz}$, and dQ, DQ &c. $=\sqrt{zz-pz+qq}$ (For continuing the Arch ZD (for Instance) to ζ in the Diameter; $ZA\ (=P\zeta)=z$. $PZ=z-p$. Therefore $PD\ (=\sqrt{P\zeta\times PZ})=\sqrt{z\times z-p}=\sqrt{zz-pz}$. And PQ being $=q$. DQq. $(=DPq+PQq)=zz-pz+qq$. 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 $mr=y$, 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 $6=x$.

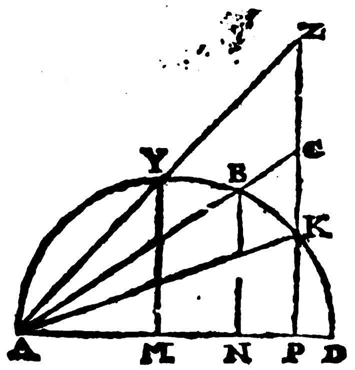
For another *Example*, may be propos'd the doubling of the Cube; that is, having the Root or Side of a Cube given, to find another Line whose Cube shall be double the former Cube. In this Case, let $A\beta$ (*Fig.* 1.) be the Side of the given Cube; $mC=2AB$, $Az=z$, the sought Root taken by guess, by 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. $AB\times ABq=2AB$, cub. $=Azq\times mr=Az$ cub. (when $Az=mr$.)

Several things might be added conducing to a more ready determining of the Root sought; 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^2 the Quotient I call CC, $\frac{n}{bb}=CC$, then $n=b^2C^2$. I divide also the other Side of the Equation into two Multipliers, *viz.* $x^2\times\overline{2x^2+px+qq}=b^2\times C^2$, whence $x\times\sqrt{x^2+px+qq}=b\times C$. Or, Substituting y and z for x (as I do in Cubes) while x is unknown) $q\times\sqrt{zz+pz+qq}=b\times C$. 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 ZCP perpendicular to AD, and applying $AZ=\sqrt{zz+px+qq}$, so is the intercepted Chord $AY=y$, and if $y=z$, then is either equal to x, the Root sought. Else Trial must be made with another x.

I might have taken the Biquadratick Root of n, and then $b-c$, to which the Diameter AD must have been equal; the Demonstration depends on this, that $AY\times AZ=AB\times AC$, which I thus prove, (having drawn AK to the Intersection of



ZP with the Semicircle) $ABq : AKq :: (An : AP ::) AB : AC \therefore AB\times AC=AKq$. By a like Reason $AYq : AK :: (AM : AP ::) AY : AZ \therefore AY\times AZ=AKq=AB\times AC$.

The same Method will hold for compleat Biquadraticks, but will be too operose.

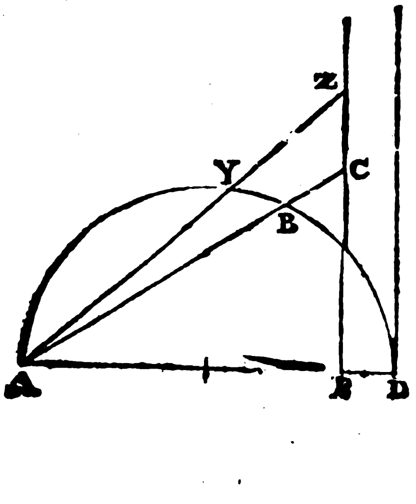
See Mr. *Halley*'s Construction of Cubicks and Biquadraticks, in *Phil. Trans.* N°. 188, 190. As also *Bernoulli*'s Animadversions on the *Cartesian* Geometry, in the *Act. Erud. Lip.* 1. for *June* 1688. And his *True Geometrical Construction of Solid, and more than Solid Problems by Right Lines and 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 signifies 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 say,



say '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 Stones, are found on the Sea-shore in *Essex*, *Hampshire*, and so *Westw rd.* 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 sadder 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-coal.

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, whereby 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 considerable Quantity of Liquor; and before that, the Liqour which they yield is but weak.

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 hastned. Thus the old Earth never becomes useless.

The Cistern before-mentioned, is made of strong Oaken Boards, well joined and calked. That 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 in the middle, by Oaken Boards calked as before; whereby one of them may be mended in case of a Defect.

The more Rain falls, the more but the weaker will be the Liquor: The goodness whereof is tried by Weights prepared for that purpose. Fourteen-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-Castle* 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 soon it will gather and crust about the Sides thereof. But now of late, by the Ingenious Contrivance of Sir *Nicholas Crisp*, the Work is much facilitated. For at his Work at *Dep:f.rd*, 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 10 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 with 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 slowly, they put in more Iron, which will soon 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 the Bottom, made of Terras. Into this they let the Liquor run so soon as it is boil'd enough. The Copperas herein will be gathering or shooting 14 or 15 Days, and gathers as much on the sides

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as in the Bottom; *sc.* 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 signifies 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 *Picts* 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 Laminæ, 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 *Præputium* begins.

CORONARE *Filios*, The ancient 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 rising in several Branches from the *Testes*, tends towards the *Abdomen* in the Production of the *Peritonæum*, 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 setting the Watches and Centries, and relieving them; and who sees that 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 Newton* 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 Execrations, 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 engag'd the *Carthaginian* Fleet, and was framed (as *Polybius* describes it, *Lib.* 1.) after this manner.

On the *Prow* of their Ships they erected a round piece of Timber about 1½ 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 sort 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 *Carthaginians*, 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, signifying 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 Position.

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-Work*.

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 Consistories: But they were also the Rural Chapters where the Rural

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Rural Dean or Dean of Christianity presided, and the Clergy were Assessors and Assistants. Dr. *Kennet's Glossary*.

CRASIN-*Mill*; See *Craze-Mill*.

CRAYONS, are Pencils of several Colours made purposely to paint withal: They are chiefly used in Portraicts; and Pictures done after this way of Painting, are said to be done with *Crayons*.

CRAZE-*Mill*, or *Crazing Mill*, is a Mill (in all respects like a Grist Mill to Grind Corn) and is so call'd by the Tin Miners, who use it to Grind their Tin, which is yet too great, after Trambling; and then 'tis Trambled only; See Tin.

CRIMEN *Ambitus*, is getting into Publick Offices by Bribing with Money or other Gifts, or by Canvasing with Intreaties; as the Civilians Define 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 consists in three points, *Corruption of Truth*, *Deceit*, and *Damage* to another.

Crimen fraudatæ annonæ, 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 applying to any Use at all.

CROOTES, is a Substance found about the Oar in the Lead Mines in *Mendip*, being a mealy, white, soft Stone matted with Oar.

CROSS-*Multiplication*, is a Kind of Multiplication 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 $\frac{6}{12}$ of an Inch, by 2 Foot, 4 Inches and 6 Parts. They set the Number down thus:

	F. In. Pa.
	5 : 3 : 6
	2 : 4 : 6
Then say, twice 5 Feet is 10 Feet, which they write down first of all, as you see under Feet.	10 : : :
Twice 3 Inches is 6 Inches	: 6 : :
Twice 6 Parts is 1 whole Inch	: 1 : :
Then working with 4, 4 times 5 Feet is 20 Inches.	1 : 8 : :
Four times 3 Inches give 12 Primes, or one Inch.	: 1 : :
Four times 6 Parts or Primes give 24 Seconds or 12th of the 12th of an Inch, which makes two Twelfths.	: : 2 :
Six times 5 Feet gives 30 Inches	: 2 : 6 :
Six times 3 Inches is 18 Parts	: : 1 : 6 Seco.
Six times 6 Parts produce 36 thirds or 12ths of a Second, which makes	: : : 3 Seco.
	12 : : 6 : 9 : 9

And this Method they are very fond of (tho' it be very absurd in Reality; for to multiply Inches by Feet, &c. *i. e.* a thing of one Name or Denomination by another, is Nonsense;) 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 4 Sides square to one another about $\frac{1}{2}$ an Inch over; and each is graduated like a Line of Tangents, and to every Side belongs a peculiar Cross-piece. 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-piece 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 Distance between two Stars, or of any Star from the Moon, &c. and 'tis us'd by some to take Distances by Land.

To observe the Altitude of the Sun or Stars.

There are four Crosses belonging to the *Staff*, one called the *Tencross*, which belongs to that Side where the Graduation begins 3 *deg.* and ends with 10 *deg.* another called the *Thirty-cross*, belonging to that Side of the *Staff* where the Divisions begin with 10, and end with 30 *deg.* The Third is the *Sixty-cross*, 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 Cross, and at the Horizon with the lower End, moving or sliding 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 Staff for that Cross, 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 substract 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 Eye-End of the Staff, and a Shoe of Brass to the End of any of the Four Crosses, which will serve instead of a Sight Vane. Having done this, and fitted 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

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the Horizontal Vane at the End of the Brass; 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 Ninety-cross 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 *Joggle-piece*.

CRUCIFORM *Hyperbola*, is a Curve by that Name; which is so called by Sir *Isaac Newton*, because 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. *4to.* by *Gustavus Selenus*, in 9 Books in *Fol.* printed at *Luneburgh*, 1624. *cum Fig.* by *Schottus*, in his *Schola Steganographica.* Bishop *Wilkin's Secret and Swift Messenger*.

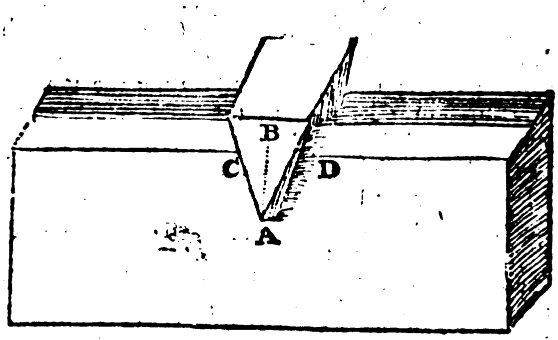
CUBICAL *Paraboloid.* See *Paraboloid* and *Curves*.

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 Indictment; which is express'd by pronouncing the Words *Cul-Prit: Cul* being an Abbreviation of the *Latin* Word *Culpabilis, Guilty*; and *Prist*, 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 *ready* to prove it upon him; this Word *Cul-Prit* is derived.

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 Praedictus A.* (the Clerk) *pro Domina Regina dicit, Quod Praedict. B.* (the Prisoner) *est Culpabili*, &c. *Et hoc paratus est verificare*, &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 *Dorsum*, 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 Altitude. In the Figure, *B A* is the way of Power, and *C D* the way of the Impediment or Resistance: So that while the Wedge is driven down into the Wood, &c. by its whole Altitude, the Wood is divided 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 divide 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 suppose 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 in different Senses. Sometimes it signified the Persons or Feudatory Tenants, who did their Suit and Service at the Court of the Lord.

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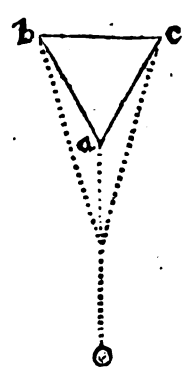
Sometimes it signified a House, as *Curia Canonicorum*, the *Convent* or *Conventional* House. *Curia Personæ Ecclesiæ*, the Parsonage House. And sometimes it was used for the Service it self, of coming to the Court of the Lord; *Curiæ adventus*. Dr. *Kennet*.

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 correct 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 *West*, take good Notice whether she alter her Latitude.

As for those *Guesses*, by the *Ripplings* of the Water, and by the driving of Froth, &c. along Shore, when you are in sight 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 sink 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 she 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, $\frac{1}{3}$ Part; if of 80 Fathom, $\frac{1}{4}$; if of 100 Fathom, the $\frac{1}{5}$ Part, &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 set 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.

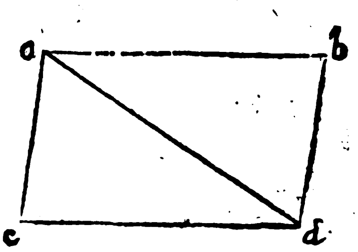
As if a Ship sail N. N. E. 20 Miles, in a Current setting the same way, and in the same time 8 Miles, her true Course will be N. N. E. 28 Miles in the same time.

But if the Current 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 sail 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 astern 10 Miles in that time.

But if a Ship sail 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 setting of the Current from *a* to *b*; the Ship will, by the Composition of those two Motions be carried from *a* to *d* in the Diagonal *a d*. See *Composition of Motion*.



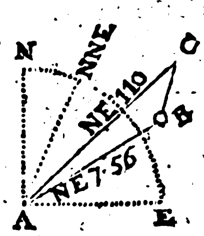
Wherefore if a Ship sails N. E. 110 Miles, in a Current which sets S. W. 30 Miles in the same time, and her true Course and Distance sailed be requird, you may proceed thus:

1st. Geometrically.

1. Set off 4 Points from N. towards E. and draw A C equal 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

Given { A C 110; 7 at C 22 30; B C 30 } and it will be by Case 4. Sect. 4.

$A+CBC : AC-BC :: t, \frac{1}{2}\angle A+B : t, \frac{1}{2}\angle B-A$, *i. e.*
As the Sum of A C and B C 140 2.1461280

To their Difference 80 4.9030900
So is the Tangent of 78° 45' 10.7013382

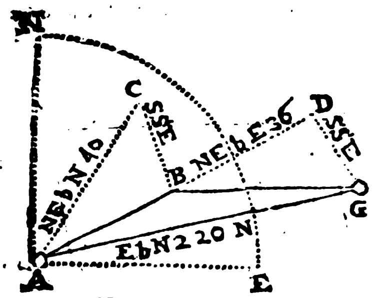
To the Tangent of 70 49 10.4583002
Now 78° 45' — 70° 49' = 7° 56' = ∠ C A B.
Hence it appears that her true Course is N E 7° 56' Easterly.
But for her Distance it will be by Case 1. Sect. 4.
s, ∠ A : B C :: s, ∠ C : A B. *i. e.*
As the Sine of the Angle at A 7°, 56' 9.1399445

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 1.9200164

Ex. 2. If a Ship from the Latitude 36° 30' S Sails N E b N 40 Miles, then N E b E 36 Miles, in a Current that sets S S E 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.

1*st.* Having constructed it, as in the former.



In the Triangle *A C B*, are Given { *A C* 40; ∠ at *C* 56°, 15'; *B C* 21, 05 } To find *A B*, and the Angles at *A* and *B*.

It will be, by *Case* the 4th of *Sect.* the 4th.
$AC+BC : AC-CB :: t, \frac{1}{2}\angle A+\angle B : t, \frac{1}{2}\angle B-\angle A$; *i. e.*
As the Sum of *A C* and *B C* 61, 05 1.7856857

To their Difference 18, 95 1.2776092
So is the Tangent of 61°, 52½' 10.2720432

To the Tangent of 30, 08½ 9.7639667
Now, 61°, 52½' — 30°, 08½' = 31°, 44' = ∠ *C A B*; 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 *Sect.* the 4th,
s, *CAB* : *CB* :: *s*, *ACB* : *AB*; that is,
As the Sine of the ∠ *C A B* 31°, 44' 9.7209581

To *C B* the Drift of the Current 21, 05 1.3232521
So is the Sine of the ∠ at *C* 56°, 15'. 9.9198464

To the Distance run, 33, 28. 1.5221404
2. In the Triangle *B D G*, are given { *B D* 36; ∠ at *D* 78°, 45'; *D G* 18, 95 } To find *B D* and the ∠s *D B G* and *D G B*.

Wherefore,
As the Sum of *B D* and *DG* 54, 95 1.7399677

To their Difference 17, 05 1.2317244
So is the Tangent of 50°, 37' 10.0856980

To the Tangent of 20°, 42' 9.5774547
Hence the Angle *D B G*, will be found 29°, 55'; wherefore the Ship's second Course is E. by N. 7°, 25'. Eastwardly, and consequently the Angle *A B G* = 159°, 19'.
But for *B G*, the Distance run, it will be
As the Sine of the Ang. *B D G* 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 9.9915739

To *BG* the Distance run, 37, 27 1.5713090
3. In the Triangle *A B G*, are Given { *A B* 33, 28; ∠ *A B G* 159°, 19'; *B G* 37, 27 } Whence must be found ∠*BAG* and *AG*, and 'twill be,
As the Sum of *A B* and *B G* 70, 55 10.8484970

To their Difference 3, 99 0.6009729
So is the Tangent of 10°, 20'' 9.2612203

To the Tangent of 00°, 36' 8.0136962
Hence the Angle *B A G* is 10°, 56', and consequently the bearing of the Ship from her first Port is E. by N. 2°, 20'. Northerly; and for the Distance it will be,
As the Sine of the Angle *BAG* 10°, 56'. 9.2789911

To the Distance run *B G* 37, 27 1.5713090
So is the Sine of the ∠ *A B G* 159°, 19'. 9.5480240

To the Distance between the Ship and her Port 69, 24 } 1.8403419
Now for the Difference of Latitude, it will be as the Radius 10.0000000

To the Distance sail'd, 69, 24 1.2403571
So is the Co-Sine of the Course, 76°, 25' 9.3708079

To the Difference of Latitude 16, 26 1.2111650

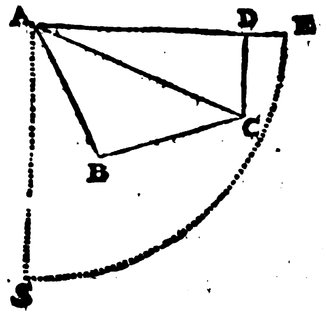
Hence, because she sail'd from a South Latitude	} ——	Nly
From the Latitude she sail'd from	36°, 30' —	Sly
Take the Difference of Lat. made	16⅓' ——	Nly
Remains the Lat. the Ship is in	36°, 13⅔' ——	Sly

Admit a Ship, from a certain Head-line, in the Latitude of 34°, 00'. North, sails S. E. by S. 24 Miles in 6 Hours, in a Current that sets 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?

Geome-

Geometrically.

1. Set off 3 Points from *S* towards *E*, and draw the Line *A B* equal to 24 Miles.



2. Set off two Points from *E* towards *S*, and draw the Line *A C*.

3. At the Distance of 15 Miles, equal to the Difference of Latitude, draw a parallel to *A E*, till it intersect *AC* as in *C*.

4. From the Intersection *C*, draw *C D* parallel to *A S*; also the Line *B C* the Drift and Setting of the Current.

To find which *Arithmetically*.

In the Triangle *A D C*, Right-angled at *D*, are

Given $\left\{\begin{matrix} DC\ 15 \\ \angle A\ 22^\circ,\ 30' \end{matrix}\right\}$ to find *A C*

Wherefore *S* ∠ *A* : *DC* : : *R* : *AC*; that is,

As the Sine of the Angle at *A* 22°, 30' 9.5828397

To the Difference of Latitude 15 1.1760912
So is the Radius 10.0000000

To the Distance run 39, 2 1.5932515

Again, In the Triangle *A B C*, are

Given $\left\{\begin{matrix} AB\ 24 \\ \angle A\ 33^\circ,\ 45' \\ AC\ 39,\ 2 \end{matrix}\right\}$ to find $\left\{\begin{matrix} \angle C \\ BC \\ \angle B \end{matrix}\right.$

Wherefore,

$\overline{AB + AC} : \overline{AC - AB} :: t\tfrac{1}{2}\,\overline{\angle B + \angle C} : t\tfrac{1}{2}\,\angle B - \angle C$

As the Sum of the Sum of the Sides *AB* and *A C* 63°, 2' } 1.8007171

To their Difference 15°, 2' 1.1818436
So is the Tangent of 73°, 07½' 10.5180608

To the Tangent of 38°, 24½' 9.8991873

Which added to 73°, 07½', gives 111°, 32'. the Angle at *B*. And hence the Current will be found to set E. by N. 00°; 58' Northerly.

For *B C*, the Drift of the Current, it will be,

s, ∠ *B* : *AC* : : *s*, ∠ *A* : *B C*; that is,

As the Sine of the Ang. at *B* 111°, 32' 9.9685783

To *A C* the Distance run 39°, 2'. 1.5932515
So is the Sine of the Ang. at *A* 33°, 45'. 9.7447390

To *B C* the Drift of the Current in 6 Hours, 23°, 41'. } 1.3694122

And consequently it sets at the Rate of 3°, 9'. 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 *Analemma*, 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* Isaac 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 distinguish'd into *Classes*, *Genders* or *Orders*, according to the Number of the Dimensions of an Equation, expressing the relation between the *Ordinates* and the *Abscissa*; 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 *Second* 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 *Cissoid* 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 Gender*, the same with a Line of the *Third Order*; and a Line of an *Infinitesimal 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.

3. For if any right and parallel Lines be drawn and terminated on both Sides by one and the same *Conick Section*; and a Right Line bisecting any two

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 *Axis* to 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 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 Centre*.

Assymptotes and their Properties.

4. The Hyperbola of the first Gender has two *Assymptotes*, that of the second, three; that of the third, four; 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 Recta* 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 Rectangles 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 third; as the Rectangle 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 seeking the Tangent to that Leg at a Point infinitely distant: And the *Course*, *Place* or *Way* of an infinite Leg, is found by seeking the Position 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 parallel CBc be drawn, terminated (if possible) at both Ends at the Curve. Let this parallel be bisected

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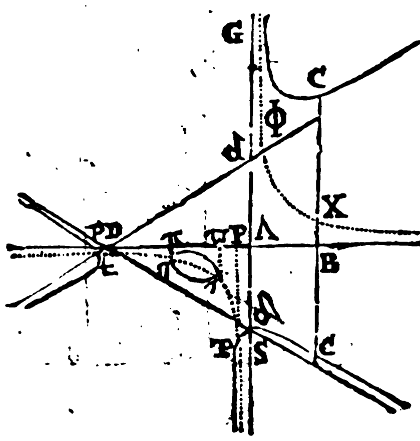
fected in X; and then will the Place of that Point

Fig. 1.



X be the *Conical Hyperbola* $X\phi$, 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 Absciffa AB is determined, if AB be put $=x$ and $BC=y$, will always be in this Form, $xyy+ey=ax^3+bxx+cx+d$, 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 Defect, 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 II.

9. But if the Right Line CBc 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 AS in A; as also any other Right Line, as BC, parallel to the Assymptote, and meeting the Curve in the Point C: And then the Equation by which the Relation between the Ordinate BC and the Absciffa AB 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 Absciffa AB is determined, will always be in this Form, $yy=ax^3+bxx+cx+d$.

CASE IV.

11. But if the Right Line CBc 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 the Relation between the Ordinate BC and the Absciffa $A\beta$ is determined, always be in this Form, $yy=ax^3+bxx+cx+d$.

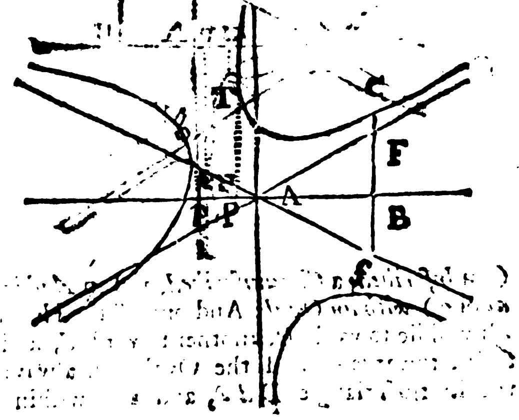
The Names of the Forms.

12. In the Enumeration of Curves of these Cases, we call that an *Inscribed Hyperbola*, which lies entirely within the Angle of the Assymptotes, like the *Conical Hyperbola*; and that a *Circumscribed* 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 Assymptote with its Concave Vertex and diverging Legs; and that an *Anguineal or Eel-like* one, which cuts its Assymptote with contrary Flexions, and is produced both ways into contrary Legs. I call that a *Cruciform or Cross-like one*, which cuts its Conjugate crosswise; and that *Nodate*, which by returning round into, decussates 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 *Pure*, which, by the Impossibility of its two Roots, is without any Oval Node, Spike or Conjugate Point. And in the same Sense I denominate a Parabola also, to be *Converging*, *Diverging*, *contrary leg'd*, *Cruciform*, *Nodate*, *Cuspidate*, *Punctate* and *Pure*.

Of the redundant Hyperbola and its Assymptotes.

13. In the first Case, if the Term ax^3 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 none are parallel, two Legs towards each Assymptote, and towards contrary Parts; and these Assymptotes, if the Term bxx be not wanting in the Equation, will mutually intersect each other in three Points, forming thereby the Triangle $Dd\delta$. But if the Term bxx (see Fig. 1.) be wanting, they will all converge to the same Point. In the former Case take $AD=\frac{-b}{2a}$, and $Ad=A\delta=\frac{b}{2\sqrt{d}}$, and

Fig. 4.



join

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join $D\,d$, $D\,\delta$; so shall AD, $D\,d$, and $D\,\delta$, be the three Assymptotes. In the latter Case, draw any Ordinate, as $B\,C$, in which, both ways produced, take, on each Side, $B\,F$ and $B\,f$ equal to one another, and in the same Ratio with $A\,B$ that $\sqrt{a}$ hath to l; and then joining $A\,F$, $A\,f$; $A\,B$, $A\,F$, and $A\,F$, 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 Position of its infinite Legs.

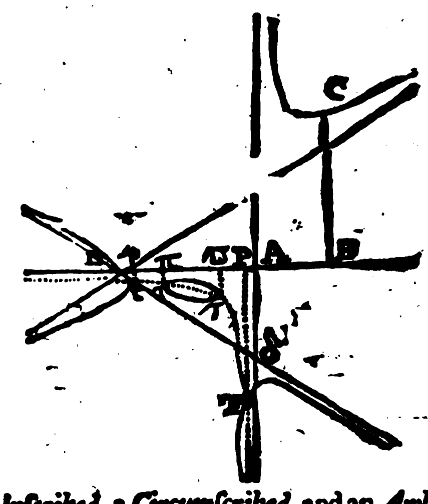
14. In every redundant Hyperbola, if neither the Term $e\,y$ be wanting, nor $b\,b - 4\,a\,c$ equal to $+ a\,e\,\sqrt{:a}$, the Curve will have no Diameter; but if either of those happen, it will have *one only Diameter*, and *three* if they both happen. And the Diameter will always pass through the Intersection of two of the Assymptotes, and bisect all Right Lines which are terminated each way by those Assymptotes, and which are parallel to the third Assymptote: And the *Abscissa* $A\,B$ will be the Diameter of the Figure, as often as the Term $e\,y$ is wanting. I take the Word *Diameter* here, and in the following Pages, *Absolutely*; and in the common Acceptation of it, *viz.* for an *Abscissa* which hath every where two equal Ordinates, one on each Side, insisting at the same Point.

Nine redundant Hyperbola's, having no Diameter, but three Assymptotes, which form a Triangle.

15. If the redundant Hyperbola have no Diameter, let the four Roots or Values of x in this Equation $a\,x^4 + b\,x^3 + c\,x\,x + d\,x + \frac{1}{4}\,e\,e = 0$, be sought: And suppose them to be AP, $A\varpi$, $A\pi$, and Ap. Let the Ordinates PT, $\varpi\tau$, πʇ, and $p\,t$, be erected, and those shall touch the Curve in the Points T, τ, ʇ, t, and by that Contact shall give the Limits of the Curve, by which its *Species* will be discovered.

For if all the Roots AP, $A\varpi$, $A\pi$, Ap, (see *Fig.* 1.) are real, having the same Sign, and are unequal; the Curve consists of three Hyperbola's,

Fig. 2.



(an *Inscribed*, a *Circumscribed*, and an *Ambigenial* one) *with an Oval*: And one of the Hyperbola's will lie towards D, another towards d, and the third towards δ; and the Oval will always lie within the Triangle $D\,d\,\delta$, and also within the middle Limits ʇ and τ, where it will be touch'd by the Ordinates π ʇ and $\varpi\,\tau$. And this is the *First Species*.

But if either the two greatest Roots, $A\pi$, Ap; or the two least, AP, $A\varpi$, are equal to one another, and have the same Sign with the other two; then the *Oval* and *Circumscribed Hyperbola* will join with one another, the Points of Contact ʇ and t, or T and τ, co-inciding; and the Legs of the Hyperbola decussating one another, will be continued in the *Oval*, and make the *Nodate* Figure. The *Second Species*;

Fig. 3.

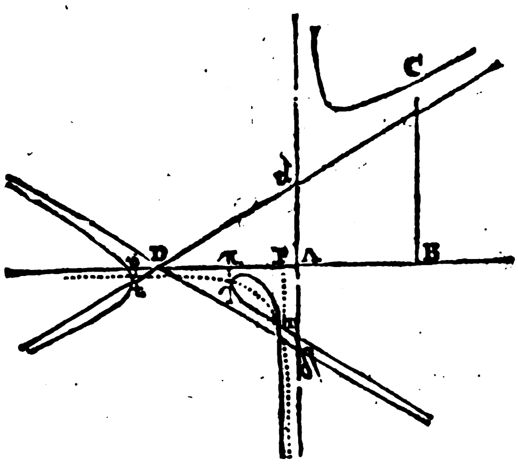
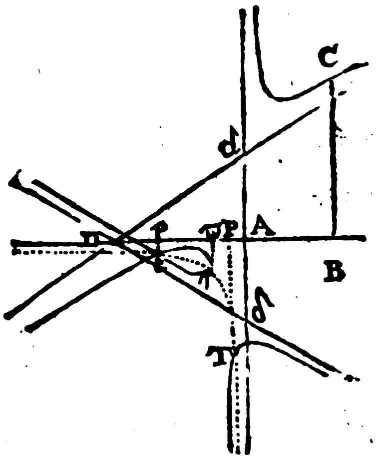


Fig. 4.



If the three greatest of the Roots, Ap, $A\pi$, $A\varpi$; or the three least, $A\pi$, $A\varpi$, AP, are equal

Fig. 5.

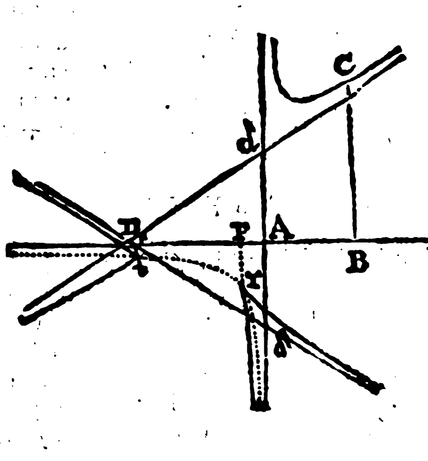


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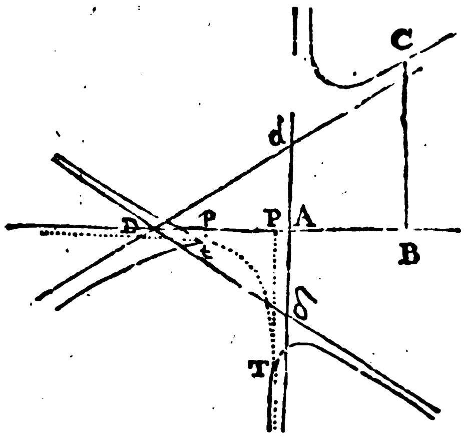
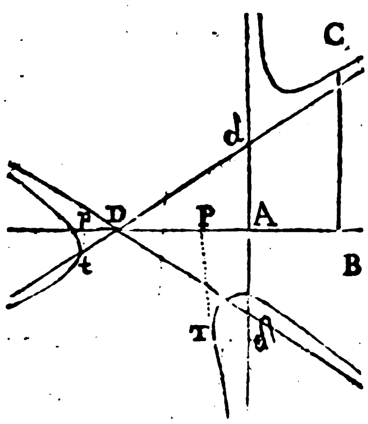
Fig. 6.



to one another, the *Nodus* will be turned into a very sharp *Cuspis*; for the two Legs of the circumscribed 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 *t* will be coincident; wherefore the *Oval* will vanish into a Point, and the Figure will consist of three Hyperbola's, an *Inscribed*, a *Circumscribed*, and an *Ambigenial* one, with a Conjugate *Point*: Which makes a *Fourth Species*.

Fig. 7.



If two of the Roots are impossible, and the other two unequal, and of the same Sign, (for they
(See Fig. 7.)

Fig. 8.

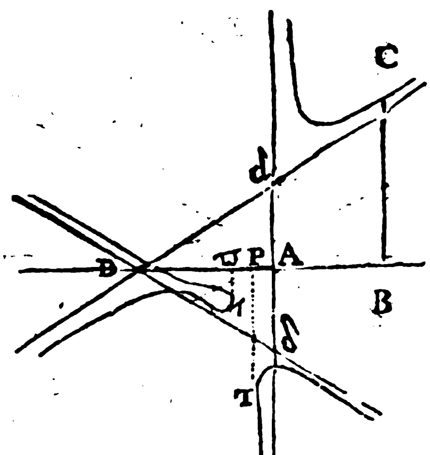


Fig. 13.

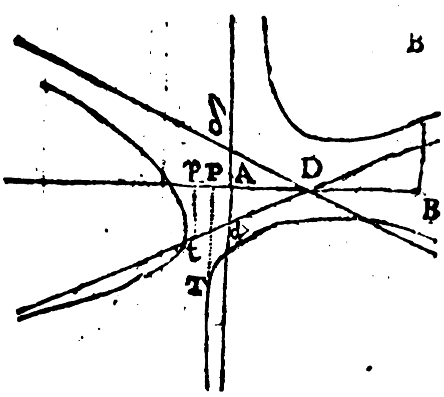
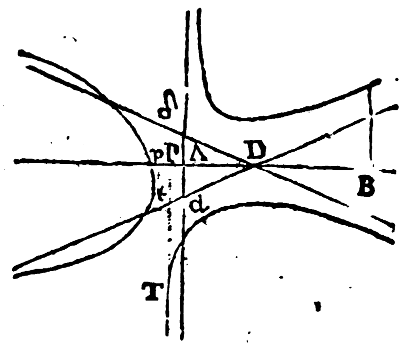


Fig. 14.



can't have contrary Signs); there will be three pure Hyperbola's, without any *Oval*, *Node*, *Cusp*, or *Point Conjugate*; 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.

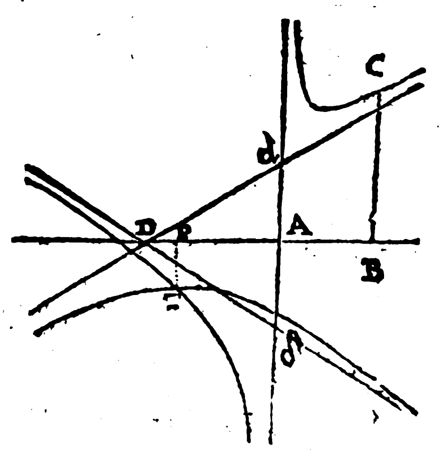


Fig. 10.

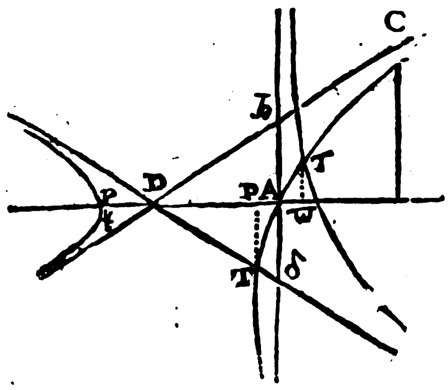


Fig. 15.

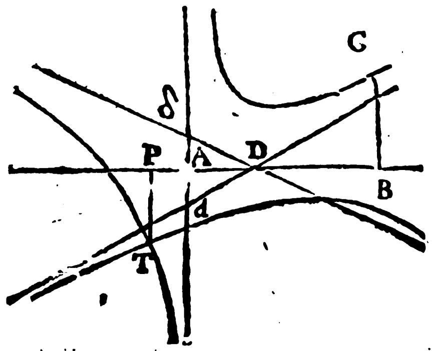
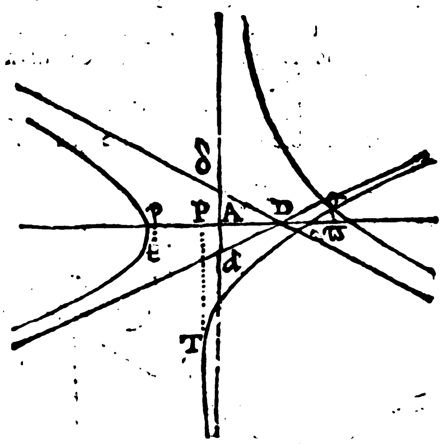


Fig. 16.



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 Assymtotes, or at its Base; and these two are the *Seventh* 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.

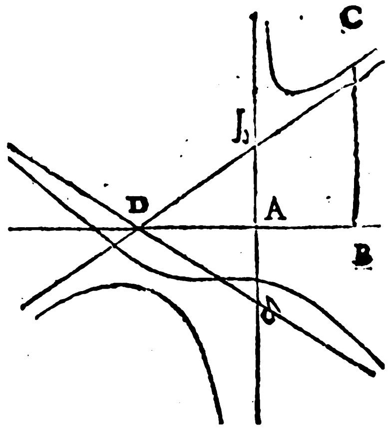
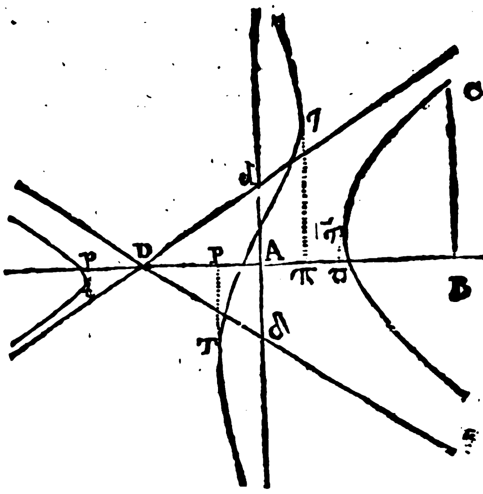


Fig. 12.



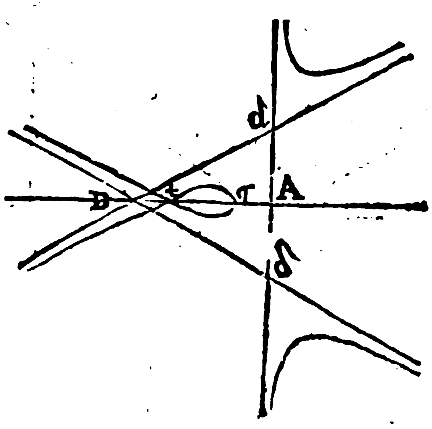
And these are all the possible Cases of the Roots; for if any two Roots are equal to one another, and the other two are equal also, the Figure will become a *Conick Section* with a Right Line.

Twelve redundant Hyperbola's with one only Diameter.

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 the 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 *Oval* lying

Fig. 17.

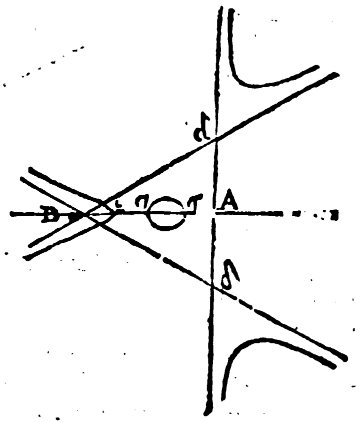


within

within the Triangle $D\,d\,\delta$, and of three Hyperbola's as its Angles, *viz.* one circumſcribed at the Angle D, and the other two inſcribed at d and δ; and this makes a *Tenth Species.*

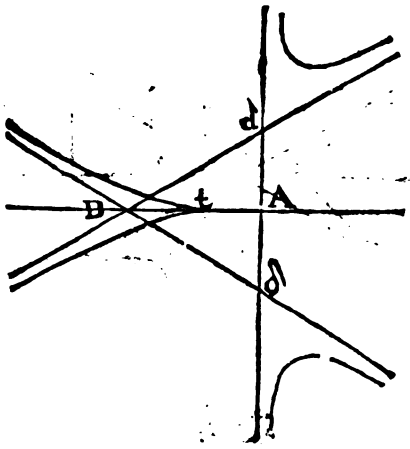
If the two great Roots are equal, and the third of the ſame Sign with them, the Legs of the Hyperbola lying towards D, will decuſſate one another in the Form of a *Node*, by reaſon of the Contact of the *Oval.* Which is the *Eleventh Species.*

Fig. 18.



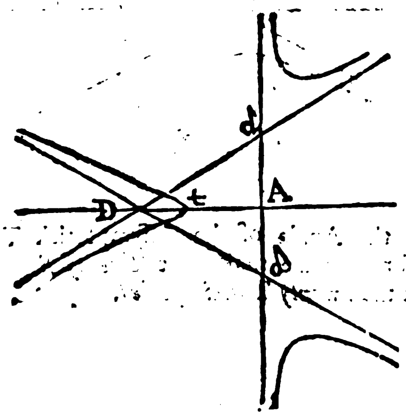
If the three Roots are equal, the Hyperbola becomes *Cuſpidate*, without any *Oval.* Which is the *Twelfth Species.*

Fig. 19.



If the two leaſt Roots are equal, and the third of the ſame Sign with them, then the *Oval* vaniſhes into a Point. Which makes a *Thirteenth Species.*

Fig. 20.



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 will be three pure Hyperbola's, without any *Oval*, Decuſſation, or Cuſpis. And there are four Caſes of this *Species*, *viz.* a *Fourteenth*, if the circumſcribed Hyperbola lie towards D, and a *Fifteenth*, if the inſcribed Hyperbola lie towards D, a *Sixteenth*, if the circumſcribed Hyperbola lie under the Baſe $D\,\delta$ of the Triangle $D\,d\,\delta$, and a *Seventeenth*, when the inſcribed Hyperbola lies under the ſame Baſe.

(See *Fig.* 20.)

Fig. 21.

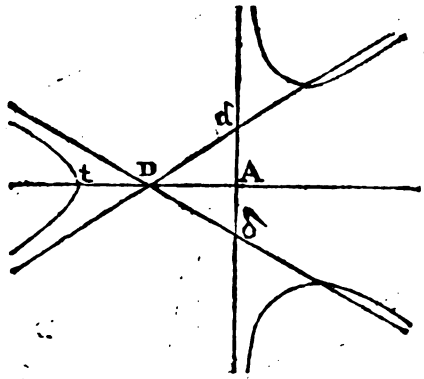


Fig. 22.

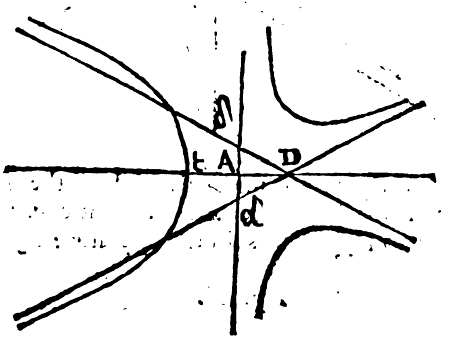
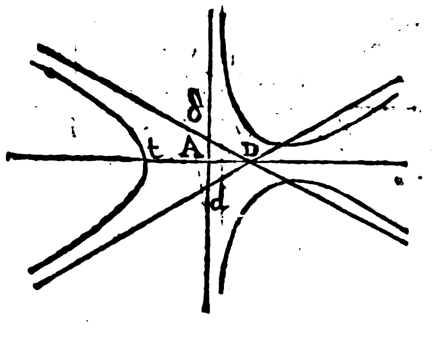


Fig. 23.



If two Roots are equal, and the third of a different Sign from them, the Figure will be *Cruciform*; for two of the three Hyperbola's will decuſſate one another, either at the Vertex, or at the Baſe of the Triangle made by the Aſſymptotes. Which

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Which two *Species* are the *Eighteenth* and *Nineteenth.*

Fig. 24.

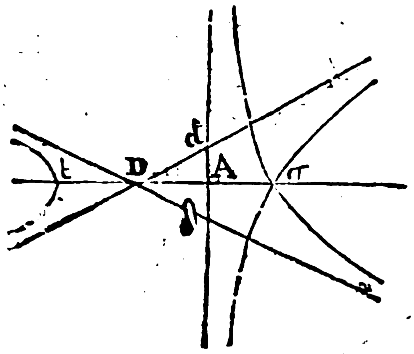
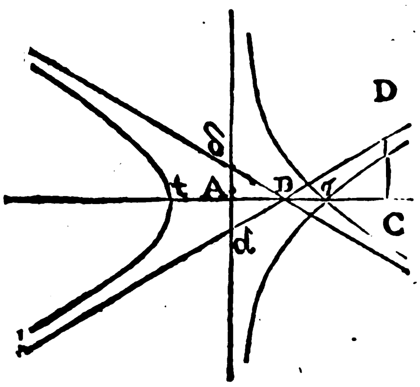


Fig. 25.



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.

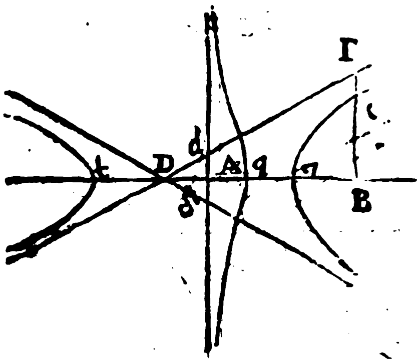
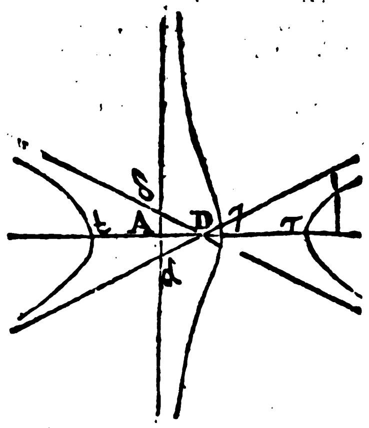


Fig. 27.



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, consists of three Hyperbola's lying within the Assymptotes, and that either at the Sides,

Fig. 28.

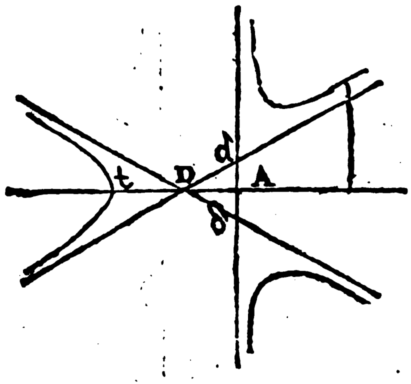
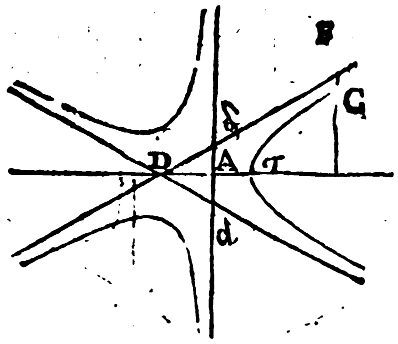


Fig. 29.



or at the Angle of the Assymptotick Triangle. The former Case makes the *Twenty Second*, this Latter the *Twenty Third Species.*

Nine

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Nine redundant Hyperbola's with three Assymptotes, converging towards one common Point.

18. If the three Assymptotes do intersect one another in one common Point, the 5th and 6th Species will be changed into a *Twenty Fourth*, the Seventh

Fig. 30.

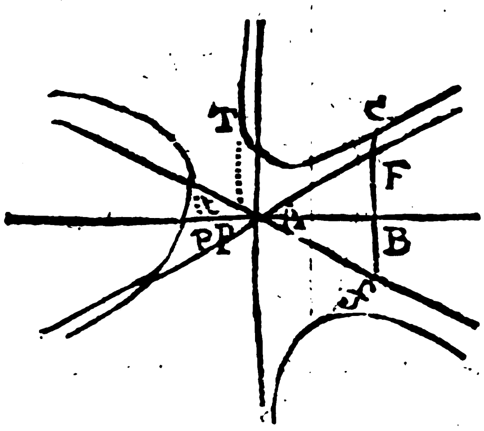


Fig. 31.

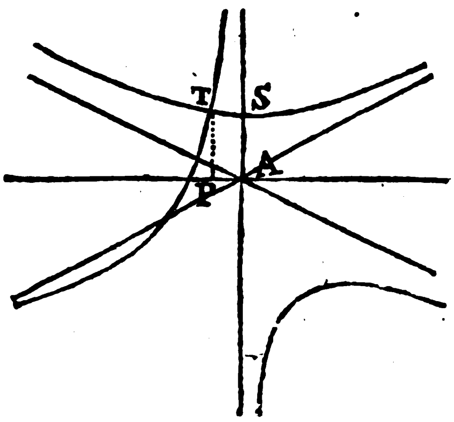


Fig. 32.

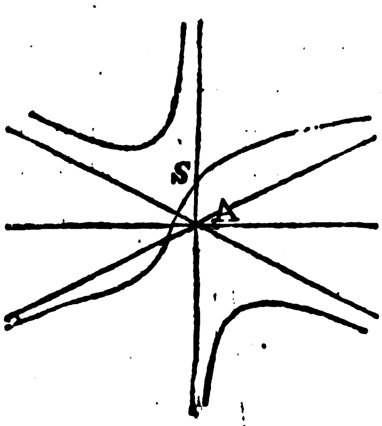
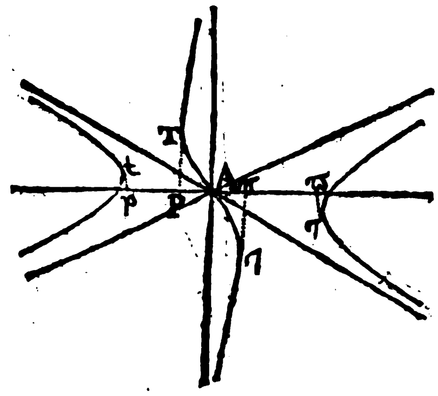


Fig. 33.



and Eighth into a *Twenty Fifth*, and the Ninth into a *Twenty Sixth* Species, where the *Anguineal* doth not pass 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 Assymptotes is the Centre of the Figure, equally distant from all its opposite Parts. And these four 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 Ninth.*

Fig. 34.

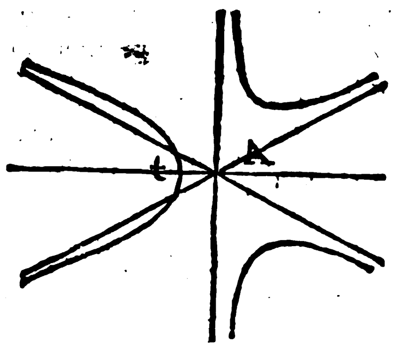


Fig. 35.

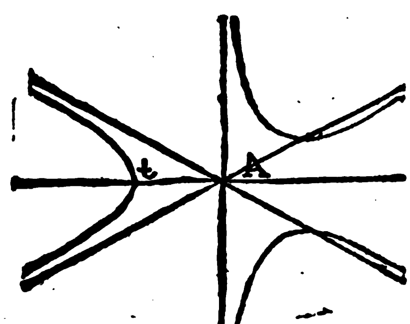


Fig.

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Fig. 36.

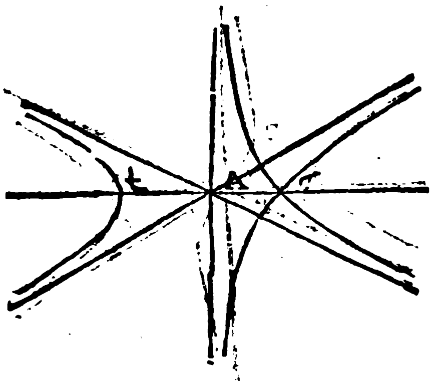
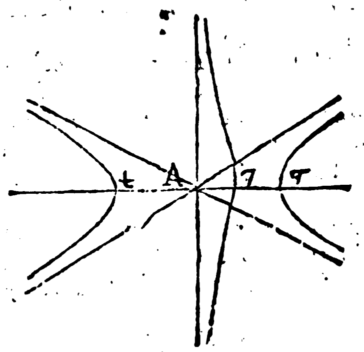
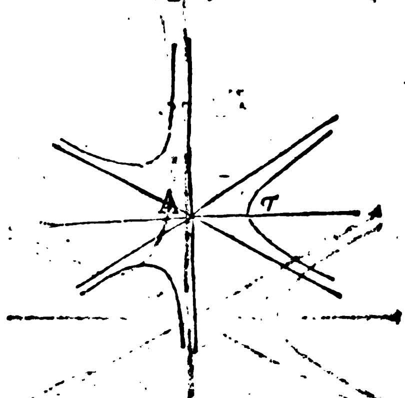


Fig. 37.



The Eighteenth and Nineteenth 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.

Fig. 38.



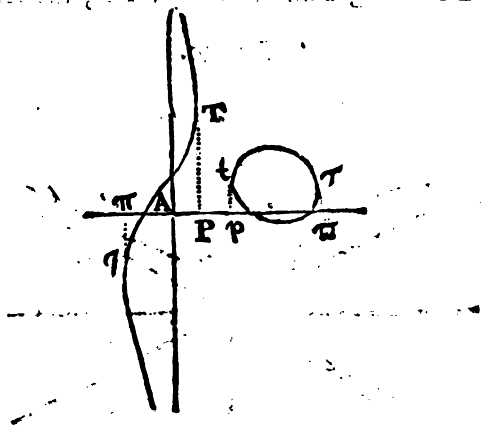
All which Changes will be easily understood, if you suppose the Assymptotick Triangle to be diminished till it vanish into a Point.

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:

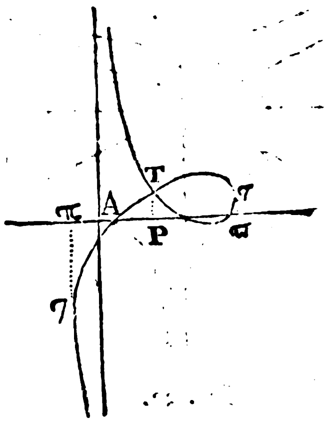
If all the Roots $A\pi$, AP, Ap, $A\varpi$, of this Equation $ax^4 = bx^3 + cxx + dx + \frac{1}{4}ee$, be real and unequal, the Figure will be an *Anguineal* Hyperbola approaching towards the common Assymptote by a contrary Flexion, and with a Conjugate *Oval*. Which makes the *Thirty Third Species*.

Fig. 39.



If the two middle Roots AP and Ap be equal one to another, then the *Oval* and the *Anguineal*

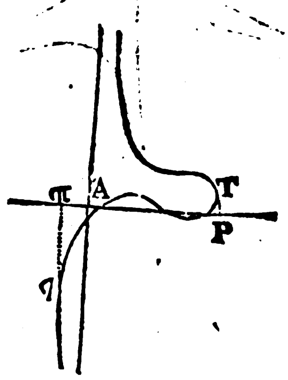
Fig. 40.



will be joined, decussating one another in the Form of a *Node*. And this is the *Thirty Fourth Species*.

If three of the Roots are equal, the Node will be changed into a most Acute *Cuspis* in the Vertex of the *Anguineal*. And this constitutes a *Thirty Fifth Species*.

Fig. 41.



If

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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 sixth 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.

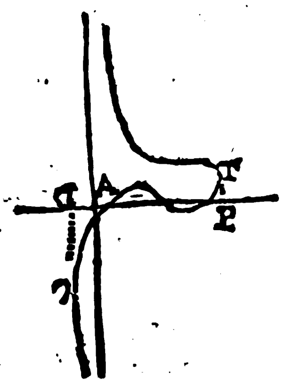
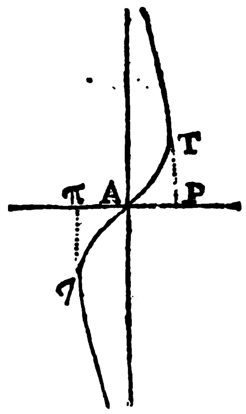


Fig. 43.

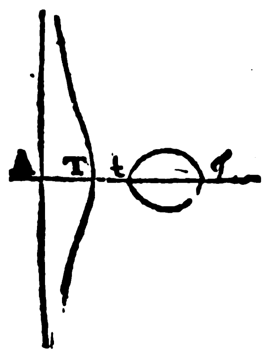


If the *Anguineal* don't pass through the Point *A*, it makes the *Thirty seventh Species*; but if it doth pass through *A*, (as it will do when the Terms *b* and *d* are wanting) then that Point will be the Centre of the Figure, bisecting all Right Lines drawn through it, and terminated both ways by the Curve. And this is a *Thirty eighth Species*.

Seven defective Hyperbola's, having a Diameter.

20. In the other Case, where the Term ey is wanting, and consequently the Figure hath a Diameter, if all the Roots AT, At $A\tau$, of the

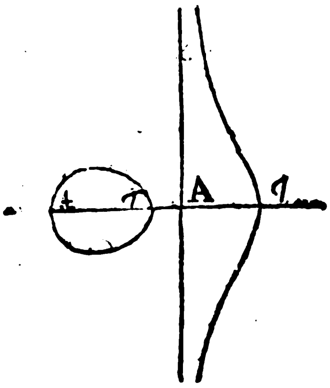
Fig. 45.



Equation $ax^3 + bxx + cx + d$, are real, unequal, and of the same Sign; then the Figure will be a *Conchoidal 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*

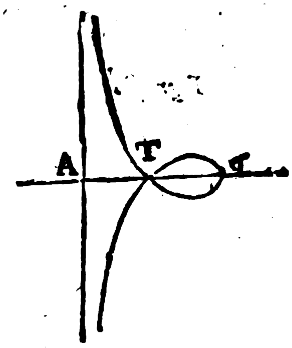
Fig. 44.



will lie on the Concave Side of the *Conchoidal Hyperbola*. And this makes a *Fortieth Species*.

If the two lesser Roots AT, At, are equal, and the third $A\tau$, be of the same Sign with them,

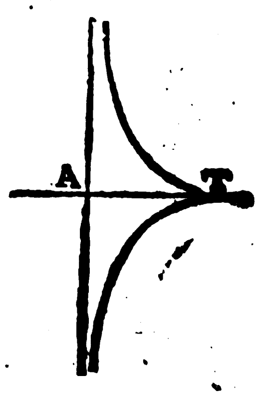
Fig. 46.



then the *Oval* and the *Conchoidal* will be joined, decussating 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

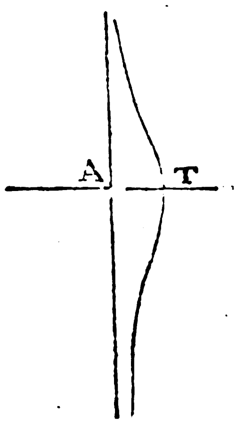
Fig. 47.



Ciſſord of the Ancients. And this makes a *Forty ſecond Species.*

If the two greater Roots are equal, and the Third of the ſame Sign with them, then the Con-

Fig. 49.

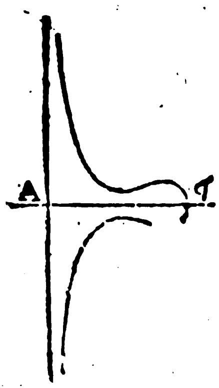


choidal Hyperbola, will have a *Conjugate Point* at its Convexity. Which is a *Forty third Species.*

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.



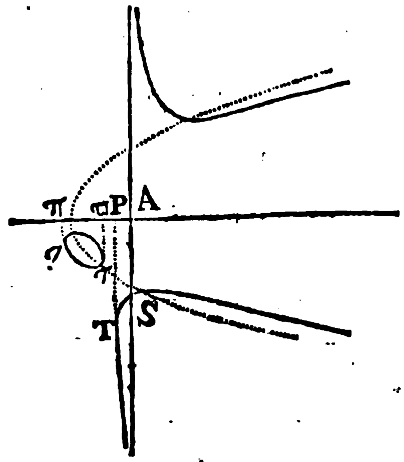
Cuſp, or Conjugate Point. And this is a *Forty fifth Species.* (See *Fig.* 49.)

Seven Parabolick Hyperbola's, having 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 Aſſymptote $S A G$, converging towards one and the ſame Sign. If the Term $e y$ 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 $A P$, $A \pi$, $A \pi$, of this Equation $b x^3 + c x^2 + dx + \frac{ee}{4} = 0$, be unequal, and have the ſame Sign, the Figure will conſiſt of an Oval, and of two other Curves, which are partly Hyperbolical, and partly Parabolical; that is, the Parabolick Legs, by being continually

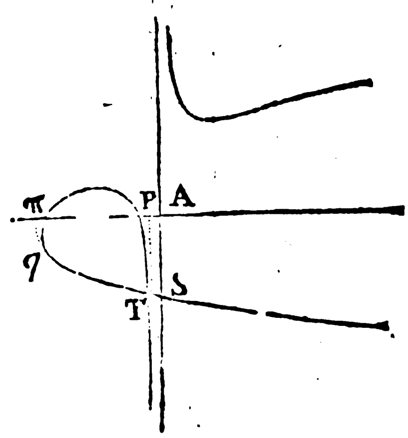
Fig. 50.



drawn out, are joined with the Hyperbolical Legs which are next to them. And this is the *Forty ſixth Species.*

If the two leſſer Roots are equal, and the Third of the ſame Sign with them; then will the Oval,

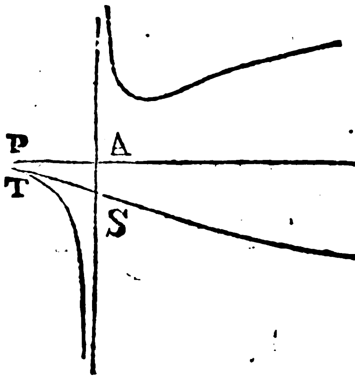
Fig. 51.



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.

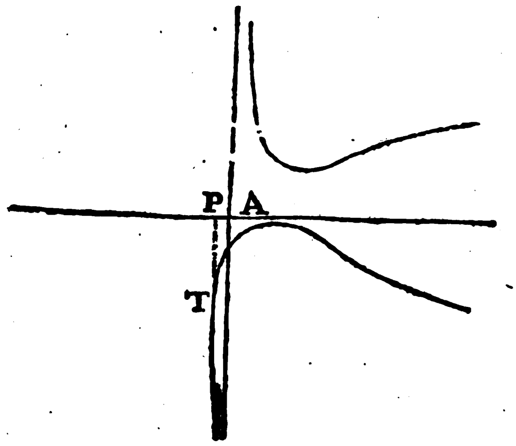


into a Cuſp. Which makes a *Forty eighth Species.*

If

If the two greatest Roots are equal, and the Third hath the same Sign with them, the *Oval*

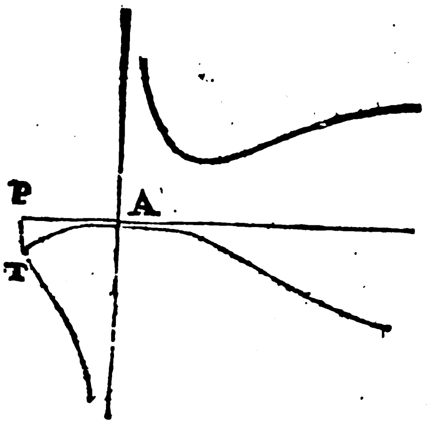
Fig. 53.



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.)

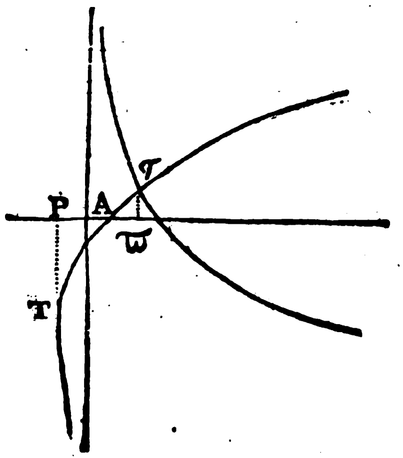
Fig. 54.



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

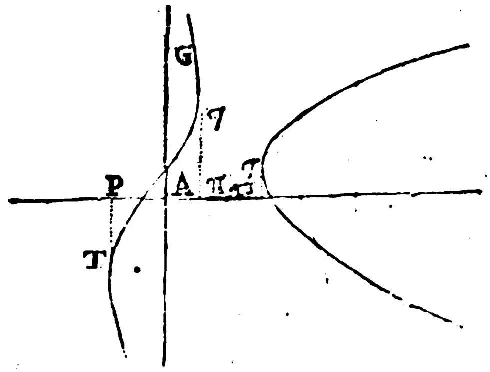
Fig. 55.



Parabolick Curves will be joined, decussating 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.

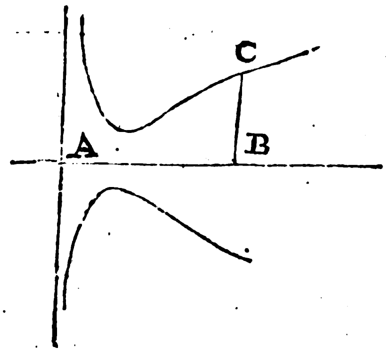


Assymptote *AG*, together with a *Conjugate Parabola.* And this will be a *Fifty second Speciees.*

Four Parabolick Hyperbola's which have a Diameter.

22. In the other Case, where the Term ey is wanting, and the Figure hath a Diameter, if the two Roots of this Equation $bxx + cx + d = 0$

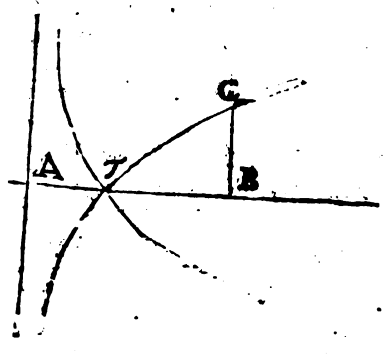
Fig. 57.



are impossible, there will be two Hyperbola Parabolick Figures equally distant from the Diameter *A B*, 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

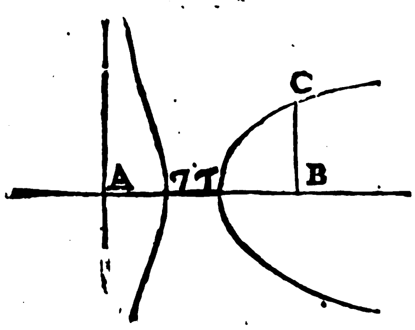
Fig. 58.



intersect one another in the Form of a Cross. And this will be a *Fifty fourth Species.*

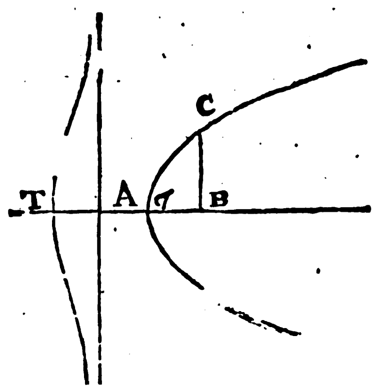
If the Roots are equal, and have the same Sign, there will be a Conchoidal Hyperbola with a Parabola on the same Side of the Assymptote. And this makes a *Fifty fifth Species.*

Fig. 59.



If the Roots have contrary Signs, there will be a Conchoidal Hyperbola on one Side of the Assymptote, and a Parabola on the other. And this makes a *Fifty sixth Species.*

Fig. 60.



Four Hyperbolisms of the Hyperbola.

23. Whenever in the first Case of the Equations, the Term $a x^3$ and $b x x$ are both wanting, the Figure will be a *Hyperbolism* of some Conick Section.

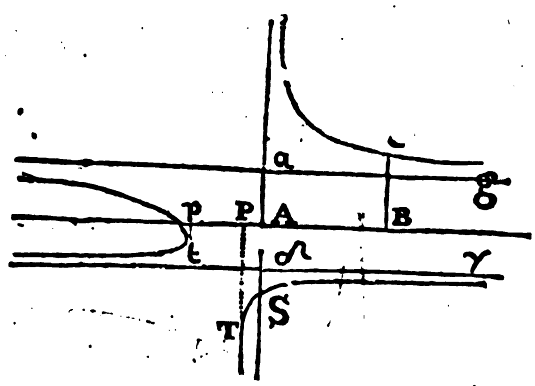
I call that the *Hyperbolism* of a Figure, when the Ordinate comes out by dividing the Rectangle under the Ordinate of that Figure and a given Right Line, by the common *Abscissa*. By this means a Right Line is changed into a Conick Section, and every Conick Section into some one of those Figures which I here call the Hyperbolisms of the Conick Sections. For the Equation for the Figure, of which we now speak, *viz.* $x y y + e y = c x + d$, gives the Ordinate $y = \frac{e \pm \sqrt{e e + 4 d x + 4 c x x}}{2 x}$; which is generated by dividing the Rectangle under the Ord. of the Conick Section, $\frac{e \times \sqrt{e e + d x + 4 c x x}}{2 m}$ and a given Right Line m, by the common Abscissa x. Whence it is plain, that the Figure produced 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 of it.

In the principal Ordinate $A\ d$, take $A\ d$, $A\ \delta$ equal both ways to the Quantity $\sqrt{:c}$; and thro' the Point d and δ, draw dg, $\delta\ \gamma$ as Assymptotes, parallel to the Abscissa $A\ B$.

When the Term $e\ y$ is not wanting, the Figure hath no Diameter. In this Case, if $A\ P$ and $A\ p$, the two Roots of the Equation $c\ x\ x + d\ x + \frac{e\ e}{4} = 0$, 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 between the parallel Assymptotes, and the other two without them. And this is a *Fifty seventh Species.*

Fig. 61.



If the two Roots are impossible, there will be two opposite Hyperbola's without the parallel Assymptotes, and an Hyperbolical Anguineal within them. This Figure is of two Species; for it hath no

Fig. 62.

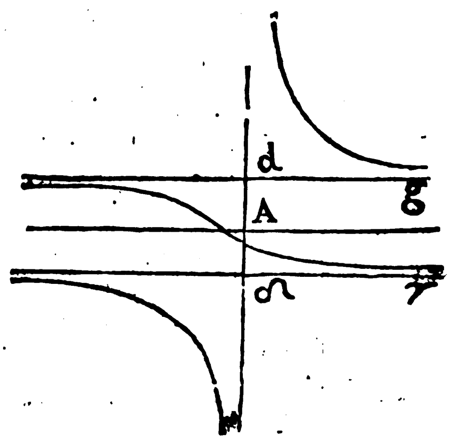
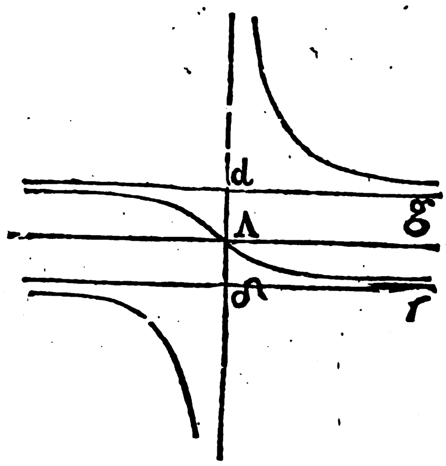


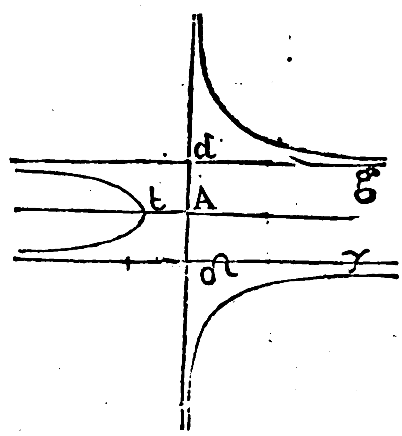
Fig. 63.



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 *Fifty eighth*, the latter a *Fifty ninth Species*.

But if the Term ey is wanting, the Figure will consist of three opposite Hyperbola's, of which one will lie between the parallel Assymptotes, and

Fig. 64.

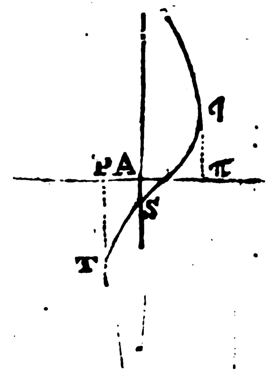


the other two without, as in the 54th Species: And besides this, it will have a Diameter, which is the Abscissa AB. And this constitutes a *Sixtieth Species*.

Three Hyperbolisms of the Ellipse.

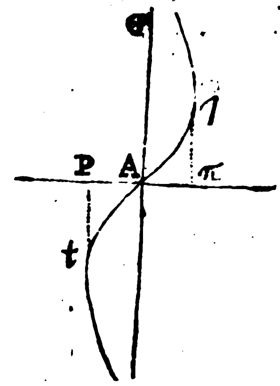
24. The Hyperbolism of an Ellipsis is determined by this Equation $xyy + ey = cx + d$; and hath only one Assymptote, which is the principal Ordinate Ad. If the Term ey be not wanting, the Figure will be an Anguineal Hyperbola without any Diameter, and even without any Centre, if the Term d be not wanting. Which makes the *Sixty first Species*.

Fig. 65.



But if the Term d be wanting, the Figure will have a Centre without any Diameter, which will

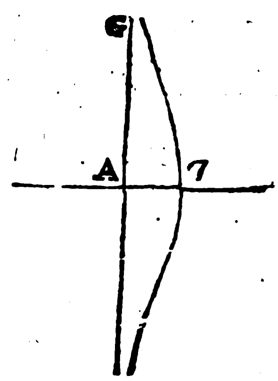
Fig. 66.



be the Point A. And this makes a *Sixty second Species*.

And if the Term ey be wanting, and not d, the Figure will be a Conchoidal Hyperbola to the

Fig. 67.



Assymptote 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

gles of the Assymptote, but in the contiguous or adjoining ones, and that on each Side the Abscissa

Fig. 68.

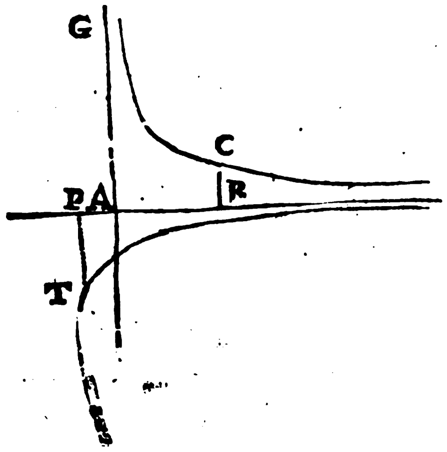
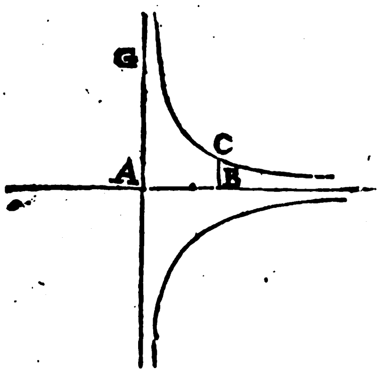


Fig. 69.

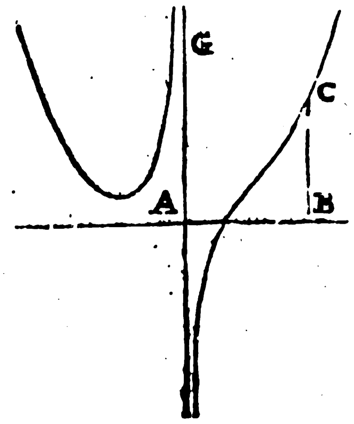


A B; and even without any Diameter, if the Term $x y$ be there, but with one if that be wanting. Which two *Species* are the *Sixty fourth* and *Sixty fifth*.

A Trident.

26 In the second Case of the Equation there is $x y = a x^3 + b x x + c x + d$: 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 six Dimensions. This therefore is the *Sixty sixth Species*.

Five Diverging Parabola's.

27. In the third Case the Equation was $y y = a x^3 + b x x + c x + d$; and designs a Parabola, whose Legs diverge from one another, and run out infinitely contrary ways. The Abscissa *A B* is its Diameter, and its five Species are these:

If, of the Equation $a x^3 + b x x + c x + d = 0$, all the Roots $A\tau$, AT, At, are real and unequal; then the Figure is a diverging Parabola

Fig. 70.

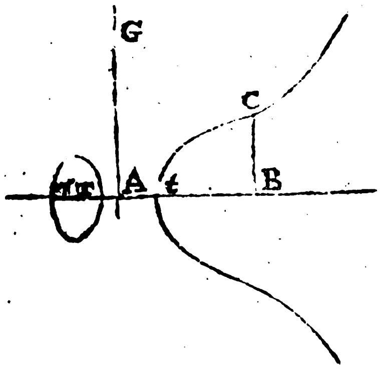
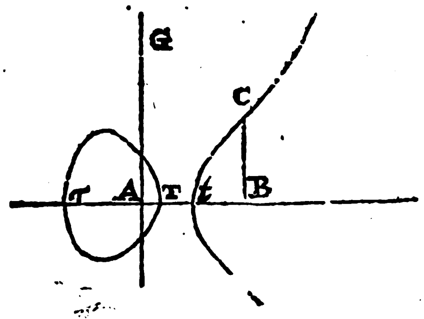


Fig. 71.



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.

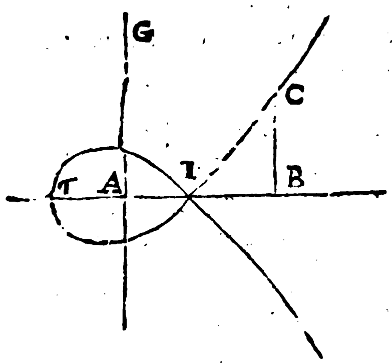
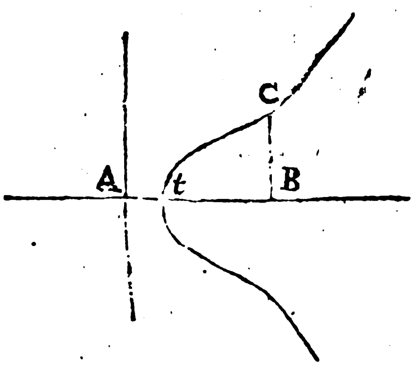


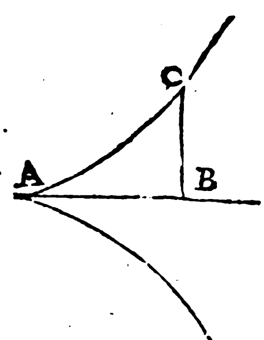
Fig. 73.



or *Punctate*, by having the Oval infinitely small. Which two *Species* are the *Sixty eighth* and *Sixty ninth*.

If three of the Roots are equal, the Parabola will be *Cuspidate* at the Vertex. And this is the

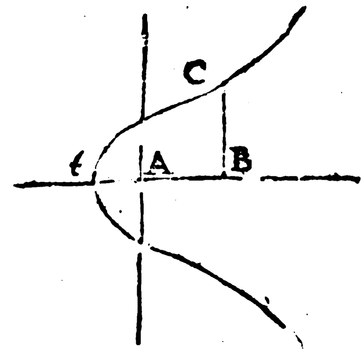
Fig. 75.



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.

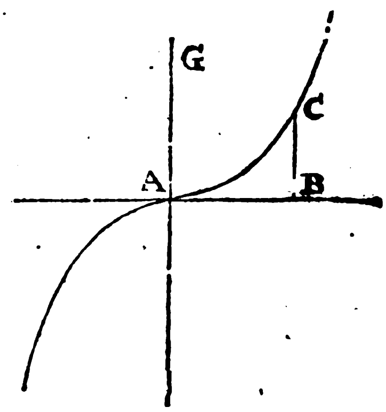


be a pure Parabola of a Bell-like Form. And this makes the *Seventy first Species*.

The Cubical Parabola.

28. In the fourth Case, let the Equation be $y = ax + bxx + cx + d$; then will it denote

Fig. 77.



the *Cubical Parabola* with contrary turn'd Legs. And this makes up, or compleats 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

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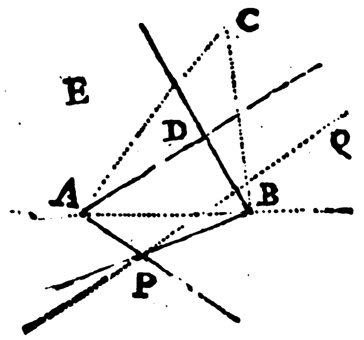
Of the double Points of Curves.

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 co-incident. As when the Right Line passes by an Oval infinitely small, or by the Concourse of two Parts of a Curve mutually intersecting 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, do cut 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 Theorems.

Theorems for the Organical Description of Curves.

31. *Theor.* I. If two Angles, as *P A D* and *P B D*, whose Magnitude is given, be turned round the Poles *A* and *B*, given also in Position; and their Legs *A P*, *B P*, by their Point of Concourse

Fig. 78.



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 *B A D* and *A B D* vanish together into nothing; for in such Cases the Point will describe a Right Line.

II. If the first Legs *A P*, *B P*, by their Point of Concourse *P*, do describe a Conick Section passing through the Pole *A*; then will the two other Legs *A D*, *B D*, 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 A D*, *A B D*, 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 *A D* and *B D*, when the Angles *B A P*, *A B P* vanish together: And the Curve described, will be one of the Second Gender, if the Angles *B A D*, *A B 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.

32. 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 *A B C*, and suppose any two of its Angles, as *C A B* and *C B A*, to revolve round their Vertices *A* and *B*; and when *C*, the Intersection of the Legs *A C*, *B C*, is successively applied to the other two Points *D*, *E*, let the Intersection of the other Legs *A B* and *B A*, fall in the Point *P* and *Q*. Let also the Line *P Q* be drawn, and infinitely produced; and let the moveable Angles be so turned round, that the Intersection of the Legs *A P* and *B P*, may describe the Right Line *P Q*: 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 having a double Point, by seven given Points.

33. All Curves of the Second Gender which have a *double Point*, are determined from their seven 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 A B*, and also either of the other two Angles of the Triangle *A B C* (as the Angle *A B C*) revolve round the two Vertexes *A* and *B*. And when the Point of Concourse *C*, of the Legs *A C*, *B C*, is successively applied to the four remaining Points *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 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.* the *Second*.

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 *A D*, *A P*, will be coincident; and instead of the Angle *D A P*, there will be a Right Line revolving round the Pole *A*.

If the *double 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 *A B C* 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 is, that by their Interſections Problems may be ſolved. Let an Equation be propoſed to be conſtructed having Nine Dimenſions, as $x^9 * + b x^7 + c x^6 + d x^5 + e x^4 + f x^3 + g x x + h x + k = 0$; where b, c,
$+ m$
d, &c. ſignify any given or known Co-efficients, adfected with the Signs $+$ and $-$. Let an Equation to a Cubical Parabola $x^3 = y$ be aſſumed: Then will the former Equation, putting y for x^3, ſtand thus, $y^3 + b x y y + c y y + d x x y + e x y + m y + f x^3 + g x x + h x + k = 0$, be an Equation to another Curve of the Second Gender, where m or f may either be wanting or aſſum'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 conſtructed.

Note, 'Tis enough to deſcribe the Cubical Parabola once.

If 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 deſcrib'd as above.

If the Equation to be conſtructed hath the three laſt Terms $g x x + h x + k$ wanting, and therefore is but of ſix Dimenſions, the other Curve, expunging f, will become a Conick-Section.

And if the ſix laſt Terms being wanting, the Curve be reduced to three Dimenſions, its Conſtruction will fall in with Dr. *Wallis*'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, $a + c x x + d x^3 + e x^4 + f x^5 + \begin{array}{l} g \\ + m \end{array} x^6 + h x^7 + k x^8 + l x^9 = 0$. Let there be an Equation aſſumed to that Hyperboliſm; thus, $x x y = 1$; and ſubſtituting y for $\frac{1}{x x}$, the Equation to be conſtructed will be changed into this Form, $a y^3 + c y y + d x y y + e y + f x y + m x x y + g + h x + k x x + l x^3 = 0$, which denotes a Curve of the ſecond Gender, by whoſe Deſcription the Problem may be ſolved, and of the Quantities m and g, either may be wanting or aſſumed 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 fifteen Dimenſions, and ſo on infinitely. And theſe Curves of the third, fourth, and ſuperior Genders, may always be deſcrib'd by finding their Points by plain Geometry.

As if this Equation were to be conſtructed, $x^{12} * + a x^{10} + b x^9 + c x^8 + d x^7 + e x^6 + f x^5 + g x^4 + h x^3 + i x x + k x + l = 0$, 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^3, the Equation will put on this Form,

$$
\begin{array}{llllll}
y^4 & + a \; y y^3 & + c \; x x y & + f \; x x y & + i \; x x & = 0 \\
 & + b & + d x & + g x & + k x & \\
 & & + e & + h & + l . &
\end{array}
$$

Which is an Equation to a Curve of the Third Gender, by whoſe Deſcription the Problem may be ſolved. And this Curve may be deſcrib'd 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 riſing towards, or aſcending 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. Tranſ. N.* 217. *P.* 111. produces, from his Tracts *de Cycloide* and *de Motu*, 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 conſidered 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 conſider'd; and yet not firſt by *Bovillus* neither, for Cardinal *Cuſanus*, as appears by an Antient Manuſcript of his Works, tranſlated by *J. Scoblant* in the Year 1451. had taken it into Conſideration before. Indeed the Figure, both in the Manuſcript, and in the *Baſil* Edition of his Works, is ill drawn; but being corrected by the Cardinal's own Words, it plainly repreſents the Modern Cycloid.

In *Philoſ. 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

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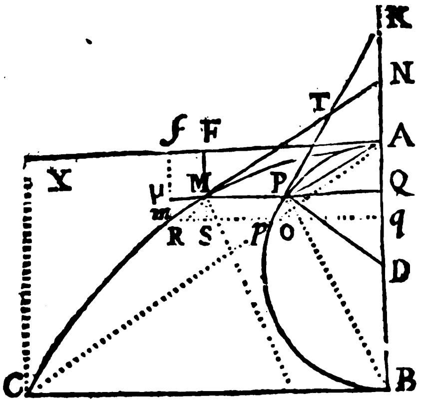
To investigate the Area's of Cycloidal Spaces.

Let AMC be a Vulgar Semi-cycloid, and the Generating Circle APB from any Point in the Ordinate, *v. g.* Q. Draw QM parallel to the Base BC, cutting the Periphery of the Circle in



P; make the Parallelogram $AFMQ$, and draw fm infinitely near FM, cutting QM produc'd in μ, and the Curve in m. Put $AB = 2r$, $AQ = FM = x$, $\mu m = \dot{x}$, $QP = y$; then (by the Property of the Circle) $2rx - xx = yy$. Whence $r\dot{x} - x\dot{x} = y\dot{y}$, and $\dot{y} = \frac{r\dot{x} - x\dot{x}}{y}$: And because the Triangles DPQ, pPO are similar, therefore $PQ\,(y) : Dp\,(r) :: PO\,(\dot{x})$ $Pp = \frac{r\dot{x}}{y}$. Now it is the Nature of the Vulgar Cycloid, that the Arch AP + the Right Sine of that Arch PQ are equal to QM: Therefore it is manifest, that the Fluxion of the Ordinate of the Cycloid QM, *viz.* MS, is equal to the Aggregate of the Fluxions of the Arch AP, and the Right Sine PQ; that is, $mS = Pp + po = \frac{r\dot{x} - x\dot{x}}{y} + \frac{r\dot{x}}{y} = \frac{2r\dot{x} - x\dot{x}}{\sqrt{2rx - x}}$, and consequently the Rectangle $F\mu$ is equal to $FM \times M\mu = x \times \frac{2r\dot{x} - x\dot{x}}{\sqrt{2rx - xx}} = \frac{2rx\dot{x} - xx\dot{x}}{\sqrt{2rx - xx}} = \dot{x}\sqrt{2rx - xx} =$ to the Fluxion of the Area AMF. But the Fluxion of the Portion of the Circle $APQ = \dot{x}\sqrt{2rx - xx}$; 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 $APBA$.

CONSECTARY II.

The Cycloidal Space $AMCB$, is to the Circumscrib'd Parallelogram AC, as 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 $\frac{3}{4}$ Parallelogram AC, and the Triangle ACB is equal to $\frac{2}{4}$ 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 Space $AMCX = \frac{1}{2}$ the inscrib'd Triangle ACB.

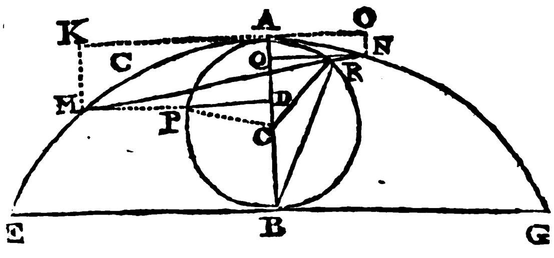
CONSECTARY IV.

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 squar'd without supposing the same.

Let EAG be a Vulgar Cycloid, the Base EG, and AB the Axis, and the generating Circle APB. I say, if the Point Q be taken at pleasure in the Axis AB, and if CD be taken equal to AQ and the Ordinates DM, QN, and the Line MN connecting their Extremities be drawn, the Segment of the Cycloid $MENM =$ Rectangle Triangle $PBD \pm$ Rectangle Triangle RBQ.

Draw OAX parallel to the Base, and NO, MK parallel to the Axis AB, and draw the Radij CP, CR.

First, If the Ordinates DM QN be on the contrary Sides of the Axis AB, then the Segment $MeMN$ is equal to the Trapezium $MKON$ — Trilineal Figures AKM and AON. Now



the Trapezium $MKON$ is $= \frac{1}{2}MK + \frac{1}{2}NO \times KO =$ (because NO is $= AQ = CD$, and $KM = AD$) $\frac{1}{2}CA \times KO = \frac{1}{2}CA \times AK + \frac{1}{2}CA \times AO$. And by the Property of the Cycloid, $\frac{1}{2}AC \times AK$ is $= \frac{1}{2}CA \times$ Arch $AP + PD =$ 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 AQR; therefore if from the Trapezium $MKON$ the Trilineal Figures AKM, AON be subtracted, and if from the Sectors PBA, RBA, the Segments ADP, AQR be subtracted, there will remain the Segment of the Cycloid $MeNM$ equal to the Triangles $PDB + BQR$.

Secondly,

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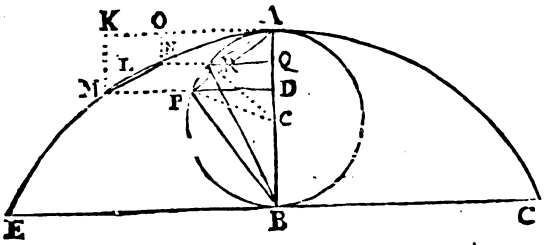
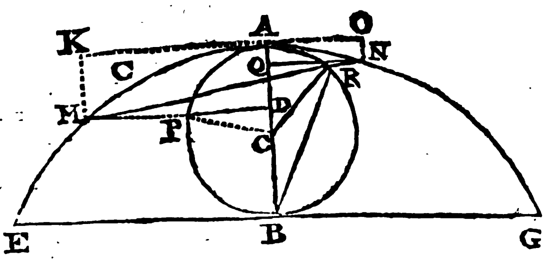
Secondly, But if the Ordinates QN, DM be on the same Side of the Axis AB, then the Segment of the Cycloid $MeNM =$ Trapezium $MKON +$ Trilineal Figure $AON -$ Trilineal Figure AKM. Now the Trapezium $MKON$ $= \overline{\tfrac{1}{2}MK + \tfrac{1}{2}ON} \times OK = \tfrac{1}{2}CA \times AK - \tfrac{1}{2}CA \times AO =$ Sector $PBA -$ Sector RBA



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 $AQR -$ Segment $ADP =$ Rectangle Triangle $PDB -$ Rectangle Triangle RBQ.

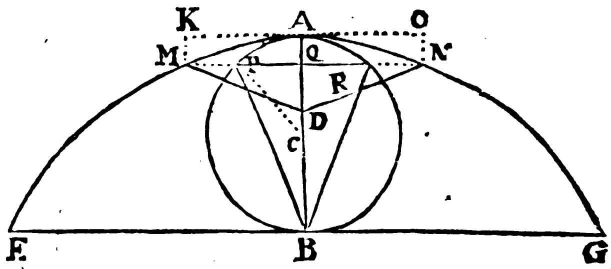
5. If the Points D and Q coincide, then it is manifest that BD or $BQ = \tfrac{1}{2}BC$, and the Chord MN is perpendicular to the Axis AB, and the Segment $MeANM$ will be equal to



an Equilateral Triangle inscrib'd in the Generating Circle, and Space $MPBAM$ will be equal to three times the Area of the Triangle CPB. Which was first discover'd by the Excellent Mr. *Hugens*.

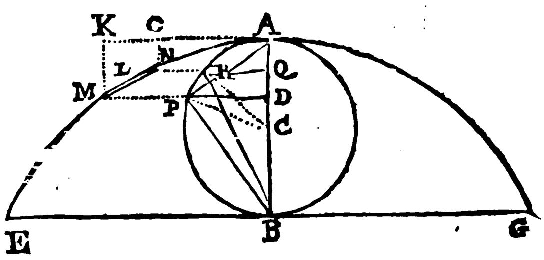
6. But if the Point D fall in the Center, then Q will be in A, and the Segment $MeNM$ will degenerate into that which the Celebrated Mr. *Leibnitz* first squar'd, without having Recourse to the Area of the Circle. And the said Segment $MeNM$ will be equal to the Rectangular Triangle $PBD = \tfrac{1}{2}$ 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 $= \tfrac{1}{2}\overline{DQ + AQ} \times AK = \tfrac{1}{2}AC \times AK = \tfrac{1}{2}AC \times$ Arch $\overline{AP + PQ} =$ to the Sector PBA, and the Trilineal Figure AKM is equal to the 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 BPR.

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 APD, and that $AP = MP$, 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 consist 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 $ACR = \tfrac{1}{2}au$, and the Sector ACP



$= \tfrac{1}{2}ac$, and consequently the Segment AQR, or the Figure AON, is $= ACR - CQR = \tfrac{1}{2}au - \tfrac{1}{2}px$; and the Segment ADP, or the Figure AKM, is $= ACP - CPD = \tfrac{1}{2}ac - \tfrac{1}{2}qz$. But the Cycloidal Segment AQN is $= \overline{QO - AON} = \overline{QO} - \overline{AQR} = \overline{AQ} \times \overline{QR + RN} - \overline{AQR} = AQ \times \overline{QR + AR} - AQR = \overline{a - x} \times \overline{p + u} - \tfrac{1}{2}au + \tfrac{1}{2}px = ap - \tfrac{1}{2}px + \tfrac{1}{2}au - xu$.

And in like manner the other Segment ADM is $= aq - \tfrac{1}{2}qz + \tfrac{1}{2}ac - zc$.

And consequently the Zone $DMNQ = ADM - AQN$ is $= aq - \tfrac{1}{2}qz - ap + \tfrac{1}{2}px + \tfrac{1}{2}ac - zc - \tfrac{1}{2}au + xu$.

Whence it appears, that the Four first Members consist of Rectilineal Figures only, and that the other Terms affected with u and c, hinder the Zone

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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 $= aq - \frac{1}{2}qz - ap + \frac{1}{2}px$. And the remaining Terms muſt be $= 0$, that is, $\frac{1}{2}ac - zc - \frac{1}{2}au + xu = 0$; and if we ſuppoſe the Ratio of c to u 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 $u : c :: 1 : 2$, 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.

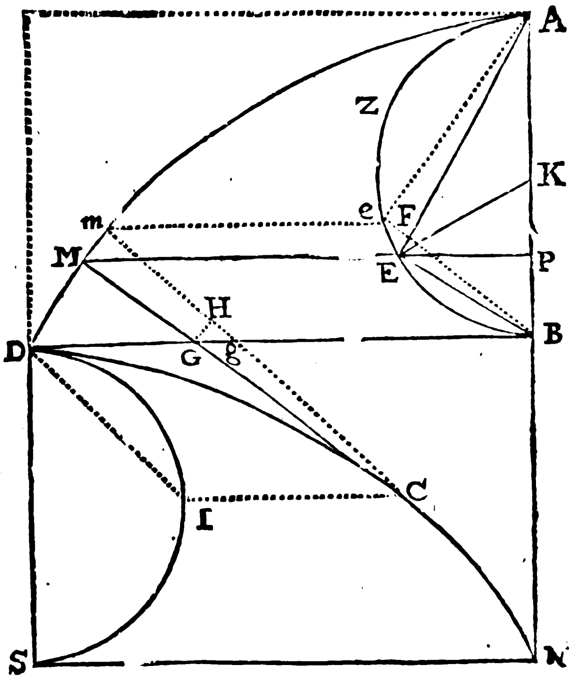
And to find the Value of z in other Terms; if we ſuppoſe CQ the Sine Complement of the Arch AR to be given, then CD the Sine Complement of Double, Triple, Quadruple, &c. that Arch may be found by common Algebra. Therefore if c be $= 2u$, then $z = \frac{2xx - aa}{a}$; if $c = 3u$, then $z = \frac{4x^3 - 3aax}{aa}$; or if $c = 4u$, then $z = \frac{8x^4 - 8aaxx + a^4}{a^3}$, &c. and comparing theſe Values of z with thoſe formerly found, we may find the Value of x in any Suppoſition. *V. g.* If c be $= 2u$, then $z = \frac{a + 2x}{4} = \frac{2xx - aa}{a}$; and conſequently $\overline{8xx + 2ax} = 5aa$. Whence x is $= \frac{1}{8}a + \sqrt{\frac{5}{8}aa + \frac{1}{64}aa} = \frac{1}{8}a + \sqrt{\frac{41}{64}aa} = \frac{1}{8}a + \frac{1}{8}a\sqrt{41}$.

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 $= aq - \frac{1}{2}qz - ap + \frac{1}{2}px =$ the Rectilineal Triangles $CAP + DAP - CAR - AQR$.

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 AMD *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* MC.

Suppoſe $AP = x$, $PM = y$, the Arch $AE = n$, and the Diameter $AB = 2a$; then, by the Property of the Circle, PE is $= \sqrt{2ax - xx}$ and by the Property of the Cycl. $y = u + \sqrt{2ax - xx}$; therefore $\dot{y} = \dot{u} + \frac{a\dot{x} - x\dot{x}}{\sqrt{2ax - xx}}$: But $\dot{u}$ equal $\frac{a\dot{x}}{\sqrt{2ax - xx}}$, therefore $\dot{y} = \frac{2a\dot{x} - x\dot{x}}{\sqrt{2ax - xx}} = \dot{x} \times \frac{2a - x}{\sqrt{2ax - xx}} = \dot{x} \times \frac{2a - x}{\sqrt{x} \times \sqrt{2a - x}} =$



(dividing by $\sqrt{2a - x}$) $\dot{x} \times \frac{\sqrt{2a - x}}{x}$; whence $\ddot{y} =$ (ſuppoſing $\dot{x}$ invariable) $\frac{-a\dot{x}^2\sqrt{x}}{xx\sqrt{2a - x}} = \frac{-a\dot{x}^2}{x\sqrt{2ax - xx}}$; and ſubſtituting this Value in the General Theorem $\frac{\overline{\dot{x}^2 + \dot{y}^2}\sqrt{\dot{x}^2 + \dot{y}^2}}{-\dot{x}\ddot{y}}$, or $\frac{\overline{\dot{x}^2 + \dot{y}^2}|^{\frac{3}{2}}}{-\dot{x}\ddot{y}}$ we ſhall have (becauſe $\dot{y} = \dot{x}\sqrt{\frac{2a - x}{x}}$)

$$\frac{\overline{\frac{2a\dot{x}^2}{x}}|^{\frac{3}{2}}}{-\dot{x}\ddot{y}} = \frac{\sqrt{\frac{8a^3\dot{x}^6}{x^3}}}{-\dot{x}\ddot{y}} = \frac{\sqrt{\frac{8a^3\dot{x}^6}{x^3}} \times x\sqrt{2ax - xx}}{a\dot{x}^3}$$

$$\frac{\sqrt{\frac{8a^3}{x^3}} \times x\sqrt{2ax - xx}}{a} = \frac{\sqrt{\frac{16a^4x^3 - 8a^3x^4}{x^3}}}{a}$$

$2\sqrt{4aa - 2ax} = MC = (2\sqrt{EPq + PBq} = 2EB) = 2MG$, becauſe MC perpendicular to the Curve in the Point M is parallel to the Chord BE.

CONSECTARY I.

If x be ſuppoſed $= 0$, then is $AN = 2\sqrt{4aa} = 4a =$ to the Ray of the Evoluta in the Vertex A; and if we ſuppoſe $x = 2a$, then $MC = 2\sqrt{4aa - 4aa} = 0$; that is, the Ray of the Evoluta in D, is equal to nothing; and in A it it is equal to twice the Diameter of the generating Circle; and hence 'tis evident, that the Evoluta begins in D and ends in N, so that BN is $= BA$.

CONSECTARY 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 $EB =$ Arch DI; therefore IC is $=$ Arch DI, and consequently the Evoluta DCN is a Semi-cycloid, whose Base is $SN = \frac{1}{2}$ 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 $= 2AB$ ($=$ twice the Diameter of the Generating Circle) and any Portion of the Cycloid, as DC, is $= 2CG = 2DI =$ 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, 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 BG or ME is $=$ Arch AE, and Bg or me is $=$ Arch Ae) and Hg or $mg - MG = Fe$ or $Be - BE$, and (47 *Elem.* 1.) $GH = EF$. Now the Angle MCm is $= EBe$ (because the Perpendiculars MC, mC are parallel to the Chords EB, eB, and GH, EF: The Arches that measure those equal Angels are equal; therefore the Radii CG, EB are also equal, and consequently MG is $= GC$; whence 'tis evident, that the Ray of the Evoluta MC is $=$ twice the Choard $BE = 2MG$.

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 $= \frac{1}{2}\overline{Mm + \frac{1}{2}GH} \times MG = \frac{3}{2}GH \times MG = \frac{3}{2}EF \times BE$; that is, the Trepezium $MGgm$ is $=$ three times the Sector EBF or EBe; therefore the Sum of all the Trapezia, *viz.* the Cycloidal Spacc $MGBA$ is equal to three times the Sum of all the Triangles, *viz.* the Circular Space $BEZA$; and the whole Cycloidal Space $AMDBA$ is $=$ thrice the Area of the Semi-circle $AEBA$.

If

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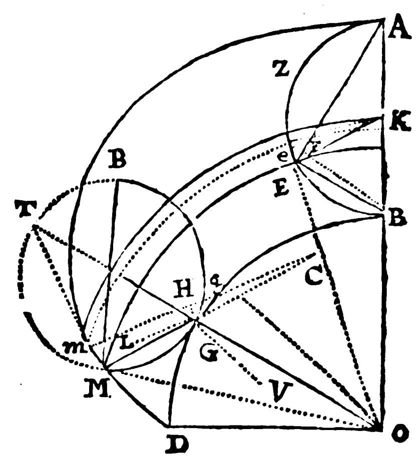
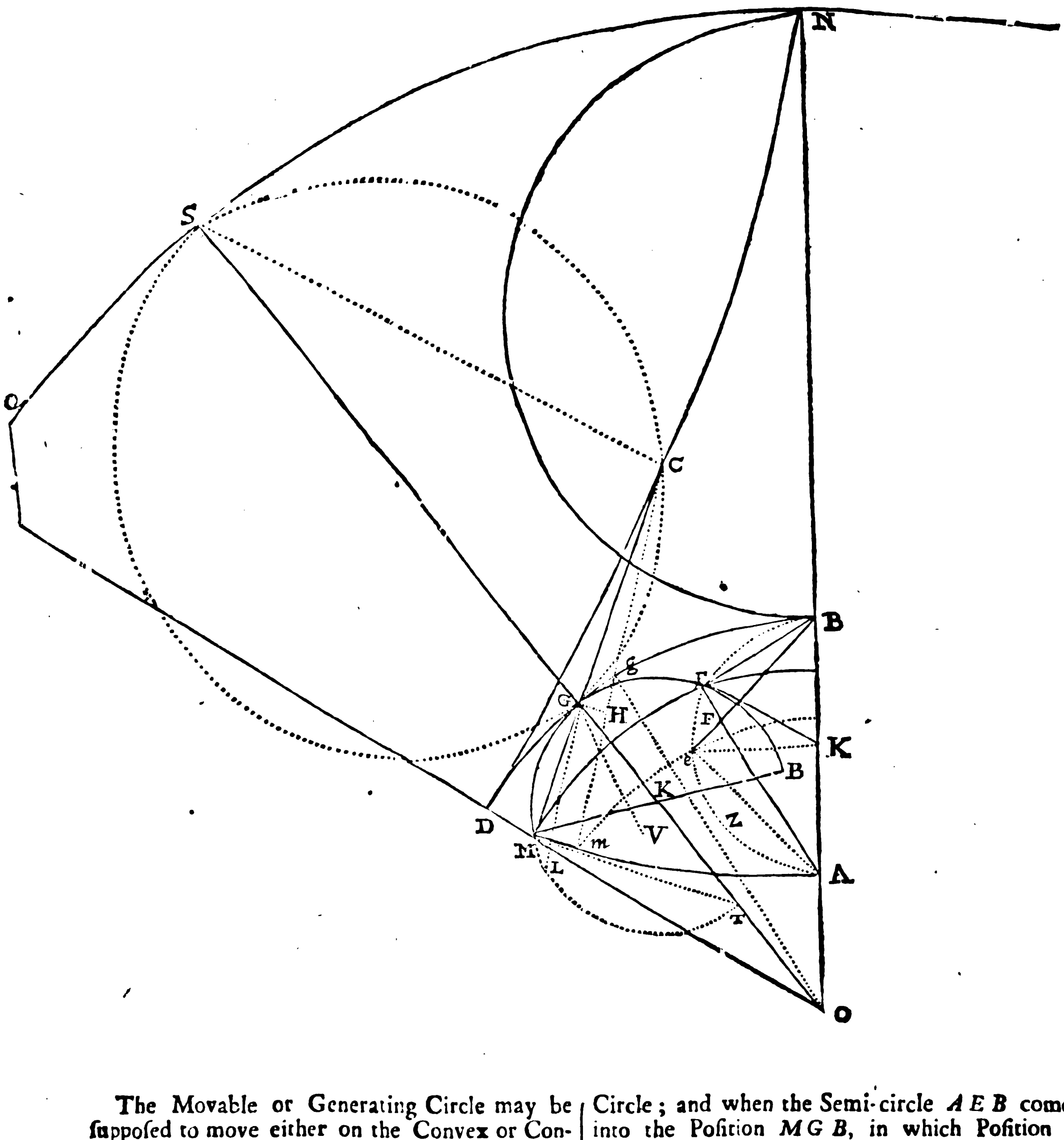
If the Curve AMD *be a Semi-cyloid describ'd by the Revolution of the Semi-circle* AEB, *on the Periphery of another immovable Circle* BDG. *'Tis requir'd to describe the Evoluta of the said Curve.*





The Movable or Generating Circle may be suppos'd to move either on the Convex or Concave Side of the Periphery of the immovable Circle; and when the Semi-circle *AEB* comes into the Position *MGB*, in which Position it touches 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 infer,

1. The Arch GM is $=$ 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 AMD; 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 in 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 deſcrib'd, 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 MG is $=$ Arch EB, and the Chord MG is $=$ Chord EB, and KGM is $=KBw$, and conſequently OGM is $=OBE$.

Theſe things being premis'd, let mC be drawn perpendicular to the Curve AMD, and infinitely near MC; draw alſo another Concentrick Arch me, and another Chord Be; and on the Centers C and B deſcribe the Arches GH, EF: Then the Rectangular Triangles GHg, EFe are equal and ſimilar; for Gg, or $Dg-DG=Ee$, or the Arch $Be-$ Arch BE; and Hg or $mg-MG$ is $=Fe$ or $Be-BE$, and conſequently the little Arch GH is $=$ Arch EF; whence it follows, that the Angle GCH is to the Angle EBF, as CE is to CG. It remains therefore to find the Proportion between thoſe Angles, which we may do in this manner:

Having drawn the Radii OG, Og, KE, Ke, 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) $LGM\mp OGV=GCH\mp GOg$; therefore the Angle GCH is $=$ Angle $EBe\pm GOg$. Now the Arches Gg, Ee being equal, it is, $GOg:EKe$ or $2\,EBF::KE$ $(a):OG$ (b); and conſequently the Angle GOg is $=\frac{2a}{b}EBF$, and GCH is $=(EBF\pm GOg)=\frac{b\pm 2a}{b}EBF$; therefore $GCH:EBF$ $(::AE:CG)::\frac{b\pm 2a}{b}:1$, 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.

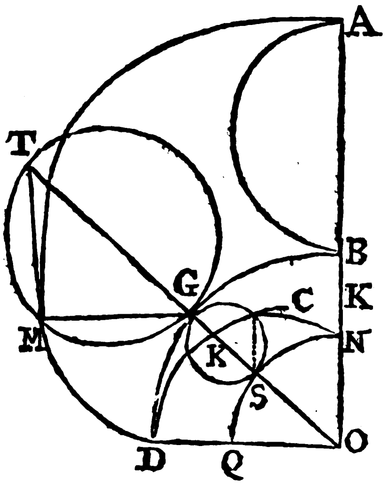
The Evoluta begins in the Point D, and touches the Baſe BGD in D; for the Chord GM (the Third Term in the Analogy) vaniſhes in that Point.

CONSECTARY II.

The Evoluta DCN terminates in the Point N, ſo that then $OA:OB::AB:BN::OA\pm AB\,(=OB):OB+BN\,(=ON)$; that is, OA, OB, ON are continually proportional.

CONSECTARY III.

If the Arch of the Circle NSQ be deſcribed on the Center O, I ſay the Evoluta DCN may be deſcrib'd by the Revolution of the movable Circle GCS (whoſe Diameter is $GS=BN$) about the immovable Circle NSQ; that is, the Evoluta DCN is a Semi-cycloid, ſimilar to the given Semi-cycloid AMD (becauſe the Diame-



ters AB, BN 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 $(=GB)$ $CS::GT:GS::OG:OS::GB:NS$; therefore the Arch CS is $=$ Arch NS; *ergo, &c.*

CONSECTARY 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 is

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is to the Tangent CG; for the Triangles CMm, CGH are ſimilar, therefore $Mm : GH$ or EF :: $MC : GC$ :: (by Conſtruct.) $OA + OB$ $(2b \pm 2a)$: *(See Fig. 2. in Page the laſt but one)* OB (b) and conſequently the Sum of all the Mm, or the Portion of the Cycloid AM, is to the Sum of all the EF, or Chord AE, or Tangent TM, as $OA + OB$ is to OB; whence 'tis evident, that $OB : OA + OB$ $(= 2OK)$ :: $AB : AMD$, and $OB : 2OK$ :: $AB - AE : DM$ :: twice the Verſed Sine of $\frac{1}{2}$ the Angle MKG or EKB : the Portion of the Curve DM.

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 $= \overline{\frac{1}{2}GH + \frac{1}{2}Mm} \times MG$; but CG $\left(= \frac{b}{b \pm 2a} MG : CM \left(= \frac{2b \pm 2a}{b \pm 2a} MG\right)\right.$ :: $GH : Mm = \frac{2b \pm 2a}{b} GH$; therefore (becauſe) GH is $= EF$, and $MG = EB$) $MGHm$ is $= 3\frac{b \pm 2a}{2b} \times EF \times EB$; 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 $MG : GC$ :: $b : b$; 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 §. 4. of *Hayes's Fluxions.* 3. The Space $MGBA$ is to the Segment $BEZA$ :: $3b : b$; which is alſo evident from §. 5. of the ſame Book.

CONSECTARY VII.

The Length of the Semi-cycloidal Curve is proportional to the Rectangle BKO, if the Semi-diameter of the immovable Circle be the ſame. Let BA be the Diameter of one, and Ba the Diameter of another movable Circle; and let OB 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 Equality and Div. $\left.\right\}$ $OA + OB : Oa + OB$ :: $aB \times AMD : AB \times amd$

That is, $2OK : 2ok :: aB \times AMD : AB \times amd$

Whence $OK \times AB : ok \times aB :: AMD : amd$;

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 *Cycloid 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 exact meaſuring of Time by Pendulums: As for Inſtance,*

1. If within the Globe BGD the Cycloid DAQ be deſcrib'd, being biſected in A, and terminating in the Surface of the Globe in D and Q, and if OA be produc'd (biſecting DQ in B) unto N, ſo that OA, OB, ON ∺ and the Globe NS be deſcrib'd on the Center O, and the Semi-cycloids ND, NQ be deſcrib'd within the ſaid Globe; then a Pendulum 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 Cheeks 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 DAQ 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 OX perpendicular to MX; then, becauſe the

Force

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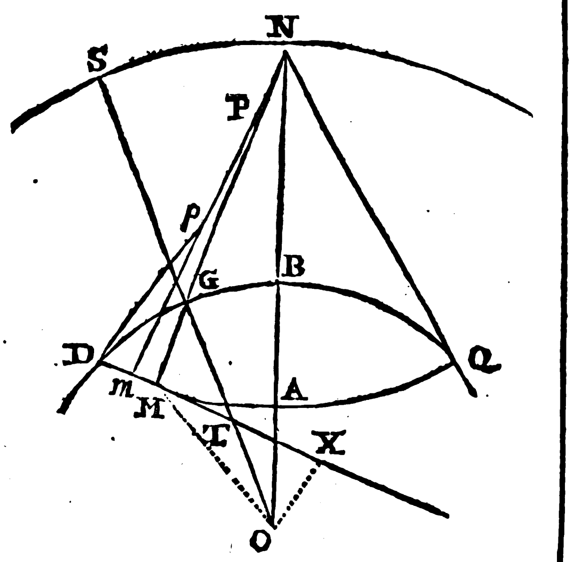
Force of Gravity is as OM, it may be resolved into the Parts OX, MX. Now 'tis evident, that the Force OX, being parallel to the Thread PM, has no other Effect but to distend the same, and is



totally destroyed by its Resistance; therefore the Force MX only accelerates the Motion of the Pendulum M in the Cycloid, and the Acceleration of the Pendulum in the Cycloid is always proportional to this Accelerating Force. 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 MA, mA, 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 describ'd, or the accelerating Forces, will be proportional to the said Arches MA, mA. Whence 'tis 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 A towards Q, with the Velocities which they have acquir'd mA, 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 Isochronal.

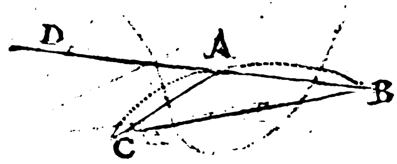
3. And if O, the Center of Attraction, be suppos'd at an infinite Distance from B, then the Curve DAQ (in which the Pendulum vibrates) will be a Vulgar Cycloid, and the Force of Gravity will always be the same in all Places of the Curve. And the Vibrations in this also will be Isochronal, for DBQ will become a streight Line, and GT and MO will be parallel to BA; whence, if MO be a determinate Quantity, and represent the Force of Gravity, then MX, or MT, or MA, will represent the accelerating Force in the Cycloid, &c. *Ergo*,

The same Excellent Person has enrich'd this Theory 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* AC, AB, BC.

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 their 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 Circumference.

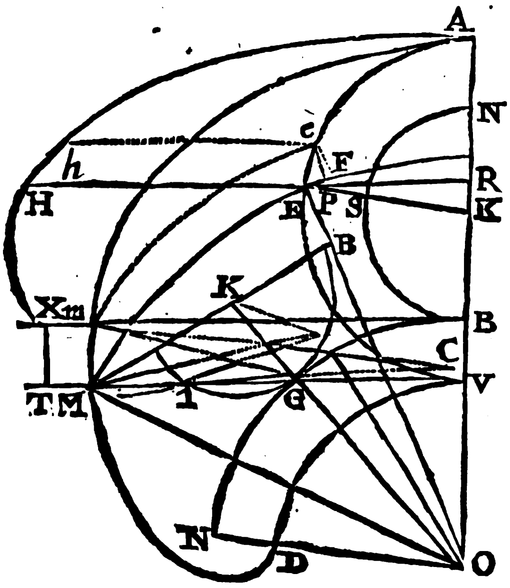
PROP. XIII.

If AMD *be a Semi-cycloid describ'd by the Semicircle* BSN, *revolving on the immovable Arch* BGN, *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* BN, *within or without the Periphery of the movable Circle: 'Tis requir'd to investigate the Value of the Ray of the Evoluta* MC.

Imagine another Perpendicular mg infinitely near MG, intersecting MG, produced in C, the Point requir'd. Draw the Right Line Gm, and take Gg on the movable Circle $= Gg$ on the immovable Circle, (*see the following Fig.*) and draw the Lines Mg, Ig, Kg, Og. Now if we consider the little Arches Gg, Gg is perpendicular to the Radii Kg, Og, then 'tis manifest that the little Arch Gg of the movable Circle falling the Arch Gg of the immovable Circle, the Point M will fall on m, so that the Triangle CMg will exactly cover the Triangle CMg: Whence it is evident, that the Angle MGm is $= gGg$, $=$ (because, adding to both the same Angles KGg, OGg, 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, 1. $OG : GK :: GKg : GOg$, and $OG\,(b) : OG + GK\,(= OK = a + b) :: GKg :$

$GKg + GOg$ or gGg or $MGm = \frac{a+b}{b}$ GKg. 2. $Ig : MI :: GMg : MGI$, and by Composition $Ig + MI$ or $MG (r) : Ig (q) :: GMg + MgI$ or $GIg = \frac{1}{2} GKg : GMg$ or $Gmg = \frac{q}{2r} GKg$. 3. MCm or MGm, $MGm - Gmg \left(\frac{2ar + 2br - bq}{2br} GKg\right) : Gmg$



$\left(\frac{q}{2r} GKg\right) :: Gm (r) : GC = \frac{bqr}{2ar + 2br - bq}$, and consequently the Ray of the Evoluta MC is $= \frac{2arr + 2brr}{2ar + 2br - bq}$.

And if we suppose $OG (b)$ the Radius of the immovable Circle, to become infinite, the Circumference BGN will become a streight Line, and the Terms $2arr$ and $2ar$ will vanish in respect of the others, and the Value of the Ray of the Evoluta MC will be $= \frac{2brr}{2br - bq} = \frac{2rr}{2r - q}$.

CONSECTARY.

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 $GMg \left(\frac{q}{2r} GKg\right)$: Angle $MGm \left(\frac{a+b}{b} GKg\right)$ :: the little Triangle (or Sector) MGg (whose Base is Ggm the movable Circle) : to the little Triangle or Sector GMm. Whence the Sector GMm is $= \frac{2r}{q} \times \frac{a+b}{b} MGg =$ (supposing $MI = s$, and consequently $r = s + n$) $= \frac{2a + 2b}{b} MGg + \frac{2as + 2bs}{bq} MGg$.

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 the Ratio of the Angle GKg to the Angle GMg, that is, as $aa \times GKg$ to $rr \times \frac{q}{2r} GKg$; and consequently the little Triangle MGg is $= \frac{rq}{2aa} KGg$, and substituting this Value in place of the Triangle MGg in $\frac{2as + 2bs}{bq} \times MGg$, we shall have the Sector $GMm = \frac{2a + 2b}{b} MGg + \frac{\overline{a+b} \times sr}{aab} KGg$; but by the Property of the Circle, $GM \times MI (sr) = BM \times MN =$ (supposing $KN = c$) $\overline{cc - aa}$, which is an invariable Quantity, and is always the same in whatsoever Point of the Curve the describing Point M be found; whence $GMm + MGg$ or mGg, that is, the Trapezium $GMmg = \frac{2a + 3b}{b} MGg + \frac{\overline{a+b} \times \overline{cc - aa}}{aab} KGg$. Now because $GMmg$ is the Fluxion of the Cycloidal Space $MGBA$ 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 KBG; it is manifest that the Cycloidal Space $MGBA$ is $= \frac{2a + 3b}{b} MGB + \frac{\overline{a+b} \times \overline{cc - aa}}{aab} \times KGB$. 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* OV *and* OA, *the Arch* EM *be describ'd, and the Radius* KSE *be drawn; I say, the Arch* EM : *Arch* SN :: OE : OB.

Suppose the movable Circle BSN to come into the Position BGN, 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 similar, 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.* GN, 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 $GB =$ superior Arch GB is $= SN$; therefore the Arch EM : Arch $SN :: OE : BB$. 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, BN, and EM, will degenerate into Right Lines VT, BX, and EH, perpendicular to the Axis VA, and consequently the Right Line EH will be $= SN$, because OB and OE being infinite, are

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are equal. Whence the Arch $EM : EH :: OE : OB$.

SCHOLIUM.

The Semi-cycloid AHT, into which the other Semi-cycloid AMD degenerates, when the Radius OB 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 suppos'd, let it be requir'd to investigate the Area of the Cycloidal Space AEM, *comprehended under the Arches* AE, EM, *and the Portion of the Cycloid* AM.

Imagine another Concentrick Arch ME infinitely near to the Arch EM, 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 FEe, OEK equal, because each added to the Angle KEF makes a Right Angle, and the Angle PEe is = Complement of OKE to Two Right Angles, because $PEe + eEK + KER$ is = to Two Right Angles $= KER + EKR + EKR$; therefore the Sine of the Angle FEe is to the Sine of the Angle PEe, as the Sine of the Angle OEK is to the Sine of the Angle OKE: That is,

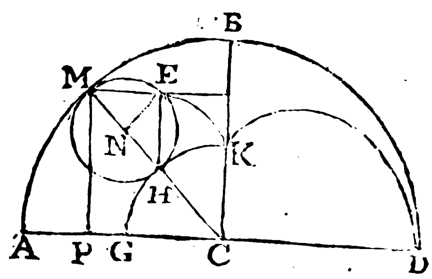
$$Fe : Pe :: OK : OE;$$

And by the Corol. of the preceding Lem. $\Big\}$ $EM : EH :: OE : OB$.

Therefore $Fe \times EM : Pe \times EH :: OK : OB$.

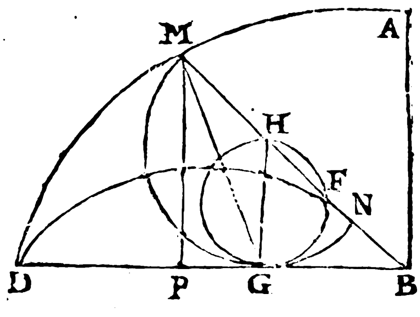
And because the infinitely little Spaces $EMme$, $EHbe$ are equal to the Products or Rectangles $Fe \times EM$, $Pe \times EH$ respectively, and the said Rectangles are always in the same Proportion to one another, that is, the Space $EMme$ is always to the corresponding Space $EHbe$, as OK is to OB; 'tis plain that the Sum of all the $EMme$ is to the Sum of all the $EHbe$, that is, the Space AME is to the Space AEH, as OK 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 suppos'd to be perpendicular to the Diameter AD:



Then the Caustick AFK will be a *Semi-Cycloid*; which will be described by the Revolution 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 CMF is equal to CMP, which is equal to HCK: And consequently the Angle HNF is equal to twice HCK. 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 Semi-circle 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 Reflexion to the said Semi-cycloid AMD.



Because MG is $= \frac{1}{2}$ 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 describing Point M, and the Point of Contact G; 'tis evident that HG will be perpendicular to BD; and that the Angle $GMH = MGH = GMP$; whence it appears, that the reflected Ray MF passes through the Centre H. Now the Circle whose Diameter is GH passes also through the Point F; because GFH is a Right-Angle: And therefore the Arches GN, and half GF, which measure the Angle GHN, are proportionable to the Diameters MN, GH, of their respective Circles: And consequently the Arch GF = Arch $GN = GB$. Whence it is manifest, that the *Caustick* DFB is a *Cycloid*, and describ'd by the Revolution of the Circle GFH on the Right Line BD. Q. E. D.

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COROLLARY.

The Space $DABFD$ is equal to thrice the Area of the Circle GFH: For the Semicircle MGN is equal to twice the Area of the Circle GFH: Wherefore the Cycloidal Space $AMDB$ is equal to 6 times the Area of the Circle GFH; and the Cycloidal Space BFD is equal to thrice the Area of the Circle GFH; and consequently the Space $DABFD$ is equal to thrice the Area of the Circle GFH; and the Curve DFB divides the Space $AMBD$ into two equal parts.

DAN

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DAKIR, by the Statute of 23 *H.* 3. *de compositione Ponderum, &c.* was a Number of Ten *Hides*, as a *Last* was of 20 *Dakirs*: But since, by 1 *Jac.* 33. a *Last* of *Hides* is 12 Dozen.

DAMNUM, did formerly signifie the Bounds or Limits of a Man's private Property or Jurisdiction; as is plain by *Bracton, 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 four 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 miss of downright Suffocation, are on their first Recovery tormented with very violent Convulsions. 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 *Mortal*. The Miners in the *Peake* of *Derby* fancy it arises there from the Multitude of *Red Trefoil Flowers*, called by them *Hony-suckles*, 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 'tis 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 purifie 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 hath a Film grows over it, and then corrupts and becomes Pestilential.

4. 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, tho' 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 K. *Ethelred*, *A. D.* 991. *Ælfred* and *Ingulph* report, that King *Edward* the Confessor remitted and abrogated this Tax: But *William* the Conqueror, tho' he would not re-induce the Annual Payment, yet 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.* I. it was computed amongst the King's standing Revenues: But K. *Stephen*, upon his Coronation-Day, promised that *Danegelt* 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 Confessor, *c.* 11. rate this Tax at 12 *d.* on every Hide: *Henry Hunt* computes it at 2 *s.* on each Hide; and *John Bramptou* 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 Glossary*.

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 sow in Time of *Pannage* or Mast-feeding.

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 already provided.

DAY, in our Common Law, is sometimes used for the Day of Appearance in Court, either Originally or on Assignation; 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 dismissed without *Day*, he is finally discharged the Court.

DAYWERC *of Land*, was anciently as much 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;) so there are Two Ways of Creating these Deans.

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For those of the *Old* Foundation, are brought to their Dignity much like a Bishop: The Prince first sending out his *Conge d' Eslire* 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 Course; 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. They were elected by the Clergy, and by their 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 Cursus*, *p.* 174.) 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:

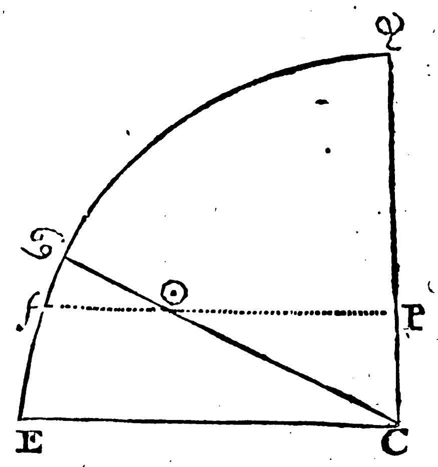
1. One of *English* Coin, 2 Shillings being the Integer.
2. *Troy* Weight, 2 Peny-weight being the Integer.
3. *Averdupois* Great Weight, 28 *lb.* being the Integer.
4. *Averdupois* Little Weight, 16 *oz* or 1 *lb.* being the Integer.
5. Liquid Measure, 36 Gallons being the Integer.
6. Dry Measure, 8 Bushels being the Integer.
7. Long Measure, one Ell or Yard being the Integer.
8. Foot Measure, where 12 Inches is the Integer. And,
9. Time and Motion, where one Hour, Minute, *&c.* may be the Integer.

To every one of these there is joined another Decimal Scale, divided into 100 or 1000 equal Parts; so that if you look on any Division in any of the Nine Scales, you may easily see what Division, or part of a Division, answers to it in 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 Corresponding Parts of any Integer. Thus if in the *Money Scale* you take out any Part of 2 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 Farthings. And so for the rest.

DECINERS, or *Decenniers*, or *Desiners*. *Decennarii*, 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 *Bracton*, *Lib.* 3. *Tract.* 2. *Cap.* 15. In the *Saxons* Times, these seems to have had large Authority, taking Cognisance of Causes within their Circuit, and redressing Wrongs by way of Judgment. In latter Times, the Word came to signifie 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 far 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 within the Leet. Now there are no *Decenniers*, but *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.

DECLINATION *of the Sun*. To find it readily by Projection of Part of the *Analemma*; having his Place in the Ecliptic, and his greatest



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 *E P*. Set 23 *Deg.* 30 *Min.* the Sun's greatest Declination, from *E* to ♋, and draw ♋ *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* ♋, being, suppose, 42 *Deg.* then will the nearest Distance from ☉ to *E C*, be the *Sine* of the Sun's present Declination = to *P C* = to the Ark *F E*, measured on the Chords.

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DECREE, in the Civil Law, is a Determination 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 sundry 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 Feoffment, *A. B.* has *given* and granted, *&c.* they call it a *Warranty.*

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, signified to prohibit and forbid: *Leg. Edw. Confess. c.* 37. and 5 *R.* 2. *c.* 7. And in this Sense *Chaucer* also uses 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. See *Curves.*

DEFLECTION *of the Rayes of Light*, is a Property which Dr. *Hook* observed $167\frac{4}{5}$, 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 the Right Owner. Wherefore a

DEFORCEOR, is he that overcometh and casteth a Person out by Force.

DEFORCIATIO, is a Distraint or Seizure of Goods for Satisfaction of a Lawful Debt. In Assizes and Trials formerly, the *Claimer* or *Plaintiff* was called *Quærens*, 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 written, *Disgrading*, 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. See 18 *E.* 2.

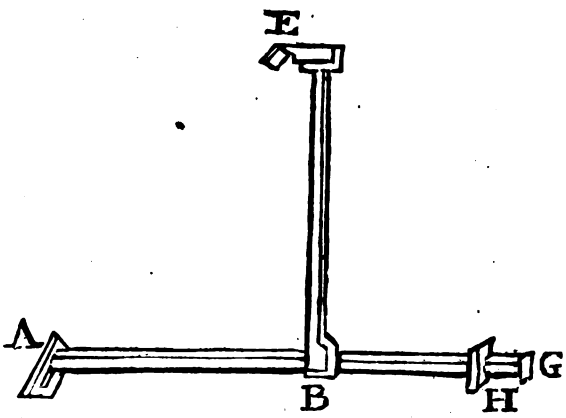
In the Common Law also there are two Sorts of *Degrading*; one *Summary*, by Word only; the other *Solemn*, by divesting the Party *degraded* of those Ornaments and Rites, which are the Ensigns of his Order and Degree. *See.* 13 *Car.* 2. *c.* 15.

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*, 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.

DELEGATION, 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 *A G* is graduated easily, being only a Line of whole Tangents, whose Radius is *E B*, 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 Cross-piece or Transum to and fro, 'till you cause the Shade of the Vane at *E* to fall 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 Cross-piece, 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 9 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 Whitsun-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*.

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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.

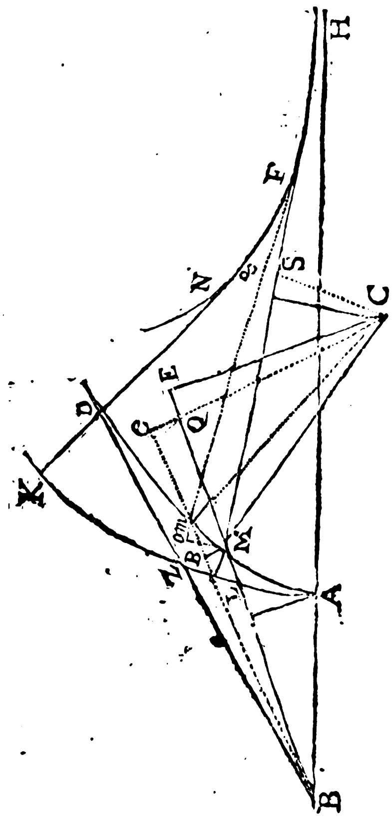
DEPARTURE, in Navigation, is the Easting or Westing of a Ship with respect to the Meridian it *departed* or sail'd from. Or 'tis the difference of Longitude (either East or West) between the present Meridian the Ship is under, and that where the last Reckoning or Observation was made: This *Departure*, any where but under the Æquator, must be accounted according to the Number of Miles in a Degree proper to the Parallel the Ship is 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 imperfect Design is usually call'd a *Sketch.*

DIACAUSTICK Curve, or the *Caustick by Refraction.* If you imagine an infinite Number of Rayes, *B A*, *B M*, *B D*, &c. issuing from the



same Luminary Point *B*, to be refracted from or to the Perpendicular *M C*, at the Curve *A M D*; and so 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 *H F N*, which touches all the refracted Rays, is called the *Diacaustick*, or Caustick by Refraction. How to find these *Causticks by Refraction* to all Sorts of Curves, see *Hayes'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 *Leipsick* Acts of *May*, 1693.

DIACENTROS, is a Word used by *Kepler*, to signify 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 & Umbræ. Rom. 1646.
Marignani Perspectiva Horaria.
Leybourn's Dialling.
Colling's Geometrical Dialling.
Cir. Clavii Gnomonices, Libri 8. Fol.
Voellus de Sciotericis Horologiis.
Cæstii Horologiographia Plana.
Hollwell's Dialling. 4*to.*
Fr. Comondini de Horologio Descriptione. 4*to.*
Sargue's Universal Way of Dialling.
Foster's Elliptical Horologiography.
Fale's Art of Dialling.
Wells's Art of Shadows. 8*vo.*

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 sink an *Airshaft*, or to bring an Adit to a desired 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 designed to expedite the Constitution of all Kind of Dials.

These Lines are,

1. *A Scale of six Hours*; which is only a double 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 six 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 Arks.* 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 set off *C B* and *C A* each equal to 51 *Deg.* 30 *Min.* or the Stile's Height. Then take the whole Scale of six Hours, and set it from *A* to *E*, and from *B* to *E*, dividing those two Lines *A E* and *B E* with the Compass-

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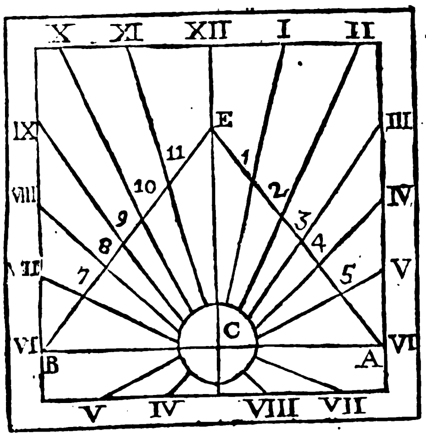
Compasses accordingly; as you see in the Figure:



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 intersect all the other Lines in their proper Points: Or you may open the Compasses to the Planes Declination in the Chords, and then that Distance will find all the rest in the other Scales. Thus, suppose a Plane decline 35 *Deg.* from the Meridian, then all the Requisites by these Scales will be found thus:

	Deg.	*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* shews 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 Money recover'd for Dilapidations, by 14 *Eliz.* 11. shall be employ'd in the Repair of the same Houses.

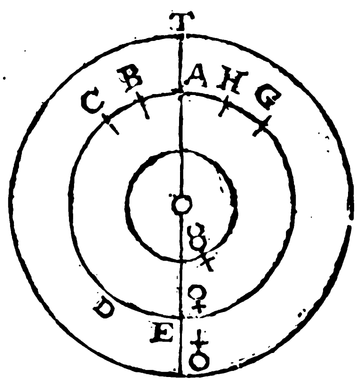
DILVING, is a Word used in the dressing of *Tin Oar*; and means, taking the Forehead of what is in the 2d Buddle after the 2d *Trambling*, and putting it into a Canvass Sieve, to shake it lustily about in a large Tub of Water, so that the Filth goes over the Rim of the Sieve, leaving the *Black Tin* 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 Position. They allowed to this *Diazeutick Tone*, which is our *La*, *Mi*, the Proportion of 9, to 8, as being the unalterable Difference of *Diapente* and *Diatessoron*, or of the *Fifth* and *Fourth*.

DICASTRICK *Muscles*, sometimes called *Biventres*, 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 his 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 *A C D F* 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 *D E F*, 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 Astronomers speak, and so is said to be *Direct*. 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 seem to move with equal Celerity with the Sun, for then she tends directly towards the Earth: Nor can she appear to have any other Motion, than as if her Orbit were carry'd by the Sun moving towards the East. Therefore now she will appear to move slower than before, but still she will

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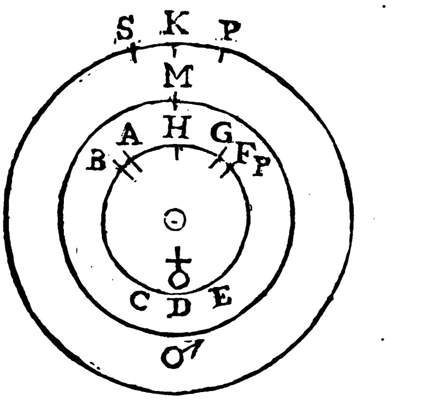
will be direct. But when she gets beyond *H* towards *A*, and then to *B*, she in reality moving swifter than the Earth, (because nearer to the Sun) she will pass by between the Earth and the Sun; and therefore to an Eye placed at the Earth must appear to change her Place among the fix'd Stars, but yet 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, she 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 considerable Time. Also after her *Retrogradation*, and before she begins to *Direct* again, we will be again *Stationary*, as about *B*; and then she is said to be *Stationary towards her Direction*, as before she was *so towards her Retrogradation*.

And 'tis the same Case, 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 least, when she is remotest from the Earth.

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 *A C* ♁ *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 Retrogradation, 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, signifies the same as an Interruption or Breaking off; and is of two Kinds, either

DISCONTINUANCE *of Possession*; the Effect of which is, that Man may not enter on his own Lands or Tenements alienated, whatsoever his Right be to them, of his own self, or by his own Authority; 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 under 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 5 *l.* (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 fallen 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 *Dispaupered*, *i. e.* put out of the Capacity of suing any longer in *Forma Pauperis*.

DISPENSATION of a Law, is a Thing distinct from the Equity of it, or from an equitable Construction of it: For *Equity* 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* ♌ for the Æquator; and to it, at 20 *Deg.* Distance draw *a b* for the Parallel 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 Z *c*, draw *e d*, crossing the Vertical Circle in *d*; measure *c d* on the Sines, it will be a-

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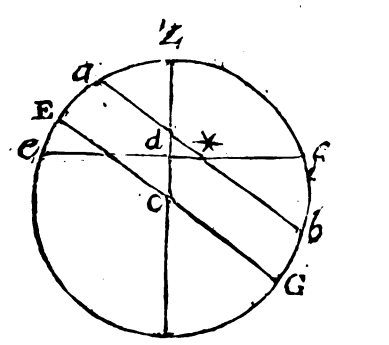
bout 20 *Deg.* whose Complement 70 *Deg.* is the Places Distance from *London*, or Z. Multiply 70 by 70, you have 4900 Miles, the Distance required.



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 Writing*. 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 Deprehension 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 Register, which was called *Dom-Boc*; *i e.* 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 Additiou of *Dey*, 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, signifies Judgment: And in the North, to this Day, a *Daysman* is an Arbitrator, Umpire, or Judge; and so 'tis translated in our English Bible, in *Job.* ix. 33. *Domes-day Book* therefore is no more than the Book of *Judicial Verdict*, *Decretory Sentence*, or *Dooming of Judgment*. *Kennet*'s *Paroch. Antiq. in Gloss.*

DORMANT *Tree*, is a Word used in Architecture, by some Workmen, for a great Beam lying a-cross the House; which is usually called a *Summer*.

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 inferior Ordinary, for his delaying of Justice in some Cause Ecclesiastical; as to give Sentence, to institute a Clerk presented, &c. The Effect whereof is, That the Archbishop taking Knowledge of the Delay, directs his Letters, under his Authentick Seal, to all and singular 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 before 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 whose Petition Justice is delayed. *Cowel*'s *Interpreter*.

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 Abscissæ 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 Intersections, 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, signifies 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 each

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each Side, one near the Trunion Hole, and the other at the Train. Large Guns have *Draught-hooks* near the middle *Transum*, to which are fix'd the Chains which serve to ease the Shafts of the *Limbers* on a March.

DRAW-*Bridges*, are made after several Fashions, 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 Counterpoise, 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.* say, were Tenants *in Capite:* Such as at the Conquest being put out of their Estates, were afterwards restor'd by King *William*, because they being Owners thereof, were neither against him by their Persons or Councils. *Co.* on *Lit. Fo.* 6. says, these *Drenches* are Free Tenants of a Manor.

DRENGAGE, was the Tenure by which the *Drenches* held their Lands.

DRIFTWAY of a Ship, the same with *Leeway*.

DUCTILITY. Captain *Halley*, in *Philosoph. Trans. N.* 194, gives this further Account of the extreme Ductility, and exceeding Minuteness of the Parts 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 Earth's Centre, since 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 bestow 4 *oz.* of Gold; that is, to every 48 *oz.* 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 single 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 $\frac{1}{2}$ and Gold 18 $\frac{1}{2}$; he found the Diameter of such Wire to be $\frac{1}{186}$th Part of an Inch, and its Circumference $\frac{1}{123}$d Part of an Inch; but the Gold did not exceed in Thickness $\frac{1}{134500}$th 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 tho' the Gold be stretch'd to such a prodigious Degree as is here demonstrated, it still shews itself of so 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 *Pores*. Which argues, that even in this exceeding Thinness, 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 Plate 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-

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EALDERMAN, was a Title among the *Saxons*, of the same Import as *Earl* among the *Danes*, and signified an *Elder* or *Statesman*; such an one as the *Romans* call'd *Senator*: And to this Day we use the Word *Alderman* in the same Sense for an Associate 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.* I.) 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 Internal. 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 sticks close to the Cartilage by means of a fine Membrane. The Cartilage 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 Petrosum* 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 *Crotaphite*, and is inserted into the Upper and Back-part of the *Pinna*. The 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 Use. The Use 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 *Concha* 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 sort of Excrement into the *Meatus*, which hinders Insects 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 inwards, making it a little Concave towards the *Meatus Auditorius*: And there runs a small Twig of a Nerve from the fifth Pair upon its Inside, call'd *Chorda Tympani*; for the Membrane it self is called *Tympanum*.

Behind this Membrane there is a pretty large Cavity called the Barrel; it is about three or four Lines deep, and five or six 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 Muscles.

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 *Obliquus*; it lies in the External Part of the Conduit which goes to the Palate, and entring the Barrel, it is contained in a Sinuosity of the Bone by the upper Edge of the *Tympanum*, and is inserted into the slender 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 Petrosum*, 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 Anvil: 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 Resemblance. '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.

Besides these Bones, there are several Holes in the Barrel. The First is in its Fore-part nearest 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

Vulva,

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Vulva, is membranous. Part of the Air which we breath, enters by this Conduit into the Ear. The Third and Fourth are in the Internal Procefs of the *Os Petrofum*. The one is called *Feneftra Ovalis*; the Bafis of the Stirrop ftands upon it; it is the Entry to the *Veftibulum*. The other is called *Feneftra Rotunda*; it is covered by a fine Membrane, inchafed in a Rift of this Hole; it leads to the *Cochlea*.

The *Veftibulum* is a Cavity in the *Os Petrofum*, behind the *Feneftra 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 into it alfo.

The *Labyrinth* is made of three Semi-circular Pipes excavated in the *Os Petrofum*; they open by five Orifices into the *Veftibulum*. That which is called the Superior Pipe, joins one of its Extremities with one of the Extremities of that which is call'd the Inferior Pipe; and thefe two Extremities open by one Orifice, but the middle Pipe opens at each End by it felf into the *Veftibulum*.

The laft Cavity of the Ear is the *Cochlea*; it refembles 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 feveral Holes, through which Twigs of the Auditory Nerve pafs from the one Canal to the other. The Upper Canal opens into the *Veftibulum*, and the Lower into the Barrel, by the *Feneftra Rotunda*.

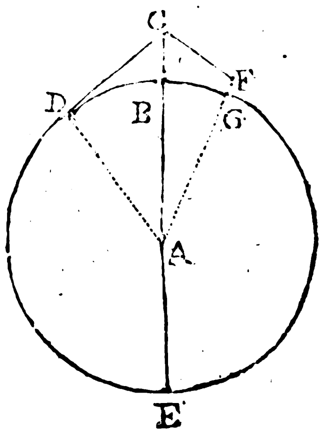
The Veffels of the Internal Ear are Arteries and Veins from the Internal *Carotides* and *Jugulars*. The *Nervus Auditorius* enters by the Hole in the Internal Procefs of the *Os Petrofum*. It confifts of two Bundles, of which one is hard, the other foft. Its *Portio Mollis* is diftributed through all the *Cochlea* and *Labyrinth*, and the *Portio Dura* is beftowed on the External Parts about the Ear.

Sounds being gather'd by the External Ear, pafs 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; thefe little Bones move the Internal Air which is in the Barrel and *Veftibulum*: which Internal Air makes an Impreffion 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 Refractions of the External Air, the Internal Air makes various Impreffions upon the Auditory Nerve, the immediate Organ of Hearing: Thefe different Impreffions reprefent different Sounds.

See *Maria Valtalva de Aure Humana Tractatus*.

EARL, anciently was the Title given to fuch as were Affociates to the King in his Councils or Martial Expeditions; as *Comes* was to thofe who followed the Magiftrates 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, faith **Cambden**, gave this Dignity in Fee to his Nobles, annexing it to this or that County, and allotting them a Proportion of Money, arifing from the Prince's Profits, for the Pleadings and Forfeitures of the Province: Now, and long fince, 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 fome 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 Marquifs, and before a Vifcount.

EARTH. There have been feveral Methods thought of to find the Magnitude of the Earth: As, 1. *To find its Diameter, by having the Height of fome very eminent Mountain, and the Length of a Vifual Ray, that fhall be a Tangent to the Earth's Surface at fome confiderable Diftance from the Top of the Hill*: For the Square of fuch 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 *D C A* by *C B*, *i. e.*



the Square of the Diftance, 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 fo.

2. Let a Spectator on the Top of a high Hill, as at *C*, with an Inftrument, take the Angle *D C B*; which may beft be done by the Help of the Sun or Moon's being in the Horizon; for that Way the Horizon will be the moft accurately determin'd. Then the Length of the Tangent *C D*, being fome-how known, in the Right angled $\triangle$ *D C A*, the Line *D A* = to the Earth's Semidiameter may eafily be drawn, and its Length found by Calculation.

3. The Angle *D C A* being taken, and the Mountain's Height *C B* known; the Earth's Radius *B A* may be had without knowing the Diftance *C D*: For in the $\triangle$ *D C A* all the Angles are known, and the Length *B C* is only the Excefs of the Secant *C A* above the Radius *B A* or *A D*; wherefore by the Tables of Sines, Tangents, and Secants, the Radius *A D* will be known.

There is alfo another way a-kin to thefe, of finding a Part of the Circumference of a great Circle on the Earth, by having the Altitude of two high Mountains, and their Diftance from each other. But none of thefe Ways can be depended upon, tho' they are built upon Geometrical Principles, and are great Inftances of the due Thought and Penetration of the Inventers; becaufe there will be fo many unavoidable Difficulties in the different Refraction of the Atmofphere, in taking the exact Height of the Mountains, or the Diftance of their Tops from the Earth's Surface in *D*, that there can nothing certain be determin'd from hence.

The

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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 seem 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* 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 $3962\frac{1}{4}$ Statute Miles; or more exactly $20923500\frac{1}{4}$ Statute Feet.

Since 'tis known that the Orbit of the Earth is Elliptical, and that its Motion round the Sun is slowest in the *Aphelion*, and swiftest in the *Perihelion*; 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 considerable 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 asserted, 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* saith, 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 since there is no Centrifugal Force at the Poles, a Body there weighs 289 ℔. which, at the Equator would weigh but 288 ℔.

And *p.* 123. He shews;

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* Principles, *Lib.* 3. *Prop.* 21. *The Axis of the Earth* doth, in every Annual Revolution of the Earth round the Sun, *twice incline towards the Ecliptic*, and twice return to its former Position; 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 Inclinationof 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 distinguish them from larger Pictures, which are drawn on Cielings, Roofs, or the Walls of Rooms.

EASEMENT, (*Aisiamentum*) in the Law, is a Service which one Neighbour hath of another, by Charter or Prescription, without Profit; as a Way through his Ground, a Sink, *&c.* and this, in the Civil Law, is called *Servitus Predii*.

EAVESLATH, in Architecture, is a thick feather-edg'd Board, nail'd round the Eaves of a House, for the lowermost Tiles, Slate, or Shingles 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 Astronomy, is the Distance between the Focus and the Centre of the Earth's Elliptick Orbit: How to find which, Mr. *Whiston* shews, *p.* 90. of his *Prelect. Astron.* from the Apparent Motion of the Sun, compared with the two Extreams of the *Apsides*. For since 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, $\frac{1486}{10000}$.

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 *Polysyllabical*; 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 *Centrum Phonicum*; and the Object or Place that returns

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turns the Voice is called the *Centrum Phonocampticum*. 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 sooner, 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, whose *Centrum Phonicum* was on the North Side of *Shipley* Church in the Wild of *Sussex*; and which would repeat distinctly these Words, in the Night;

Os Homini sublimè dedit, Cælumque tueri
Jussit & Erectos-------

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-Glass; 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 *Prælect. Astron. p.*160. and of a Lunar, *p.* 150.

ECLIPSES. 'Tis now discovered, that Lunar Eclipses do not arise from the Interposition of the Earth's *Body* between ☉ and her, but only from the Interposition of her *Atmosphere*.

Of which, and all the *Phænomena* of Eclipses, see *Whiston*'s *Prælect. 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. When therefore hard Bodies are either *bent* or *struck*, so 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*, *bc*, 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 Phœnomena 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 Glass of $1\frac{1}{2}$ in Diameter, 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 totally 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 considerable 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

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point directly towards the Axis of the revolving Glass.

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.

ELLIPSIS. To describe this Figure readily by means of the Sector, see *Analemma*, Vol. I.

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 *Ymbren*, *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 St. *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 *Embraceur*; 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 & 3 *Edward* 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 Assize of Cloth, that it be of the just Ell, or due Measure.

EMENDATIO *Panis & Cervisiæ*, is the Assize of Bread and Beer; or the Power of supervising and correcting the Weights and Measures belonging 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 *Dissolve* (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 Attenuation of the Fluid) being taken away, or at least made less than the natural *Momentum* of the Glands, the Matter must necessarily flow 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 Emetick 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 lb. 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 assist the natural Motion of *Digestion*, 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 Houses or Lands are given, to be possess'd for ever, upon Condition that the Lands shall be improv'd, 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 seems to signify, 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 Monumental Inscriptions and Laws.

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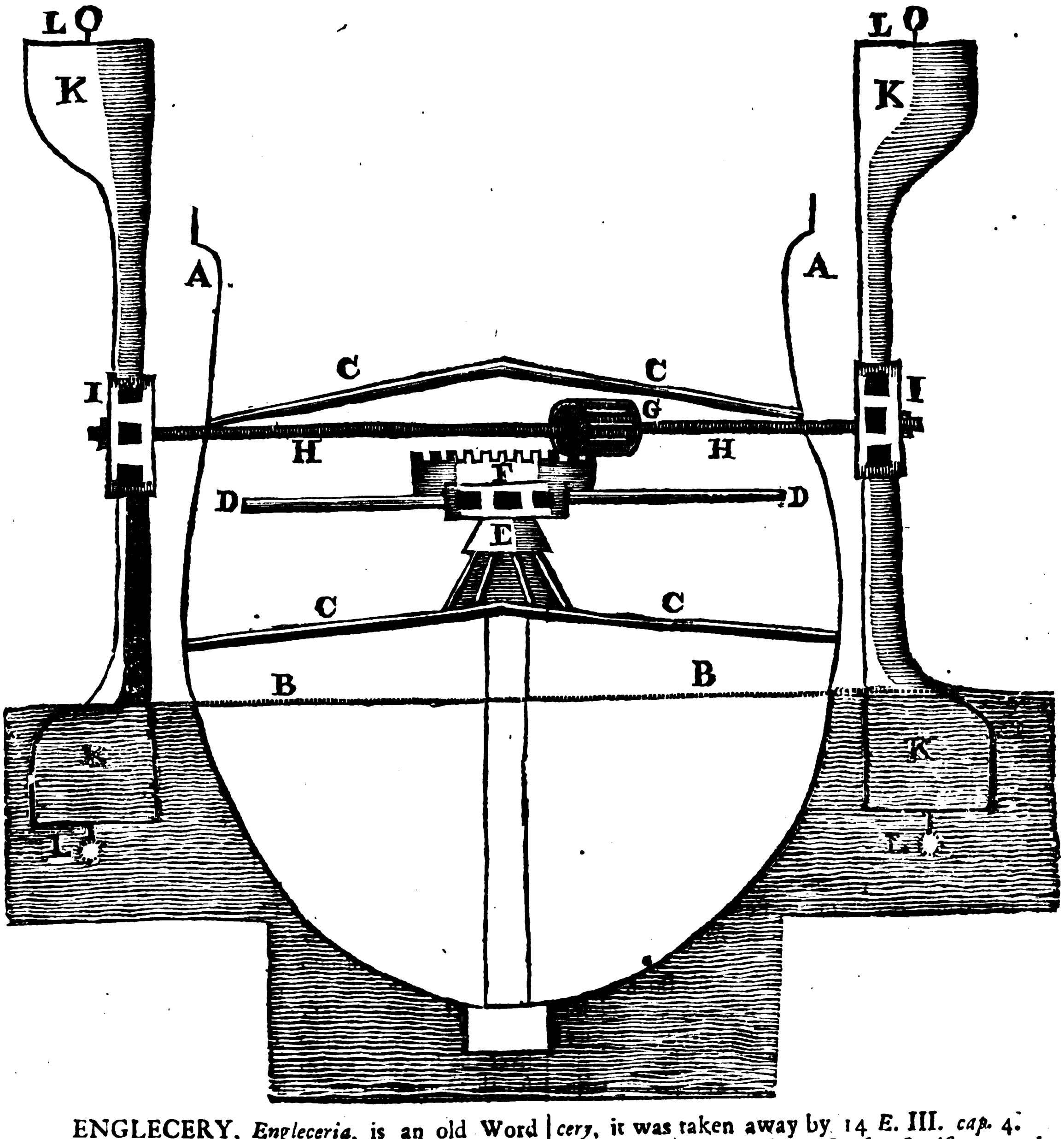
ENGINE for Rowing Ships: The Figure of this Engine being omitted in *Vol.* I. is here added.

Deſcription.

A. The Line the Ship makes.
B. The Water Line.
C. The Decks.
D. The Capſtand Barrs.
E. The Capſtand.
F. A Wheel on the Drum-head 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.
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 Compleat Wheel on each Side the Veſſel.



ENGLECERY, *Engleceria*, is an old Word ſignifying to be an *Engliſhman*: For in the Time of the *Danes*, if a Man were privily ſlain or murdered, it was accounted *Fracigena*, which Word then comprehended every Alien, until *Englecery* was prov'd, that is, 'till it was made manifeſt that he was an *Engliſhman. Vid. Bracton, Lib.* 3. *Tract.* 2. *Cap.* 15. *Fol.* 134. But there being many Abuſes and Troubles about this *Englecery*, 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 Releaſe ſhall *Enure* by way of Extinguiſhment; and a Releaſe made to a Tenant for Term of Life, they ſay, ſhall *Enure* to him in Reverſion.

EPICYCLOID, is a Curve generated by the Revolution of the Periphery of a Circle along the

Convex

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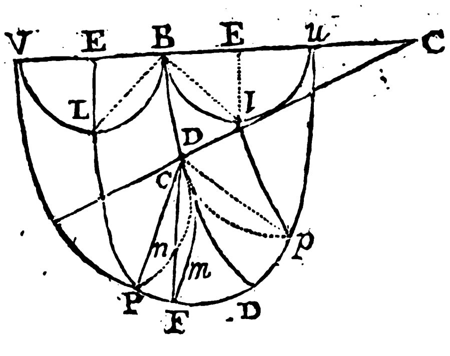
Convex or *Concave* Part of another Circle; which Part of this other Circle is call'd the Base of the *Epicycloid*; as in this Figure, *D B* is the Base of



the *Epicycloid*; *V* its Vertex; *V B* its *Axis*; *D P V* 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 *D B*: As *D P V* is the *Interior Epicycloid*, formed by the Generant's revolving along the *Concave* Side of the Base.

How a Portion of this Epicycloid is squarable, see *Phil. Transf.* N. 217. by Mr. *Caswell*, and in *Phil. Transf.* N. 218. you have a general Proposition 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 formerly collected by the Rural Deans, by them transmitted to the Bishop.

These Customary Impositions were called *Onus Episcopale*, and were by special Privilege remitted to those free Chapels as were built on the *Demesne* of the King, and exempt from Episcopal Jurisdiction.

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;

1. The Diameter of a Sphere being given, to find the Sides of the 5 Regular Bodies, severally, 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 severally to the first Body given.

EQUATIONS. Captain *Halley* in *Philosoph. Transf.* N. 190. *p.* 38. gives an Account of the Number of Roots in Cubick and Biquadratick Equations, together with their Signs and Limits. And in N. 210. he gives a Method for the Extraction of all Roots out of them without any previous Reduction.

In N. 309. there is an Analytical, Geometrical, Mechanical, and Universal Method for the Resolution of Cubick and Biquadratick Equations, by Mr. *J. 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 Cubicks.

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 resolv'd. As all *Quadratick Equations* may be, by the 84th and 85th Propositions of the same *Data*.

EQUES *Auratus*, is used to signify 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 Asymptotes 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 whosoever 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 *Extension 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, shall answer by *Equity* of the said Act: *Quia sunt in Equali genere. Cow. Interpret.*

EQUIVOCAL *Generation*. There is scarce any thing seems more to countenance Equivocal Generation, than the Production of Worms, &c. in the Bodies of Animals; and yet Mr. *Andry*, 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 insensibly. He judges that the Eggs of small Insects 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 smooth in their *Bark* as the other Parts of the Tree

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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* saith, it seems 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*, hath, 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, 72, 75.

Mr. *Willoughby* accounts for the *Ichneumon Wasps*, and the Manner of their laying their Eggs in the Bodies of other Insects; as of Caterpillers, *&c. Phil. Transf. N.* 76.

Dr. *Lister*, *in Phil. Transf. N.* 83. hath refuted the vulgar Notion, that Horse-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 Insects*, as of the *Common Black Beetle*, &c.

ERRANT, in our Law, is the same as *Itinerant*, being attributed to Judges that go the Circuit; 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, signifies, in the Civil Law, a violent or Privy Evasion out of some lawful Restraint.

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 *Spigurnel*, 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 Esquires 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 worshipful Calling; such 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 *Huse 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 Sea.

ESTRAY, signifies any Tame Beast 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 Grass 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 Paroch. Antiq.*

EVICTION, in the Civil Law, is a Recovery of the Title to any thing sold by a Stranger.

EVOLUTA. See in *Involute* and *Evolute* Figures, in *Vol.* I.

EVOLUTION. The Equable Evolution of the Periphery of a Circle, or any other Curve, is such a gradual Approach of the Circumference 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 into a strait Line.

In Philos. Transf. 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 feudatory 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 a 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*, 1693.

EXHIBITION, was anciently an Allowance for Meat 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 1 *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 confess, accuse, or clear himself of any Criminal Matter, *&c.* But this Branch, relating to the said Oath, is repeal'd by *Stat.* 17 *Car.* 1. *c.* 11.

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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 consist 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 *simple* 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 *Exponential* of the second Degree, *&c.*

Thus z^y is an *Exponential* of the first Degree; because the Quantity y is a *simple* flowing Quantity. But z^{y^x} is an Exponential Quantity of the second Degree; because y^x is an Exponential of the first Degree. So also $z^{y^{x^y}}$ is an Exponential of the Third Degree; the Expotent y^{x^y} being one of the second.

See D. Bernoulli's Tractatus de principiis Calculi Exponentialis: And *Craig's* Correction also of a Mistake in it; *in Phil. Transf. 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 construct *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, signifies the valuing of Lands and Tenements of one bound by Statute, *&c.* and hath forfeited his Bond to such an indifferent Rate, as that, by 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, or 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. saith, 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 are now not supposed to be such.

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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 Church-yard, or draw it there, with an Intent to strike, 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 Re-building, 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 *Fasciæ*,) are nothing but broad Lists or Fillets, and are commonly made in Architraves, and in the Corners of Pedestals. In Brick Buildings, they call the Juttings-out of the Bricks over the Windows in all Stories but the highest, by this Name; these are sometimes plain, and sometimes moulded; and this moulding is 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 *Boultine*; which the Workmen call a *Boultrea* and a *Boltell*.

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 such 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 setting 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 *Secta Faldæ*. This Faldage in some Places they call a *Fold Course*, or Free-fold; and in some old Charters 'tis called *Fold-soca*, *i. e. Libertas Faldæ* or *Faldagii*.

FALDFEY, or *Faldfee*, was a Composition paid some Customary Tenants antiently, that they might have Liberty to fold their Sheep upon 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 used in antient Times, containing in value the 4th Part of a Noble, *viz.* Twenty-pence in Silver: In Weight, the 6th Part of an Ounce of Gold, that is, of five 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 signifies the same with *Shelf*; which see.

FASTING *Men*, *Homines habentes*. An old 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 more.

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*, *Osseous*, and *Nervous* Fibres, according to the Matter of which they consist. The *Carnous* Fibres, of which the Flesh is composed, are vascular and hollow, being full of little Cells: They are called *Fibræmotices*, 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 Angles are called *Transverse*; but those which intersect them at any other Angles, *Oblique Fibres*.

FIDE *Jussor*, in the Civil Law, is the same with *Repromissor*, *Adpromissor*, *Sponsor*, *Prædes*, 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 at the End, which, on each Side, hath Ears

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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 Diameter. *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 *Anconies.*

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 signified the *Reception* and *Entertainment* of the King, or any other Lord and his Retinue; and frequently in the Doomsday Book, a Condition of Tenure was *pro firma per unum diem*, or *pro firma per unum noctem*: And so, 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*, *Primitiæ*, 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, forfeits the double Value thereof. Every Clerk therefore, before his Induction, (or soon after,) 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 four equal Half-yearly Payments. Only one Tenth of the whole Yearly Sum mention'd in the Queen's Books to be deducted; because that must be paid by itself the first Year. Formerly four Bonds were given for the four several Payments; but by Statute 2 and 3 of Her 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 unalterable. 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 Notch at the End of the *David*, and serves to hawle up the Fluke of the Anchor to the Ship's Bow.

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. *Willoughby* 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 *Bellæ Marinæ*) 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* Sort, 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 *Spinæ* up and down in their Flesh to strengthen it.

But he thinks it would be yet more proper to divide Fishes into the *Cetaceous* Kind, or such as *breath with Lungs*, and into such as *breath with Gills.* 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 *Galei*, and *Canes* or *Sharks*, and *Dog-Fish*: And the *Broad Kind*; such as the *Pastinacæ*, *Rajæ*, *Squatinæ*, &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 such 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 *Passeres*; or *Longiusculi*, as the *Soleæ.*

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 soft Back Fin*, are of three Sorts; the first Kind have one long continued Fin from Head to Tail, as the *Hipparus* of *Rondeletius*, &c. the second have this Fin, but short, and placed just in the Middle of their Back; and these are either *Marine*, as the *Herring Kind*; or *Fluviatile*, as those we call *Lether-mouthed Fishes*; such as *Carp*, *Tench*, &c.

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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 Carcharius*, 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 lævis*, the *smooth* or *unprickled Hound Fish*.
   6. *Catulus major, vulg. Canicula Aristotelis*, the *Rough Hound*; in *Cornwal*, the *Bounce*.
   7. *Catulus minor*, the lesser *Hound Fish* or *Morgay*.
2. Of the *Plain Cartilaginous Kind*; are the
   1. *Raja levis undulata*, the *Skate* or *Flare*.
   2. *Raja Clavata*, the *Thornback*.
   3. *Raja Aspera Nostras*, the *White-horse*.
   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. *Passer 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 Fluviatilis*, 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-Potts-Hog*; the *Cornish* Boys call it *Father-Lasher*.
5. Of the Kind of Fishes *wanting the Belly Pair of Fins*; we have,
   1. *Mola Salviani*, the *Sun Fish*.
   2. *Acus Aristotelis*, *Species major*.
   3. *Acui Aristotelis congener*, the *Sea Adder*.
   4. *Xiphias*, *seu Gladius piscis*, the *Sword Fish*.
6. Of the *non Spinous Kind* of Fishes, with 3 *unprickly soft Fins* on their Backs; we have,
   1. *Asellus vulgaris 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 *soft Fins* on their Backs; are found with us,
   1. *Merlucius*, the *Hake*.
   2. *Asellus longus*, the *Ling*.
   3. *Thynnus*, see *Thunnus*; 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 Griseus*, the *Gray*.
   11. *Trutta Salmonata*, the *Salmon Trout*.
   12. *Trutta Lacustris*, the *Scurf*, or *Bull Trout*.
   13. *Trutta Fluviatilis duum generum*, the *Trout*.
   14. *Umbia Minor Gesn*, the *Red Charr*, or *Welsh Torgoch*.
   15. *Carpio Lacus 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 Schonfeldii*, in the *West* of *England*, a *Dog*.
8. Of the *non Spinous Kind*, with only 1 *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 *Fœtus* 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. *Capito*, *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. *Bobites Fluviatilis barbatula*, the *Loche*.
   20. *Varias*, *seu Phoxinus Lævis*, the *Pink* or *Minnow*.

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,
   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 *Rotchet*.
   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*.

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10. 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-head*, 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 Aberti*, the Common *Prickle-Back*, or *Sharpling*, or *Banstickle*.
6. *Piscis aculeatus minor*, the lesser *Prickle-Back*.

11. Of the *Cetaceous Kind*, we account only,

1. *Balæna Britannica Antiquorum*; which now seems to be gone from our Seas, and we scarce know what kind of Fish it was.
2. *Balæna vulg. Rondel*, the *Whale*, which is sometimes found stranded on our Coasts; or rambles up our Rivers.
3. *Delphinus Antiquorum*, the *Dolphin*, very rarely, but sometimes seen here.
4. *Phocæna*, 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 Disposition 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. *p.* 3. See *Light*.

FIXED *Stars*. The Phœnomena's that have been oserv'd by Astronomers about the Fix'd Stars are these:

1. That they all, together also with the Planets, or Erratick Stars, and all the Celestial 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 easily 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.

Provehimur Portu, Cœlique ac Astra recedunt.

2. It hath been observ'd of the Fix'd Stars, that besides the former apparent Motion round the Earth in 24 Hours, they also seem to have another 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 Consequentia* by a slow 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 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 *Præcession* therefore of the Terrestrial Equinoxes may serve to account for this Motion of the Fix'd Stars, since 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 before, they annually do their Longitude.

Which is a difficult Thing to account for without the New Astronomy. For allowing the former 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 since there is no such Thing observ'd, 'tis likely, that Motion of Longitude belongs not to the Stars, but to the *Nodes* of the Earth's Orbit, as has before shewn. But allowing that Recession of the 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.

4. 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 adscititious Rays which strike 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 guess at which, Mr. *Hugens* supposes the Dog-Star, *Syrius*, to be about the Bigness of our Sun; and then considers how remote our Sun must be placed, before his Diameter would appear as little as that of *Syrius*: And on the whole, he concludes, that *Syrius* and the nearest Fix'd Stars, cannot be less distant than 150000000000 of our Miles from the Earth, which is 27000 times as far off as our Sun is from us.

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And by that Annual Parallax which hath been found to belong to the fix'd Stars, and is about 47 Seconds, they conclude, that they are distant from us about 9000 times the Radius of the *Magnus Orbis*, *i. e.* 9000 times as far off as the Sun; or about 50000000000 Miles.

6. The *Milky Way* is a circular Tract in the Heavens, extending over a very considerable 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 inconspicuous 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 strong 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 Reflection from the Sun.

9. The Fix'd Stars are observ'd to twinkle much more than the Planets: because their apparent 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 Observations of our Modern Astronomers.

In *Phil. Trans. N.* 73. there is an Account that *S. Montanari* 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 *Cassiopæia*; two others in *Eridanus*; and four towards the *Arctick* 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 Pectore Cygni*. 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 Constellation.

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*, p. 46.

Dr. *Hook, Op. Posthum.* p. 109. gives very probable Reasons why the Fix'd Stars should be of the same Nature with the Sun; which are drawn from their *vast Distance*, and their affecting our 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 *Is. 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 Distance from us.

"That the Fixed Stars, by reason of their immense Distance, are to be look'd upon as Points, (unless so far as their Light is dilated by Refraction) is plain from hence: That when by the Moon's Appulses to them they are eclipsed or cover'd by her Body, their Light doth not, like that of the Planets in the like Case, vanish 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, instantaneously, 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. *Huygens* computes, that the Distance of the Sun, to that of the nearest Fix'd Star, is as 1 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 else they could never keep together, when press'd by a violent Heat; which yet we find the Particles of some fix'd Bodies will do. See *Cohesion*.

FLAME-*heat*. The same with a *White-heat*; which see.

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, signifies a suddain Gust of Wind, which sometimes also the Seamen call a *Squale*.

FLEXION and *Retrogression of Curves*. See *Contrary Flexion*.

FLIGHT. In melting the Lead-Oar in the Works in *Mendip*, there is a Substance flies away in the Smoak, which they call therefore the *Flight*. They find it sweetish upon their Lips, if their Faces happen to be in the Way of the Smoak; which they

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-hearth*) 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 half Nobles of that Prince.

But what is most observable, is, that *Fabian* calls the *Floren* a Penny, val. 6 *s.* 8 *d.* the half *Floren* an Halfpenny, val. 3 *s.* 4 *d.* the Quarter *Floren* a Farthing, val. 1 *s.* 8 *d.* 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. Preciosum*, 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 Distance, 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 *singly*, and the adventitious Impulses of Light, Heat, or other external Causes, may make the Particles of Fluids continually move round about one another, and so 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 intervening 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 Heat the Vinculum is solv'd, and these Frigorifick 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 fix Quickfilver.

When a firm solid Body, such as a Metal, is by Heat reduc'd into a Fluid; doth not 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 flown out, come nearer to, attract one another, and coalesce again?

As therefore the Cause 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 Lift between every two Flutes.

FLUXIONS. This general Method of finding the Fluxions of all Powers and Roots, I had from the Honourable *Fr. Robartes*, 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 $x x \pm \dot{x}$ ($\dot{x}$ 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 $x + \dot{x}$ contains the simple Quantity and its Fluxion; so the Square, Cube, *&c.* and the Square Root, Cube Root, *&c.* of $x + \dot{x}$ must contain the respective *Powers* or *Roots* of x with its Fluxion respectively.

And consequently, if the *Flowing Quantity* be respectively substracted, the *Fluxion* only must remain.

Thus the Fluxion of $x\,x$, is $\overline{x \mp \dot{x}} \times \overline{x \mp \dot{x}} - x\,x = 2\,x\,\dot{x} \mp \dot{x}\,\dot{x}$: And the

Fluxion

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Fluxion of xxx is $\overline{x+\dot{x}}\times\overline{2x\dot{x}+\dot{x}\dot{x}}+xx-xxx=3xx\dot{x}+3\dot{x}\dot{x}x+\dot{x}\dot{x}\dot{x}$.

But since $\dot{x}\dot{x}$, Part of the Fluxion of xx, is infinitely smaller than $2x\dot{x}$, whereby it can make no sensible Change in that Quantity, it may be laid aside as of no Value.

And for the same Reason, $3x\dot{x}\dot{x}+\dot{x}\dot{x}\dot{x}$ may be left out of the Fluxion of xxx; so that their remains only

$$\left.\begin{matrix}2x\dot{x}\\3xx\dot{x}\end{matrix}\right\}\text{ for the Fluxion of }\left\{\begin{matrix}xx\\xxx\end{matrix}\right.$$

Thus also the Fluxion of $\sqrt{x}$ is $\sqrt{x+\dot{x}}-\sqrt{x}=\frac{\dot{x}}{2\sqrt{x}}$; which will be evident, by only extracting the square Root of $x+\dot{x}$ according to the common Method, thus;

$$\left.\begin{array}{lll} & x+\dot{x}\,(\sqrt{x}+\frac{\dot{x}}{2\sqrt{x}} & \\ 2\sqrt{x})\,\frac{x}{0}+\dot{x} & & \\ \quad\frac{\dot{x}}{0} & & \frac{\dot{x}\dot{x}}{4x}\end{array}\right\}$$

The Fluxion of

$$\left.\begin{matrix}\sqrt[3]{x}\\ \\ \sqrt[3]{xx}\\ \\ \sqrt{xxx}\end{matrix}\right\}=\left\{\begin{matrix}\frac{\dot{x}}{3\sqrt[3]{xx}}\\ \\ \frac{2\dot{x}x}{3\sqrt[3]{xxxx}}\\ \\ \frac{3xx\dot{x}}{2\sqrt{xxx}}\end{matrix}\right.$$

So that $\sqrt{x+\dot{x}}$ is equal to $\sqrt{x}+\frac{\dot{x}}{2\sqrt{x}}-\sqrt{x}$, which is equal to $\frac{\dot{x}}{2\sqrt{x}}$ the Fluxion of $\sqrt{x}$, as above.

Indeed $\sqrt{x}+\frac{\dot{x}}{2\sqrt{x}}$ is the true Root of $x+\dot{x}+\frac{\dot{x}\dot{x}}{4x}$ as the Operation shews, and consequently somewhat bigger than the Root of $x+\dot{x}$. But $\frac{\dot{x}\dot{x}}{x4}$ being indefinitely less than what is annex'd to the Difference between $x+\dot{x}+\frac{\dot{x}\dot{x}}{4x}$ and $x+\dot{x}$, may be consider'd as of no Value. Wherefore $\sqrt{x}+\frac{\dot{x}}{2\sqrt{x}}$ may be taken for the true Root of $x+\dot{x}$.

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 Infiniment 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 *Philos. 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, so 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. Posthum. 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 $\frac{1}{8}$ 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 ℔. Weight; at the Mines, it is $22\frac{1}{2}$ Hundred; and among the Plumbers, at *London*, it is but $19\frac{1}{2}$ Hundred.

FOETUS. The *Fœtus* is almost of an Oval Figure, whilst it lies in the Womb: For its Head hangs down with its Chin on its Breast; 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, before: 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 *Fœtus*. When it happens to present it self in any other Posture, it should be care-

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carefully put back again; and, if possible, turn'd the right Way by the Midwife: But if that can't be done, it should be drawn out by the Feet.

FOLIATE. In *Phil. Transf. N.* 245. there is a Way, communicated by Sir *Rob. Southwell*, of foliating the Globe Looking-glasses. The Mixture is of Quicksilver 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 Quicksilver is put to them. When you use it, the Glass 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 'tis 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 *Prædium Rusticum & 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-mote*; but if of all the Free Tenants of a County, 'twas called a *Schire-mote*. In Towns and Burghs, this solemn Assembly was made by the Sound of a Bell call'd the *Motbell*. In the County *Folk-mote*, all Knights and Free Tenants did their Fealty to the King, and elected their annual Sheriff formerly, (on the 1st of *October*) before the King nominated. But after that, (about the Time of *Edward* II.) the City *Folk-mote* was changed into the Common-Council, and the County *Folk-mote* into the *Sheriffs Turn* and *Assises*. The Word *Folk-mote* had also sometimes a less Extent, signifying only the Assembly 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 *Arteriæ Duræ 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 Phæroides*, by which the 3d Pair of Nerves pass out of the *Cranium*.

FORE-*Staff*, is an Instrument used at Sea to take the Sun's Altitude, 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 the Cross-Staff: Which you will find fully describ'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 *Petræ*, except 2 lb. Each *Petra* contain'd 12 lb. and each Pound contain'd the Weight of 25 Shillings.

FORNICATION, is sometimes used in Architecture, to signify Arching or Vaulting.

FORTIFICATION. Writers on this Subject.

Sir *Jonas Moor*'s Modern Fortification. *London*, 1673. 8*vo*.

Nouvelle Maniere de Fortifier 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, 1535.

Coborn'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 any 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 *Epimis*.

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 six 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 Fractions. Thus suppose $\frac{3}{4}$ of 20 *s.* or of a 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 them by 4, the Denominator; for then a Quotient of the same Value will arise, (for 4) 60 *s.* (15 *s.*) And this shews you the Reason of that manner

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manner of Expreſſion which is uſed by Geometers and Algebraiſts about Fractions; who read $\frac{a}{b}$, 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, $\frac{3aa}{6a}$, by dividing both Parts by $3a$, will be brought down to $\frac{a}{2}$ or $\frac{1}{2}a$. And $\frac{4a^3}{6a^4}$ being divided by its greateſt Common Diviſor $2a^4$, will be reduc'd to $\frac{2aa}{3}$

$$\begin{array}{l} 4z)\ \dfrac{36zz}{4bz+16dz} \left(\dfrac{9z}{b+4d} \right. \\ 4z) \end{array}$$

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 firſt, 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 ſtand $\frac{b}{1}$ or $\frac{a+c}{1}$, which, tho' in the Form of Fractions, are not alter'd, becauſe 1 neither Multiplies 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. Thus,

$$\frac{db}{d} = b, \text{ and } \frac{da + dc}{d} = a + c.$$

III. To reduce Fractions of different Denominators, to others of the ſame Value that ſhall have a Common Denominator; (*which Operation 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 $\frac{fa+fb}{df}$, and $\frac{dbb}{df}$; Fractions in Value equal to the former.

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:

$$\frac{4}{6} \qquad \frac{3}{4}$$
$$\frac{16}{24} \qquad \frac{18}{24}$$

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.* $\frac{a}{x}$, $\frac{b}{y}$, $\frac{c}{z}$, 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

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and Subscribing the *Common Denominator* before found. Thus,

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, $\frac{fa+fb+fbb}{df}$. or $\frac{fa+fb-fbb}{df}$: The former of which is the *Sum*, the latter the *Difference*, of the two given *Fractions*.

V. *Multiplication in Fractions*, is perform'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. Thus,

$\frac{a}{b} \times \frac{d}{c} = \frac{da}{bc}$, 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 $\frac{aa}{b} \times b = aa$, for $\frac{aa}{b} \times \frac{b}{1} = \frac{aab}{b}$; which, casting off the Common Letters in both Parts, leaves aa.

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,

$$\frac{a}{b}\Big)\ \frac{d}{c}\ \Big(\frac{bd}{ac}$$

The Reason of which is plain, from what was said above, That a Fraction is Divided by Multiplying its Denominator. Thus,

$$\frac{3}{4}\Big)\ \frac{12}{16}\ \Big(\frac{48}{48} = 1.$$

For to divide $\frac{12}{16}$ by $\frac{3}{4}$, is to seek how often 3, the Numerator of the Devisor, is in $\frac{12}{16}$; which is done by Multiplying 16 by 3, and the Answer is $\frac{12}{48}$: But then again, because $\frac{3}{4}$ is but $\frac{1}{4}$ of 3, it will be contain'd in $\frac{12}{16}$ 4 times oftner than 3 is; and therefore, in order to bring it to a *Par*, Divide the Value of that Fraction 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. Thus,

$$\frac{a}{b}\Big)\ \frac{c}{b}\ \Big(=\frac{c}{a}, \text{ and } \frac{b}{a}\Big)\ \frac{bb}{a}\ \Big(= b.$$

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. As $aa+\frac{b}{c}$: 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 $\frac{caa+b}{c}$.

Every improper Fraction is Reduc'd back again into its equivalent Mixt Number or Integer, by dividing the Numerator by the Denominator. Thus, $\frac{caa+b}{c}$ divided by c, quotes $aa+\frac{b}{c}$; and $\frac{aa}{1}$ divided by 1, makes aa.

FRAISING *of a Batallion*, is to line the Musketiers all round with Pikes, in case of their being 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. *Michael* by *Magna 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 determin'd 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 Tenant. *Kennet P. Antiq.*

FREEZING. The true Cause of the Congelation of Water into Ice, seems plainly to be the Introduction of the Frigorifick Particles into the Pores or Interstices 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 *Attracting 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 Fluid Form.

Now that Cold and Freezing do arise from some Substance of a *Saline* Nature floating in the Air, it seems probable from hence, That all *Salts*, 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 Stiffness 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

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why they swim in Water when once raised in it, tho' 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 abovementioned, do, by both their Extremities, insinuate themselves into the Pores of Water, and by that Means freeze it into a solid Form. And we see, that the Dimensions of Water are increas'd by Freezing, its Particles being kept at some Distance 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 Insinuation of these Chrystals, the *Volumes* of Air are driven out 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 easily 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 Substances. *Phil. Prin. of Nat. Rel. p.* 66.

FRESCO. Painting in *Fresco* is thus perform'd: 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 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 Plaister stick the better, they drive in Stumps of 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 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 Resistance arising from Friction, and of that which is the Result of the Rigidity of Chords used in Pulleys, &c.

FRIGAT, is a Ship of War, usually of two Decks, light built, and design'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 Assay*, 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, *Strait 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 Nocturnal 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 Almacanters*, or, *Parallels of Altitude*; 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 Compass 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 indeed of common Sense and Understanding.

Now of these Circles of the Sphere, whose Projection constitutes this Furniture; some are *Great*,

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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 describ'd, are parallel to such great Circles in the Heavens as they are design'd to represent, then will those straight Lines be all parallel to one another.

But if the Dial-Plane be perpendicular to any of those corresponding great Circles in the Heavens, then the straight 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 straight Lines will still meet in one Centre upon the Plane, but at *Unequal* Angles.

All lesser Circles of the Sphere, (such as are, *the 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 parallel to those lesser Circles in the Heavens; as 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 perfect 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 follow, 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 full Directions in *Wells*'s *Art of Shadows*, *Hollwell's* and *Leybourn's Dialling*, &c. And the full Demonstration of the whole Matter, *Christopher Clavius* gives us in his *Gnomonicks*. See also *Gaspar Schottus*'s *Cursus Mathematicus*, Book 14. of *Horography*.

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 Rafter from the Top of the Knee to the Cornish. Also when Rafters are rotten, or sunk 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 Rafters.

FUST, is a Term in Architecture for the Shaft of a Column, from the *Astragal* to the *Capital*.

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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 signify 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 Use 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*, signifies all manner of Plough-Tackle, or Instruments used in Husbandry, without any Respect to *Gain*, or *Profit*. For as *Magna Charta* provides, That the Knight and Freeholder shall be amerced *Salvo Contenemento suo*, and the Merchant *Salvâ Mercandisâ suâ*; so the Villain Countryman, or Plowman, was to be fined or amerced for his Offences, but still *Salvo Guinagio suo*, *i. e. Saving all his Plow-Geers, and necessary Implements of Husbandry*: For he was not to be fined so as to be ruined and undone, by taking from him the necessary Means of Life.

GALEASSE, is a large low-built heavy Vessel, 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 she forms a Vein, (which is no Branch of the *Cava*, as all other Veins are) and by it she sends 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 Corpuscles 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 since a 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 slower than it does in the Trunk of the Mesenterick 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 seems 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 hath a new Contrivance to abate the Velocity of the Blood, (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 Purpose. And the Circumference 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 Dimensions of the Spleen are six 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 slower 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.

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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 slow Motion is absolutely necessary 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 *Ductus Choledochius* 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 Mesenterick 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 since 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' so 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 Consideration of these two Contrivances does highly (he thinks) confirm the Truth of his Theory of *Animal Secretion*. For the Diminution 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 Goods 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 *Dotkins*, 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 Besiegers, 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 Main-mast and a Fore-mast, which may be struck or lowered at pleasure. 'Tis said, their Length is usually 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 Liburnicæ*. See my *Introduction to the Bibliotheca Navigantium & Itinerantium*, about the *Antient Shipping*.

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 sail 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 search 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 *Edward* III. 1350. and inferior to none in the World; consisting 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 stiled, The Companions of the Order. See *Cambden, Ashmole*, &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 Vectigalis*, 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 Dessertation*, annexed to *Fleta*, *c.* 8.

GAVELLERTH, *Gavelhert*. The Duty or Work of plowing so much Earth or Ground, done by the Customary Tenant for his Lord: As,

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; and

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and in another, whose Diameter is 19.15, every Inch in Length contains one Ale Gallon.

GAUGER, is an Officer of the King's Excise, whose 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 sold 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. 8*vo.*

Gauging Promoted; being an Appendix to the former Book. *Lond.* 1669.

Smith's Practical Gauging.

Jones's Guide to the young Gauger.

Kepleri Stereometria 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 *Pictantiæ*, or *Pittances*, which, on extraordinary 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 *Animals* are *ex Animalculo.* 2. That the *Animalcules* are originally *in Semine Marium, & non in Fœminis.* 3. That they can never come *Forward*, nor be *Formed* into *Animals* of the respective *Kind*, without the *Ova in Fœminis.*

The *First* of these seems probable from these 3 Observations; 1. That some such Thing has been so often observ'd by *Malpighius* 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 made Dr. *Harvey* conclude, that the *Blood* had a Being before any other Part of the Body, and that from it all the *Organs* of the *Fœtus* 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 Existent before, and discernable by *Glasses.* After an *Incubation* of 30 *Hours*, are to be seen the *Head*, the *Eyes*, and the *Carina*, with the *Vertebræ*, distinct, and the *Heart.* After 40 *Hours* its *Pulse* 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 *Fœtus* 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 13*th 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 *Butterfly*, the *Trunk*, *Wings*, *Feelers*, &c. folded up: But, that after the *Eruca* is *changed* into an *Aurelia*, none of these *Parts* 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* folded 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 *same kind*, and has all its little Members folded up according to their several *Joints* and *Plicatures*, which are afterwards enlarg'd and distended, 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 mutually 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

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originally *in Semine Marium, & non in Fœminis*: And this I collect from these Considerations:

1. That there are innumerable *Animalcula in Semine Masculino Omnium Animalium*. M. *Leeuwenhoek* 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 *Fœtus* in *Eggs*, which have been *Fœcundated* by the *Male*, and the seeing no such Thing in those which are not *Fœcundated*, as appears from *Malpighius* 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 *Fœtus in Ova*, both Before and After *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 *Fœtus*, both before and after *Incubation*; yea, and even the *Fœtus's* of *Animals* do appear so at *first* to the *Naked Eye*; so that Dr. *Harvey* does acknowledge, that all *Animals*, even the *most Perfect*, are Begotten of a *Worm*.

4. This gives a Rational Account of *Many Fœtus's* at *One Birth*, especially that of the Countess of *Holland*; and how, at least, a Whole *Cluster* of *Eggs* in a *Hen* are *Fœcundated* 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 *Fœminis*, which are necessary for supplying them with proper *Nutriment*; and this, these Considerations seem to evince. 1. 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 few *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 *Fœtus* 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 *Fœtus*; for they contain not only the *Cicatricula* with its *Amnion* and *Colliquamentum*, which is the immediate *Nourishment* of the *Fœtus*, but also the Materials which are to be converted into that *Colliquamentum*; so that the *Fœtus* spreads forth its *Roots* no farther than into the *White* and *Yolk* of the *Egg*, from whence it derives all its *Nourishment*. 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 Fœtus* 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 *Fœtus* 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 *Cicatriculæ* or *Ova* to be *Impregnated*, are in *Testibus Fœmineis*; 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 *Fœtus in Utero*, for some considerable Time after *Conception*, has no *Connexion* with the *Womb*; that it sits wholly loose to it, and is perfectly a Little Round *Egg* with the *Fœtus* 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 *Animalcule's Nourishment*, does not sprout from the *Uterus*, but has its Origine elsewhere, and falls in thither as into a fit Soil, from whence it may draw *Nutriment* for the *Growth* of the *Fœtus*; 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 *Fœtus'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 Fœminis*. To all these I shall subjoyn the Proposal of an *Experimentum Crucis*, which may seem to determine whether the *Testes Fœmineæ* be truly the *Ovaria*: *viz.* Open the *Abdomen* of the *Females* of some Kinds, and cut out these *Testicles*, and this

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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 *in Utero*. But as to the last, M. *Leeuwenhoek* has cleared that Difficulty, by the Discovery of innumerable *Animalcula Seminis Maris in Cornutus Uteri*, and those living a considerable time after *Coition*. And as to the former, we may either suppose that there is such an *Inflation* of the *Tubæ*, 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 easily transmit the *Seed* into the *Ovary*: Or else, that the *Ova* are *Impregnated* by the *Animalcules* after they descend into the *Uterus*, 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 *Fœcundated* by *One Tread* of the *Cock*; now this *Fœcundation* 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 *Fœcundation* 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 *Uterus*, and that if they should *Impregnate* the *Ova* in the *Ovary* it self, the *Fœtus* would encrease so fast, that the *Ova* could not pass through the *Tubæ Uteri*, but would either burst the *Ovary*, or fall down into the *Abdomen* from the Orifices of the *Tubæ*; 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 these *Animalcules* and *Insects*, and insinuates, 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 *Punctum* 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 said) 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 signifies 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 us are 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 *Lesser* 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 usually 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 10 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 Secretory Vessels of equal Diameters, which sometimes 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 Ducts, the *Lacteals*, 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 Ducts 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 *Glandulæ Lachrymales*, and the *Prostata.* And a fourth Sort is, when each little Gland hath its own Excretory Duct, 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 demonstrated, there will be no Occasion to refute the Doctrine of Ferments*, nor *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 *Fœtus*) they must, by the Pressure of their contained Fluid, be equally every where distended; 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 whose 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 Particles, of a lesser Diameter than that of the Orifice

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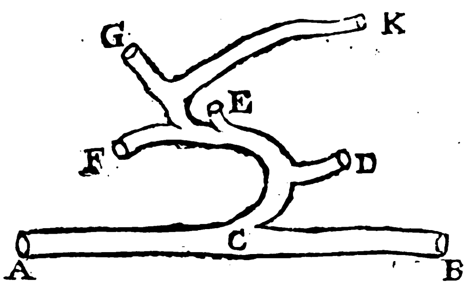
Orifice of the Gland, may enter it: So that without some further Contrivance, that Fluid which contains the biggest Particles, must likewise consist of all the Particles of all the other Secretions; neither could any Fluid thicker than the Blood be separated from it, because of the great Proportion of 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 secerned Fluid.

Now how this Inconvenience may be prevented, and how the Particles of any Size may either be separated by themselves, or with any assigned Portion of the Aqueous Fluid, or of other lesser Particles, I shall endeavour to shew.



Suppose then *A B* 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 further 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 Duct *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 Duct 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 Duct at *K*; and consequently, the secreted Fluid, on this Account, be *Thicker* or *Thinner*.

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 Duct *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 small as only to admit Particles of *Serum*, they will constitute *Lymphatick Vessels*. From whence it is, that we find *Lymphæducts* arising in great Numbers from those Glands that separate thick Humours; as from the *Testicles*, *Liver*, &c.

GLANDULÆ *Miliares*. See *Miliares*, and *Skin*.

GLANDULÆ *Myrtiformes*, are the Contractions of the Fibres of the broken *Hymen*, upon the first *Coition*.

GLANDULÆ *Sebaceæ*, 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 *Sebum*, their first Discoverer *Valsalva*, in his Book of the Ear, calls by this Name. This *Sebum* 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 Rupert'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 hot, 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 Phænomenon, *viz.* as soon as you break off the least Bit from the Stem of it, or pecked End, the whole Bulk of the Drop flies 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 Dissertation 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 *attract* 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 Art of Cutting, Carving, or Casting, the Images and Resemblances of natural Things in Metals.

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GOLD *Mines*. In *Phil. Tranf.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, Newsol, Coningsberg, Bochantz, Libeten*, and *Tiln*) *Chremnizt* is the richeft in *Gold*. They have alfo at prefent, *Gold Mines* at *Bochantz* and *Coningsberg*; and they report in that Country, that there hath been formerly a rich *Gold Mine* at *Glafs-Hitten*, but loft fince that *Bethlem Gabor* over-ran thofe Parts, when the Undertakers ftopped up the *Mine* and fled.

They have worked in the *Gold Mine* at *Chremnitz* 900 *Years*. This *Mine* is divers *Englifh Miles* in Length, and about 160 *Fathoms* Deep. Many *Veins* of the *Ore* run to the *North*, and to the *Eaft*. They work alfo towards *One, Two*, and *Three* of the Clock, as they fpeak; for the *Miners* direct themfelves under Ground by a *Compafs*, not of 32 *Points* (fuch as is ufed 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*, fome is *White*, and fome *Black, Red*, or *Yellow*: That with *Black Spots* in *White* is efteem'd the beft, as alfo the *Ore* which lieth next to the *Black Veins*. This *Ore* is not rich enough to fuffer any Proof in fmall 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 wafh 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 fo wafheth away the Earthy Parts from the Metalline: And from a clear River above the Town, by its running through fo many Works, and over fo much pounded *Ore*, it becomes below the Town a Dark-yellow Stream, of the Colour of the Earth of thofe Hills.

There have been Pieces of *pure Gold* found in the *Mine*; fome of which I have feen in the *Emperor's Treafury*, and in the *Elector* of *Saxony's Repofitory*; one Piece as broad as the Palm of my Hand, and others lefs, and upon a White Stone many Pieces of *pure Gold*; but thefe are very rare.

The common Yellow Earth of the Country near *Chremnitz*, although it be not efteem'd *Ore*, affords fome *Gold*: And in one Place I faw a great Part of an Hill digg'd away, which hath been caft into the Works, wafhed and wrought in the fame Manner as pounded *Ore* with confiderable Profit.

Some Paffages in this *Mine*, cut through the *Rock*, and long difufed, have grown up again; and I obferv'd the Sides of fome, which had been formerly wide enough to carry their *Ore* through, to approach each other, fo as we paffed with difficulty. This happens in moift Places. The Paffages unite not from the Top to the Bottom, but from one Side to another.

There is *Vitriol* in this *Mine, White, Red, Blue*, and *Green*; and alfo *Vitriol Waters*. There is a Subftance found which fticks to the *Gold Ore*, of fmall pointed Parts like *Needles*, called by them *Antimony* of *Gold*. There are *Chryftals* found here, and fome tinctured *Yellow*.

The *Miners* will not allow any *Quickfilver* or *Brimftone* to have been found here; yet in the lately mention'd *Antimony* of *Gold*, there is evidently *Sulphur*, as I perceiv'd by burning. The *Quickfilver Mine*, mentioned in the Anfwer to *Kercher's Inquiries, Mund. Subter.* is an *Hungarian Mile*, or 7 *Englifh Miles* diftant from *Chremnitz*, and is not wrought in at prefent.

There is a *Vitriol Mine* in thefe Hills near the *Gold Mine*; the *Earth* or *Ore* of it is *Reddifh*, and fometimes *Greenifh*. This Earth is infufed in Water, and after 3 *Days*, the Water is poured off, and boiled 7 *Days* in a *Leaden Veffel*, till it comes to a thick granulated whitifh Subftance, which is afterwards reduced to a *Calx* in an *Oven*, and ferveth in the making *Aquæfortis*, or the *Separating Water* ufed 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 wafh it often, and lay it in Powder upon Cloths, and by the gentle oblique defcending of the Water over it, and their continual ftirring it, the earthy, clayifh, and lighter Parts, are wafhed away, while the heavier and *metalline* remain in the Cloths; thefe Cloths are afterwards wafhed clean in feveral *Tubs*, and the Water, after fome fettling, poured off from its Sediment; which Sediment is again wafh'd, and ftirred up in feveral Veffels and Troughs, 'till at length they fprinkle *Quickfilver* upon it, and knead it well together for an Hour, and then wafhing it again in a wooden Veffel, after the feparating of much of it which the *Quickfilver* touches not; by ftriking this Veffel againft their Leg, they bring the *Gold* and *Quickfilver* together, in an *Amalgama*, to one Corner of it. From this *Amalgama* they ftrain as much of the *Quickfilver* as they can through coarfe Cloths firft, and then through fine; then they put the Mafs remaining upon a perforated Plate, which they fet over a deep Pan placed in the Earth, in the Bottom of which Pan they alfo put *Quick-filver*: This Pan they cover, and *lute* the Cover well, and then making a *Charcoal Fire* upon it, they drive down the *Quick-filver*, yet remaining in the *Gold*, to the reft in the Bottom of the Pan; then taking out the *Gold*, they caft it into the *Fire*, that it may become purer.

Concerning *Cranach-Gold*, I cannot learn that there is any fuch *Gold*, or Place where *Gold* is digg'd in *Hungary*; but in *Germany* I think there is, for *Agrigola* mentions fuch a Place as *Golde-Cranacum*, and another called *Golde-Crona*.

For the exceeding Minutenefs of the Conftituent Particles of *Gold*, fee *Ductility*.

GOTHICK *Manner of Building*, was unhappily brought into Ufe, after the Irruption of thofe barbarous Nations, the *Goths* and *Vandals*, &c. from the *North*, and the *Moors* and *Arabs*, from the *South* and *Eaft*, into the civiliz'd World. Thefe rude People demolifh'd what they could of the antient *Greek* and *Roman* Architecture, and inftead of thofe admirable and regular Orders and Manner of Building, introduced a licentious and fantaftical Manner, which, tho' fometimes adorn'd with expenfive Carvings, and coftly, tho' lamentable, Imagery, is without any of that auguft Beauty, and juft Symmetry, which the Fabricks of the Antients entertain us with.

GRAMMAR, is thus very juftly defined by Mr. *Johnfon*, in his Grammatical Commentaries: *That*

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That it is the Art of expressing the Relations of Things in 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 solemnly 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 *Candlemas Day*. These are *Dies non Juridici*, no *Court Days*.

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 Sense.

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 Astronomy, shews, 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 *Democritus*, *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 Purposes they were designed.

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*.

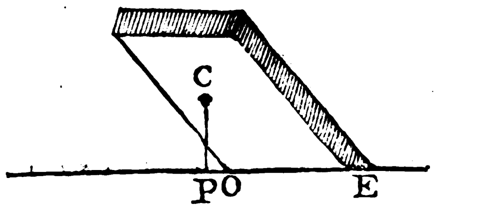
GRAVITY, its *Center*, is a Point in every heavy Body, through which any Plane whatever being drawn, will divide the Body into two Parts of equal Weight.

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) *Innition*.

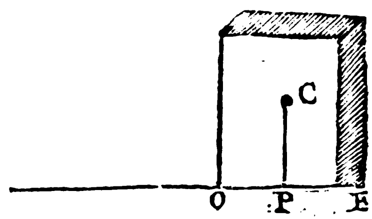
The Line of Direction of Gravity, or *Line of Gravity*, is perpendicular from the Center of Gravity to the Horizon.

If a Body, being placed upon an Horizontal Plane, have its *Line of Gravity* C P falling with-



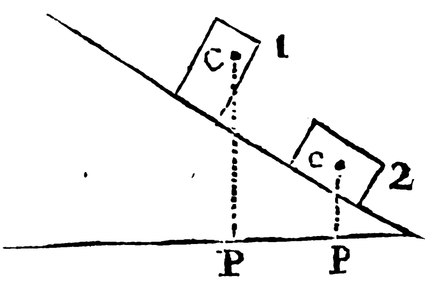
out its Base *O E*; then that Body must fall down, and will fall on that Side where the Perpendicular *C P* falls.

But if that Line *C P* falls any where within *O E*, the Base or Foot on which the Body stands;



the Body will rest there without Danger of falling.

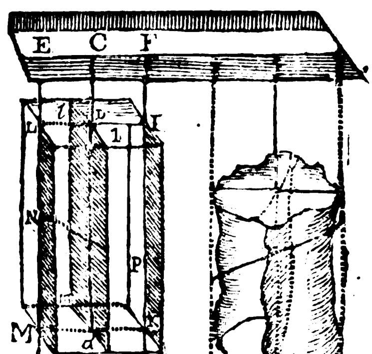
And if a Body be placed on an Inclined Plane, and *C P* the Line of Gravity, as in N. 1. falls



without the Base, it will tumble over; but when it falls within, as in N. 2. it will only slide 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 *E G*, and *F H*, so that they may touch in the Lines *I K*, *L M*, which should be mark'd out with Chalk, *&c.* and then be joined above and below by the Transverse Perpendiculars *I L*, *K M*, so that one of the Planes of Gravity, *I K*, *M L*, may be gained: Also having turned the Solid about,



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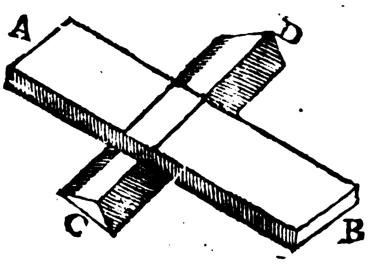
find out, after the same Manner, another such Plane of Gravity, *l i*, *k m*, which will cut the former above in *D*, and below in *d*; and then the Diameter of Gravity *D d* will be had. Then hang the Solid transversly, and the same Way find another Diameter of Gravity *N P*, which will cut the former in *O*, the Centre of *Gravity* sought.

And in some Cases, there may be yet used a more Compendious Way; *viz.* Lay the given Solid *A B* on the fine Edge *C D*, 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 poising the Solid another Way oblique to the former, so will their common Section be one of the Diameters of Gravity: Lastly, roll the Solid into another Position, 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*, signifies in our Law, Contentment or *Satisfaction*. 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 associate 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 Oar.

GROSSE. Formerly a Villain *in Gross*, 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 Disposal. 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 a confus'd Composure of Figures of different Natures, 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 *Trimmers* for the Stair-Case and Chimney-Way, and the Binding Joists.

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 Design of the Piece.

GUARD, in the Military Art, signifies 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, 1. *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 Left 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 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 *Tattou*; 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.

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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 Ditch, 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 Feſtorum*, *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 rarified, 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, (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 Buſineſs.

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 deſigned 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 ſix Subdiviſions, you will have the proper Point for 4860; and then in the next *Centeſm*, taking or gueſſing 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 ſingle 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 extended 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 forward when a greater Term is requir'd, and backward, or towards the Left 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.* So that 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 II.

To multiply or divide one Number by another.

Since in all Multiplication, As 1 is to the One Factor :: So is the Other, to the Product. And ſince 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, ſince 'tis only finding a 4th Proportional to Three Terms given. The Extent of the Compaſſes therefore, from 1 to the Multiplier, 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 Line.

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

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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 ℔. 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.

Bissect 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 Left 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 sought: 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.

PROBLEM 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, set 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 Rectangle being given in Inch-Measure, and the Length in Foot-Measure, to find the Area in Feet.

Extend 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-Measure, to find the Area in Yards.

The Extent from 9 to the *Breadth*, will reach from the *Length* to the *Area* in *Yards*.

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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 Parallelopiped being given in Inch-Measure, and the Length in Foot-Measure, to find the Content in Feet.

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 *Content* 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 Content*.

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 *l.* 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 the Arrears will amount 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.* Interest?

First find the Principal answering to 12 *l.* 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 requir'd.

PROBLEM XXI.

To know 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 fixteen Years end, and at 8 *l. per Cent.* amount to 363 *l.* 18 *s.* And I find (by the 19th *Probl.*) that the said 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 (after 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 Forfeiture to the King or Lord of the Mannor, unless the Right Owner legally claim them within a Year and a Day.

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HABENTES *Homines*, *Feasting-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 stricter Sence; and signified either the King's Guard or Retinue, which were at the King's Pleasure to be *Feasting-Men*, or plentifully entertained at the Houses of his Tenants: Or rather, those 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 Personal 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 cause a very sudden Congelation of Water. Now the same in the Clouds may cause *Hail-Stones*; and the rather, because not only in some 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 ½ or ¼ 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 fell 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 sale 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. Transf.* 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 Reflexions 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 signifie a Convention of Citizens in their Court-Hall; or, a *Holy* or Ecclesiastical Court. *Cowel'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-stringing*.

HAMMER. Besides the *Sledges*, or large *Hammers* used by Smiths, there is, 1. The *Hand-Hammer*, 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 *Rivetting-Hammer*, chiefly us'd for rivetting or setting 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 Assaulteth 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 Gangway.

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.*

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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 *Gothick* Word, signifying 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*, 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 she *Happeth* a Rent, she shall remain an Assize 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 *slower* or *fewer* they are in *the same Time*, the *graver* is the Tune.

So that *any given Note of a Tune is 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 Musical 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 *Acuteness* 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 Acuteness or Graveness of the Tune of that one, to the Tune of the other: And consequently, as the Length is, so is the determinate Time, *cæteris paribus*. 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 arise.

And as the more frequent Mixture or Coincidence of Vibrations render the *Concords* generally so much the more perfect; 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 Motions often; at least in every sixth 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 *Octave* 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 sound 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 sound a *Ditone* or *Third Major*; and their Motions unite after every fourth Recourse, or at every fifth Course.

If *A* be to *B*, as 6 to 5, then they sound a *Trihemitone* or *Third Minor*; uniting their Vibrations after every fifth Recourse, and at every sixth Course, *&c.*

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 Major*, which is 5 to 3, is within the compass of *Ratio's* between 1 and 6. But the *lesser 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 Unison; 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* hath the same Advantage.

HARO, *Harron*, is an *Outcry*, or a Hue-and-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 *Harass'd*, Tired, *&c.*

HATCH, a Term in Mining: See *Essay-Hatch*. *Hatch* is also us'd for a Cross-Board that lies a-thwart the *Pass*, to 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 Designing 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 Dwelling-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, signifies 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 formerly 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 ever.

HEART. Authors which have treated about this Muscle are chiefly *Lower de Corde*, *Bellini de Motu Cordis*, and *Borelli de Motu Animalium*; 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.*

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 Re-action of its Light, and by the Reflexions and Refraction of the Rays within its hidden *Meatus*, 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 Sun: For the Sun and the fix'd Stars seem 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 Parts 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 Receiver.

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. *Newton. Opt.* p. 296. Edit. Lat.

Heat conduces very much to the Fluidity of Bodies, by lessening the Tenacity of their Parts; for it renders many Bodies fluid, which otherwise 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: And yet it doth not much lessen the Resisting Force of Water; which it must do, 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 Inertiæ 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 Officers 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 sometimes granted by the Sovereign to some particular Persons and Societies.

HEIGHT, or *Altitude* 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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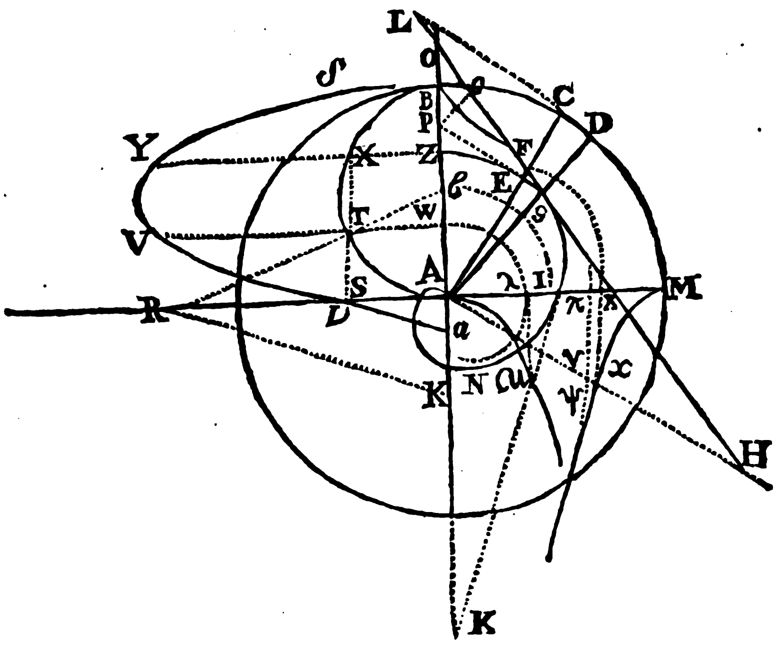
HELICOLD *Parabola*, or the *Parabolick Spiral*, is a Curve which arises from the Supposition of the Axis of the common *Apollonian Parabola's*, being bent round into the Periphery of a Circle, and is a Line then passing through the Extremities of the Ordinates, which do now converge towards the Centre of the said Circle. The *Tangent*, *Area*, *Length*, and *Flexure* of this *Spiral Curve* is investigated by Mr. *J. Bernoulli*, according to the Method of the *Differential Calculus*, in a Discourse on that Method on the *Act. Lipf.* for *Jan.* 1691. Thus,



Suppose the *Axis* of the common *Parabola* to be bent into the Periphery of the Circle BDM (in *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 $BC = x$, $CF = y$. Let also CL, AH, be drawn perpendicular to AC; and let CD be an infinitely small Arch on part of the Circumference, similar to, and concentrick with, the little Arch GE.

The Nature of the Curve is $lx = yy$ (where l stands for the Parameter of the Parabola.) Whence, in this *Calculus*, dx being the Fluxion of x, and dy the Fluxion of y, &c. (*See the Marquis l' Hospital Analyt. des Infiniment petits.*) $ldx = 2y\,dy$; and $dy : dx :: l : 2y$.

$$AD : AG :: DC : GE$$

First then for the *Tangent*. It will be $r : r-y :: dx : \frac{r\,dx - y\,dx}{r}$;

$$FE : EG \qquad FA \quad AH \qquad FC \quad CL$$

$$\text{And } dy : \frac{r\,dx - y\,dx}{r} :: r-y : \frac{dx \times \overline{r-y}^2}{r\,dy} :: y : \frac{ry\,dx - yy\,dx}{r\,dy}$$

To make a particular Application of the General Expression to the Curve proposed; instead of dy and dx, substitute their Proportional l and $2y$; Then will $AH = \frac{2y^3 - ryy + 2rry}{lr} =$ (substituting lx for yy) $\frac{2xy}{r} + \frac{2ry}{l} - 4x$; and $CL = \frac{2ryy - 2y^3}{lr} = 2x \frac{-2xy}{r}$. The greatest AH (CL) will be found, if its Differentials $\frac{6yy\,dy - 8ry\,dy + 2rr\,dy}{lr}$ (or $\frac{4ry\,dy - 6yy\,dy}{lr}$ the Differentials of CL) be put $= 0$: Whence arises $y = \frac{1}{3}r$ ($\frac{2}{3}r$;) and consequently the greatest AH (CL) $= \frac{8rr}{2yl}$ either of them.

COROLLARY.

If the Parameter $\frac{l = rr}{c}$, *viz.* that the Applicate answering to the whole Circumference be the Radius it self (as in the present *Fig.*) then the greatest AH or CL will $= \frac{8}{2y}c$.

The greatest Angle made by the Ordinate and Tangent, viz. AFH, or CFL, is found, by putting the *Ratio* $\frac{CL}{CF}$, or $\frac{2ry - 2yy}{lr}$ equal a *Maximum*; that is, its *Differential* $\frac{2r\,dy - yy\,dy}{lr} = 0$. Whence we have $y = \frac{1}{2}r$; and consequently $\frac{CL}{CF} = \frac{r}{2l}$. But more particularly in the

the Hypothesis of $l = \frac{rr}{c}$, we have $x (= \frac{yy}{l} = \frac{cyy}{rr}) = \frac{1}{4}c$, 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 $AK = \frac{1}{4}$ the Periphery.

Next,

2. *For the Area*: 'Tis $DC + GE \times \frac{1}{2} DG = CDGE$: Or $\frac{2rdx - ydx}{r} \times \frac{1}{2} y = \frac{2rydx - yydx}{2r} =$ (substituting $\frac{2ydy}{l}$ instead of dx) $\frac{2yydy}{l} - \frac{y^3 dy}{lr}$. The *Integral* of which is $2\frac{y^3}{3l} - \frac{y^4}{4l3}$, or $\frac{2}{3}xy - \frac{lxx}{4r}$; which is equal to the Curvilineal Space $BFGDCB$. Wherefore putting $y = r$, we shall find the whole Space $BANGFBCDMB = \frac{5r^3}{12l}$; that is, in the Case of $l = \frac{rr}{c}$, 'tis $= \frac{5}{12}rc$. And since the whole Circle $BDMB$ is $= \frac{1}{2}rc = \frac{6}{12}rc$; the aforesaid Space shall be to the Circle as 5 : 6: And therefore the remaining Space $BANGBA$ will $= \frac{1}{6}$ of the Circle.

Again, *Thirdly*, *For the Length of the Curve*. $FG^q = FE^q + EG^q = dy^q + dx^q \times \frac{rr - 2rq - yy}{rr} =$ (substituting $\frac{2ydy}{l}$, instead of dx) $\frac{rrll + 4rryy - 8ry^3 + 4y^4}{rrll} dy^q$.

Hence

$$FG = dy \times \sqrt{\frac{rrll + 4rryy - 8ry^3 + 4y^4}{rrll}};$$

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 $A\alpha$ be cut off $= l$; then drawing any indefinite Perpendiculars WV, ZY, equidistant from A and B, and cutting the Periphery of the Semi-circle in T and X, let the Right Line XTS be drawn, and joining $S\alpha$, take $AK = AS$, and let KR be parallel to $S\alpha$, and the Right Line $R\beta$ be drawn to the Centre of the Semi-circle; equal to which cut off the Right Lines WV, ZY; Then shall the Points V, Y, be at the Curve $\gamma VY\delta$; which is of such a Nature, that the *Abscissa* $BZ = DG$, and the Space $BZY\delta B$ divided by $A\beta$ $(= \frac{1}{2}AB)$ gives a Right Line $=$ the Curve BFG.

Demonstration.

$AK = AS = WT = ZX = \sqrt{BZ \times ZA} = \sqrt{y \times r - y} = \sqrt{ry - yy}$; and $A\alpha\ (= l) : AS\ (= \sqrt{ry - yy}) :: AK (= \sqrt{ry - yy}) : AR = \frac{ry - yy}{l}$.

Wherefore,

$ZY\ (= WV = R\beta = \sqrt{A\beta^q + AR^q} = \sqrt{\frac{\frac{1}{4}rr + rryy - 2ry^3 + y^4}{ll}}$: Whence a Portion of the Space $Zy\delta B$, of the Breadth $dy = dy\sqrt{\frac{rrll + 4rryy - 8ry^3 + 4y^4}{ll}}$; And this divided by $A\beta = \frac{1}{2}r$, gives $dy\sqrt{\frac{rrll + 4rryy - 8ry^3 + 4y^4}{rrll}} = FG$.

And consequently the whole Space $ZY\delta B$ divided by $\frac{1}{2}r$ is equal the Portion of the Curve-Line BFG. Q. E. D.

COROLLARY.

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 here, The middle Intersection* I, *in the Case of the present Figure, falls in the Radius* AM) the Portions of the Curve BG and AN, GI and NI, as also BGI and ANI, are equal to one another. Whence 'tis 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 signified 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 assign'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 $\nu\psi$, the Difference of the Ordinates ρx, $\pi\psi$, be equal to the Arch EG: Then, because of $\nu x = \pi\rho = EF$, and $\nu\psi = EG$, and the Angles $\psi\nu x$, 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 BG. Now to find the Nature of the Curve $M\psi$, we need only substitute (in the Quantity $\frac{rdx - ydx}{r}$, which always expresses EG or $\nu\psi$) the Value of dx, which in our Curve is $\frac{2ydy}{l}$; which produces $\frac{2ydy}{l} - \frac{2yydy}{rl}$, the *Integral* of which $\frac{yy}{l} - \frac{2y^3}{3rl}$, gives the Length of the Ordinate $\pi\psi$. Then putting $\pi\psi = z$, we have no Equation between z and $\frac{yy}{l} - \frac{2y^3}{3rl}$, or $3rlz + 2y^3$, or $3rlz + 2y^3 - 3ryy = 0$; which expresses the Relation between the *Abscissa* $M\pi = y$, and the Ordinate $\pi\psi = z$. But in *General*, A *Parabolical Spiral*, of any Degree, is by this means transmuted into another Geometrical *Paraboloid*, of one Degree higher. This also is to be observed; That if the Curve $ANIGB$ be the *Archimedean* Spiral, and a Common Parabola $A\mu$ be

 described

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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 BDM, then shall both the Curve Lines, and the Spaces comprehended under them, be equal, *viz.* Taking any Point λ in the Right Line AM; if to this be applied the Right Line $\lambda\mu$, cutting the Parabola in μ, and the Arch λN 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 $A\lambda\mu A$. 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 BC 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, shall be a *Minimum*, which put $= M$. Produce GE in P, and draw $P\mathcal{Q}$ parallel to EF; and let the *Secant* of the Arch $BD = s$, and the Tangent $= t$: Then we have the following Proportions; *Viz.* $r : r - y \ (= AG) :: t : \frac{tr - ry}{r} \ (= GP) :: s : \frac{sr - sy}{r} \ (= AP.)$

Again, $GE : EF :: PG : P\mathcal{Q}$

$$\frac{rdx - ydx}{r} : dy :: \frac{tr - ty}{r} : \frac{tdy}{dx}.$$

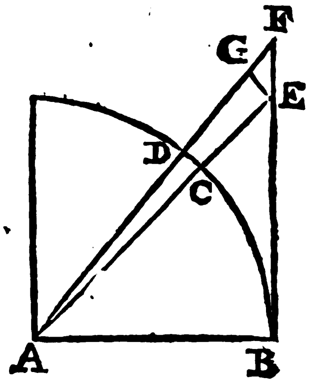
Lastly; $AF : P\mathcal{Q} :: AO : PO \ (= AO - AP)$

$$r - y : \frac{tdy}{dx} :: M : M - \frac{sr - sy}{r}.$$

Whence we shall find

$$M = \frac{rrsdx - 2rsydx + ssydx}{rrdx - rydx - rtdy}; \text{ and}$$

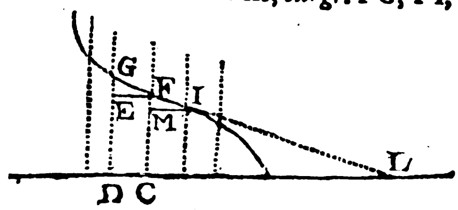
Substituting $\frac{ldx}{2y}$ for dy, and dividing by dx, we have $M = \frac{2rrsy - 4rsyy + 2sy^3}{2rry - 2ryy - rlt}$. And therefore the *Differential* of this is to be equal to nothing; but the *Differential* of a Fraction is $= 0$, when its Terms, multiplied into the Alternate *Differentials*, are equal: For the *Differential* of the Fraction $\frac{y}{z}$ is $\frac{\mp zdy \pm ydz}{zz}$; and consequently if it be $= 0$; then also shall $\pm zdy \pm ydz = 0$; that is, $zdy = ydz$. By the help of which Rule we shall come to an Equation of sixteen 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 *Differential* 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 present Case) $\frac{2ssydy}{lrr}$.

Again, $dx : ds :: DC : GF :: DC : GE + EF$; $GE + GF : GF :: AD \ (= AB) : AG + AB$; $AG + AB : BF :: AB^q \ (= rr) : AF \times FB \ (= st.)$ Wherefore $ds = \frac{stdx}{rr} = \frac{2stydy}{lrr}$: 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 $stdy$; 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 $y^6 - 3ry^5 + 3rry^4 - r^3y^3 + \frac{3}{4}rrllyy - r^3lly + \frac{1}{4}r^4ll = 0$; which may be still further divided by $r - y$, and so the Equation be reduc'd to this, $y^5 - 2ry^4 + rry^3 * + \frac{3}{4}rrlly - \frac{1}{4}r^3ll = 0$: 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 $BC = \frac{1}{36}c = 10$ *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



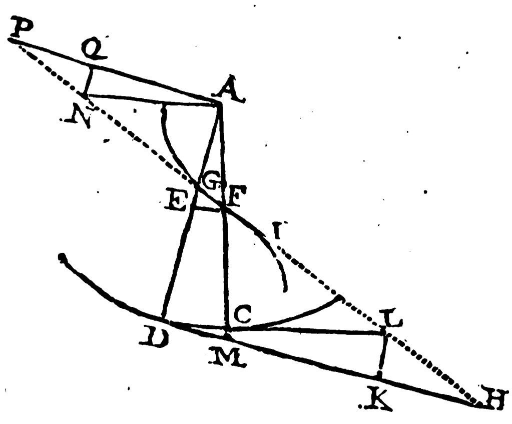
rest

rest being bent upwards on one hand, and downwards on the other. It follows from hence,

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 side and the other, according as the Portion of the Curve (that is) at the Parts of these Angles, falls either with or without them. From whence the Ratio $\frac{DG}{DL} (= \frac{y}{t})$ is either a *Maximum* or *Mininum*; and consequently (by what was shewn above) $ytd = tdy$. But since every where $tdy = ydx$ (*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 *Differential* of the *Abscissa*: Which is also thus manifest: 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, (because of the equal Angles EGF, MFI,) are similar; it follows, That if EF, MI, that is the dx, are equal, also EG, MF, or the dy, shall be equal too; and, consequently, $ddy = o$.

2. In the Curves whose Applicates tend to some common Point or Centre A. The Angle EGF



$= GAF + GFA = DAC + CFL$: Whence, since CL is the Tangent of the Angle CFL to the Radius CF, and DH the Tangent of the Angle 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 $AC = r$; $DC = dx$; $CF = y$; $CL = t$; and consequently, $FL = \sqrt{yy + tt}$. Also, Let it be $AC (= r) : DC (= dx) :: CF (= y) : = \frac{ydx}{r}$ an Arch, that is the Measure of the Angle DAC, with the Radius CF. This Arch (by *Sect.* 4.) Is to the Difference of the Tangents, in the Duplicate Ratio of the Radius to the Secant. Wherefore $FC^q (= yy) : FL^q (= yy + tt) ::$ The Arch found $\frac{ydx}{r} : \frac{yydx + ttdx}{ry} =$ the Difference of two Tangents, each to the Radius CF. To which if we add $EF = \frac{rdx - ydx}{r}$ (which Is to EG, As DH To DG, or CL to CF, or Tangent to Radius) the Aggregate will be $\frac{rydx + ttdx}{ry}$, or $dx + \frac{ttdx}{ry}$, the Difference of two Tangents, the one of which agrees to the Radius DG, that is the Difference of the Right Lines CL, DH $(= t;)$ and therefore $dt = dx + \frac{ttdx}{ry}$.

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 so $LCK = DAC$. (*Note, That* CM *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, $AC (= r) : CD (= dx) :: CL (= t) : \frac{tdx}{r} = LK$. Again, $GD (= y) : DH (= t) :: LK (= \frac{tdx}{r} : \frac{ttdx}{ry} = KH.)$ Wherefore dt $(= DH - CL = DH - CK = DC + KH =)$ $dx + \frac{ttdx}{ry}$.

COROLLARY.

If r be Infinite; that is, If CA, DA, be parallel, then $\frac{ttdx}{ry}$ will vanish, and $dt = dx$, as above.

My *Brother*, instead of the Ratio $\frac{GD}{DH}$ or $\frac{GA}{AP}$, assumes $\frac{GE}{EF}$, putting $AF = y$, $AP = t$, $EF = dz$; and so finds $dt = \frac{dzc}{dyq}$: Which Theorems well deserve notice, upon the account of their Universality.

For a particular Application of this to the *Parabolick Spiral*: Because CL (= t, *Fig. preced.*) was found before $= \frac{2rry - 2y^3}{lr}$, then shall $dt = \frac{4rydy - 6ydy}{lr}$; and since $dx = \frac{2ydy}{l}$; substituting the Values of tt, dt, t, dx, and dividing by dy; and reducing the Equation, we shall find $y^5 - 2ry^4 + rry^3 * + \frac{3}{4}rrlly - \frac{1}{4}r^3ll = o$, as before.

5. *The highest Point of the Curve* above the Radius BA, is found by making AO (found before) Infinite,

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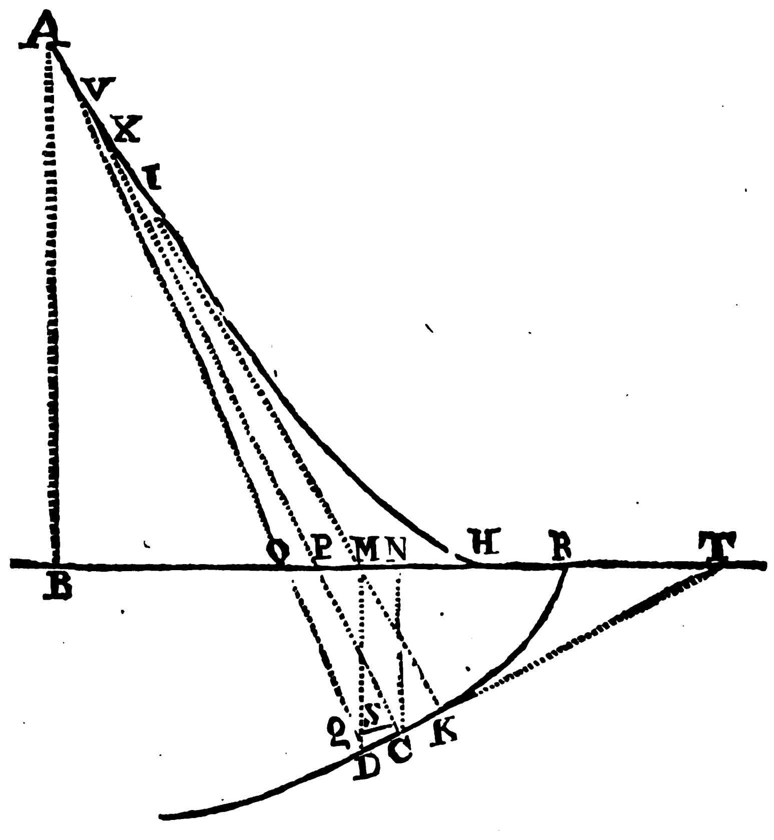
finite; *viz.* $\frac{2rrsy - 4rsyy + 2sy_3}{2rry - 2ry - rlt} =$ *Infinito*, or $2rry - 2ryy - rlt = 0$; or instead of y substituting $\sqrt{lx}$, we have $2r\sqrt{lx} - 2lx - lt = 0$: Or in the Case of $l = \frac{rr}{c}$, $2\sqrt{cx} - 2x = t$. Which Equation cannot be *Geometrically* resolv'd, upon 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 *Rectification* of any *Geometrical Recurrent* Curve, is impossible: For if this were possible, there wou'd be given the Relation between the *Curve* and the *Ordinate* or *Abscissa*: And since the Relation of these to one another, as also to the *Tangent*, is supposed to be given; also 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 Periphery of a Circle, then all the *Normals*, *DA*, *CA*, *KA*, &c. will meet in one common Point



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 intersect 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 $RN = m$; $CN = p$; $Nt = q$. Whence, $TN : NC :: NC : NP$

$$q : p :: p : \frac{pp}{q} = MO;$$

Also, $NC : NP\ (= MO) :: SD : SQ$

$$p : \frac{pp}{q} :: \quad dp : \frac{pdp}{q}:$$ Farther, $QS + SC = QC$.

$$\frac{pdp}{q} + dm = \frac{pdp + qdm}{q}.$$ Again, $OP = MN + OM - PN = dm +$ the *Differential* of $\frac{pp}{q} = dm \frac{\pm 2pqdp \pm p^2 dq}{qq} = \frac{qqdm \pm 2pqdp \pm ppdq}{qq}$

Lastly, $QC - OP : QC ::$

$$ppdq - pqdp : \frac{pdp + qdm}{q} ::$$

$$\frac{CA - PA}{\frac{\sqrt{ppqq + p^4}}{qq}}\ (= CP = \sqrt{CN^q + NP^q})$$

$: CA$

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$: CA.$

$$:\frac{pdq + qdm \times \sqrt{pp+qq}}{pdq - pdp}.$$

7. *Application to the Parabola.* If RCD be a Parabola, whose Parameter $= l$, so that $lm = pp$, then $ldm = 2pdp$, and $dm = \frac{2pdp}{l}$, and $q = 2m$. Substituting these in the Value of CA, we shall find $CA = \frac{ll + 4pp\sqrt{ll+4pp}}{2ll}$; that is, since $PN = \frac{1}{2}l$, and $PC = \sqrt{\frac{1}{4}ll + pp}$, CA will $= \frac{PC_3}{PN^2}$, that is a Fourth Proportional to PN and PC.

8. *To find the Nature of the Curve* AVX (*form'd by the Intersections of the Perpendiculars* DA, CA,) *with respect to the Axis* R B. Cut off $RH = \frac{1}{2}l = PN$, and put $HB = y$, and $BA = z$, and then $AB + NC : AC ::$

$$z + p : \frac{ll + 4pp\sqrt{ll + 4pp}}{2ll} ::$$

$NC : \quad CP;$

$$p : \sqrt{\tfrac{1}{4}ll + pp}; \text{ and } \frac{VZ}{z} \text{ will} = 2p^3.$$

Again, $NC : AB :: PN : PB$;

$$p : z :: \tfrac{1}{2}l : \frac{lz}{2p}; \text{ but } y =$$

$HB = PB + PH = PB + NR = \frac{lz}{2p} + \frac{pp}{l}$, or $2p^3 \left(= \frac{llz}{2}\right) = 2ply - llz$; that is, $\frac{3lz}{4y} = p$, and $4p^3 (= llz) \frac{27l^3 z^3}{16y^3}$; that is, $16y^3 = 27lzz$.

Farther, because AD, AC, 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 since the *Curve* AIH arises from the Intersections of the *Indistant* Perpendiculars DA, CV, KX, 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 *Evoluta'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 in it.

HEM. The Ovens wherein the *Lapis Calaminaris*, 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 *Hem*.

HEMITONE, in Musick, was what we now call an *Half Note*.

HERALD, with us signifies 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 altus*. 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, Marquisses, 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 lesser 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*, *Lancaster*, *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 succeed 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 *Hæretico*, &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 possess'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 reserv'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 Glossary*.

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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 St. *Paul*, inhabited Deserts 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 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 *Vectis* 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*. (See the *Fig.* in *Homodromus*.)

The *Dung-fork* and *Prong* are Leavers of this kind, whose 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 *Heterodromous Leavers*: As are also the outermost Wheels of all Wind and Water-Mills, and all Cog-Wheels, *&c.*

HETERODROMUS *Vectis*, 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 rises.

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 expresly 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 *Blechesdon* 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*, *cap.* 14. And *Henry* I. to Marry his Daughter, had Three Shillings from every *Hide* of Land. This Tax was call'd *Hidage*: See *Hidage*.

HIP-*Roof*, in Architecture, is such a Roof as hath neither *Gable-Heads*, *Shread-Heads*, nor *Jerkin-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 Rafters, call'd *Singlers* by the Country Workmen.) For a *Hip-Roof* hath Rafters as long, and with the Angles at the Foot, *&c.* 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 level at every Angle. The Country Workmen call them Corners; and by some they are call'd Principal *Rafters*, by others *Sleepers*. As Rafters have four plain Sides, these have usually five.

HOBELERS, were formerly a sort 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 Invasion or Danger: See 18 *Edw.* III. *c.* 7. 25 *Edw.* III. *c.* 5, 8. and *Cambd. Britan.*

HOBITS, are a sort 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* she hath made, or how many Leagues and parts of a League she hath run.

HOGENHINE, was formerly the Term for one that coming Guest-wise to an Inn or House, lay there the third Night: After which he was accounted one of the Family; and the Host was answerable for his Breach of the King's Peace. In the Laws of K *Edward*, set forth by *Lambert*, he is call'd *Agenhine*; and often in other places *Third-Night Awnehine*.

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 defying his Lord; for which there was a set Form and Method prescrib'd by the *Feudatory Laws*.

HOMO-

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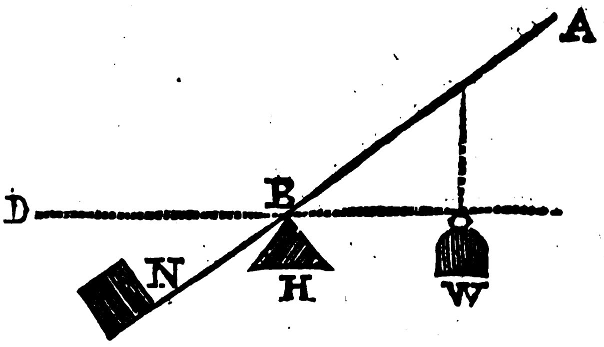
HOMODROMUS, is a Term in Staticks for a Leaver, as AB; one of whose Ends, B



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 *Vectis* 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 *Heterodromus*. 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 sort 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 afterwards in Fee to Noblemen. The Manner of Creating these *Honors* may in part be collected from the Statutes 34 *H.* VIII. *c.* 5. where *Hampton-Court* is made an *Honor*: And 33 *H.* VIII. *c.* 37, 38. where *Grafton* and *Ampthill* are made *Honors*. There are many other *Honors* in *England*; see 37 *H.* VIII. *c.* 18, &c.

HONOR-*Courts*, are such Courts as are held within the abovemention'd Honors.

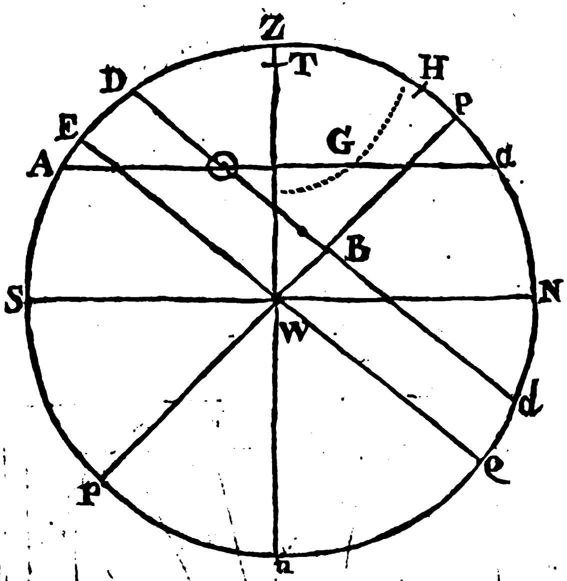
HONORARY *Services*, are such as are incident to *Grand Sergeantry*, and annexed usually to some *Honor*.

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 soon as which is done, these *Hook-Pins* are struck out, and 'tis pinn'd up fast with Wooden Pins.

HORIZONTAL-*Line in Dialling*, is a Line drawn on any Plane parallel to the Horizon. It is drawn on an Erect or Reclining Plane by a Level; or by applying a Quadrant to the Edge of a Ruler so, as that the String and Plummet shall cut 00. or 90 Degrees in the Limb.

HOSPITALLERS, were the Knights of a Religious Order; so call'd, because they builded an Hospital at *Jerusalem*, 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 Abode is now at *Malta*, and they are call'd *Knights 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 $P\,W\,p$ for the Axis. Set next the Latit. also from Z to E, and draw $E\,W\,Q$ for the Equinoctial. Then set the Sun's Declination from E to D, and from Q to d, when 'tis North, as here; but on the lower Side of $E\,Z$ when 'tis South; and draw the Parallel of Declination $D\,d$: Then set the Sun's Altitude from S to A, and from N to a, draw $A\,a$ for the Almacanter or Parallel of the Sun's Altitude at the Time. The common Intersection of these two Parallels in $\odot$, will give you the Sun's Place in the Heavens at that Time. And, consequently, setting the Sector to the Radius $D\,B$, $\odot\,B$ 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 $B\,\odot$ (the parallel Sine of the Hour from 6) strike 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 $H\,N$ 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 *Collin's* 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, set together in the middle; and so might, if there were need, be continued *in Infinitum*.

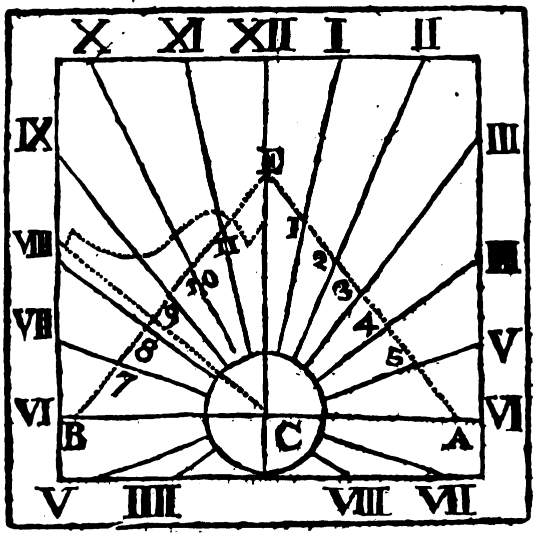
And on the other Face of this Quadrant there is also an *Hour-Scale* of another kind; being 62 Degrees of a Line of Sines, whose Radius is made equal to half the Secant of the Latitude (being fitted for *London*) to the Common Radius of of the Sines. Against it, and running by it, is a prick'd Line of Declinations: To the Sun's greatest 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 Uses.

The first *Hour Scale*, or Double Tangent, is a Scale of Six Hours; and by help of the Line of Latitudes (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 an Horizontal, 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-



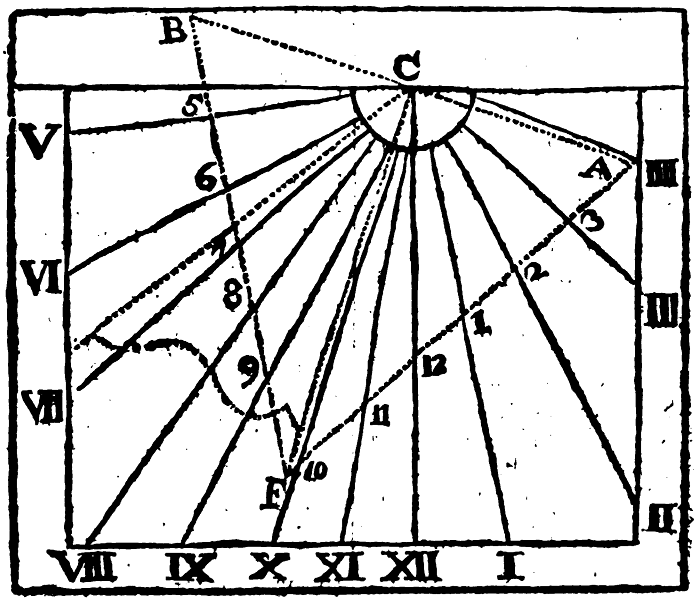
tre of the Dyal) with the Perpendicular *B A*: Then from the Scale of Latitudes take off the Latitude of the Place for an Horizontal (or the *Co-Latitude*, for a Direct South and Vertical) Dyal, and set it with your Compasses each way from *C* to *A* and *B*: Then take with your Compasses the whole *Hour-Scale*, and setting the End of it at *A* and *B*, and its Beginning at *E*, transfer it, and all its Divisions (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 *B E A*: 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 *A E* and *B E*, 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 Declining Dyal; which will be these:

The Substiles Distance from the Meridian will be	18°. 34'.
The Angle of the Hour-Lines of 12 and 6 will be	62°. 00'.
The Angle of the Inclination of Meridians will be	30°. 47'.
And the Styles Height will be an Angle of	34°. 19'.

Being thus prepared, you may then draw the Line VIII, II, as the true Horizontal Line of your design'd Dyal, and then to it, at Right-Angles, 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 Perpendicular *B A*: Then make *C A* and *C B* 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 side *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 Difference 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 said Scale



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Hour.	Min.		
0	3	From *F* to	10
1	3		11
2	3		12
3	3		1
4	3		2
5	3		3

And make Points at the Terminations with a Pin or Pen: And draw Lines from those Points to the Centre *C*; and 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.		
0	3	From *B* to	4
1	3		5
2	3		6
3	3		7
4	3		8
5	3		9

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 *B C* cannot be prick'd down: Then may an Angle be laid down on the upper Side of the Substile, equal to *F C A* on the under Side, and thereby the Scale of Hours laid in its true Situation, having 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 whatsoever.

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 *Houcre*, is a Vessel much used by the *Dutch*; built something like a Pink, but Masted and Rigg'd like a Hoy. They carry from 50 to 200 Tun: And with a small number of Hands will go to the *East-Indies*. They Tack soon 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 setting in Masts into Ships, and the like. Though antiently the Word *Hulka* seems to signifie a small Vessel.

HUNDRED, is a Part of a Shire or County, properly so called, because it contained Ten *Decennæ* 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 *Centena*, is a Jurisdiction over an hundred Towns. Hence you see the Original of *Hundreds*, which still keep the name, and remain, in some sort, the same, as to their Service in several respects: But their *Jurisdiction* is transferr'd to the County Court; some few 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 since 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 signifies some Franchise, where the Sheriff does not intermeddle by his ordinary Authority, unless when they of the Hundred refuse to do their Duty.

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-Courts* were reduc'd to the County-Courts; tho' in some few *Hundreds* the Old Franchises are still remaining.

HUNDREDERS, are Men Empanelled, or fit to be Empanelled, on a Jury, upon a Controversie; and who dwell in the Hundred where the Land in question lies. But

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 *Secta*, 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 standing Rent.

HURRICAN, is a most furious and dreadful 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*.

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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. Hawksbee, *in* Vine-Office-Court *in* Fleet-Street.

For LIQUIDS.

a a, a a, is the Foot to which the upright Piece or prop'd *b b, b b* is to be screw'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 *e e, e e, e e*. 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 *f f*. To the Loop at Bottom of it, is to be suspended by its Hair, and the Bottle *g g, g g*. Thus prepared, the Bottle being plung'd into the Glass of Water, *h h, h h*, the Beam will form an Horizontal Position: 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 sink down in *lighter*, and be buoy'd up in *heavier* 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 *f f* must be suspended the Brass Piece, represented by the Figure *i i, i i*. (See *Fig.* 2.) To the Loop, at the Bottom of which, must the Glass Bucket *k k, k k* 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 Water. Then putting the Brass Dish *l l*, by its Slit on the Brass piece *i i*, a Notch being cut in't to receive it; the Bucket then in the Water will be in *æquilibrio* with the General Scale *e e*; the Dish *l l* 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 soon find what it has lost 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; observ'd 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 soon arose into the small Ball a-top, and continued to remain there till the Water began to abate of its Heat; by which Time the Spirit in the Thermometer became of an equal degree of Temperature 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 observ'd 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 $\frac{1}{2}$ 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 $\frac{3}{4}$ of a Grain; at the Freezing Point it weigh'd about $\frac{3}{4}$ 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 observ'd by those, who at different Seasons, have occasion to find the Specifick Gravities of Liquids and Solids.

HYPERBOLA. In *Philos. 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 Construction and Properties of that Quadratrix.

HYPERBOLICAL *Cylindroid*, is a Solid Figure, whose Generation is given by Sir *Christoph. Wren*, in *Philosoph. Transact.* N. 48. There are two opposite *Hyperbolæ*, join'd by the *Axis Transversus*; 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 Body will be generated, which he calls an *Hyperbolick*

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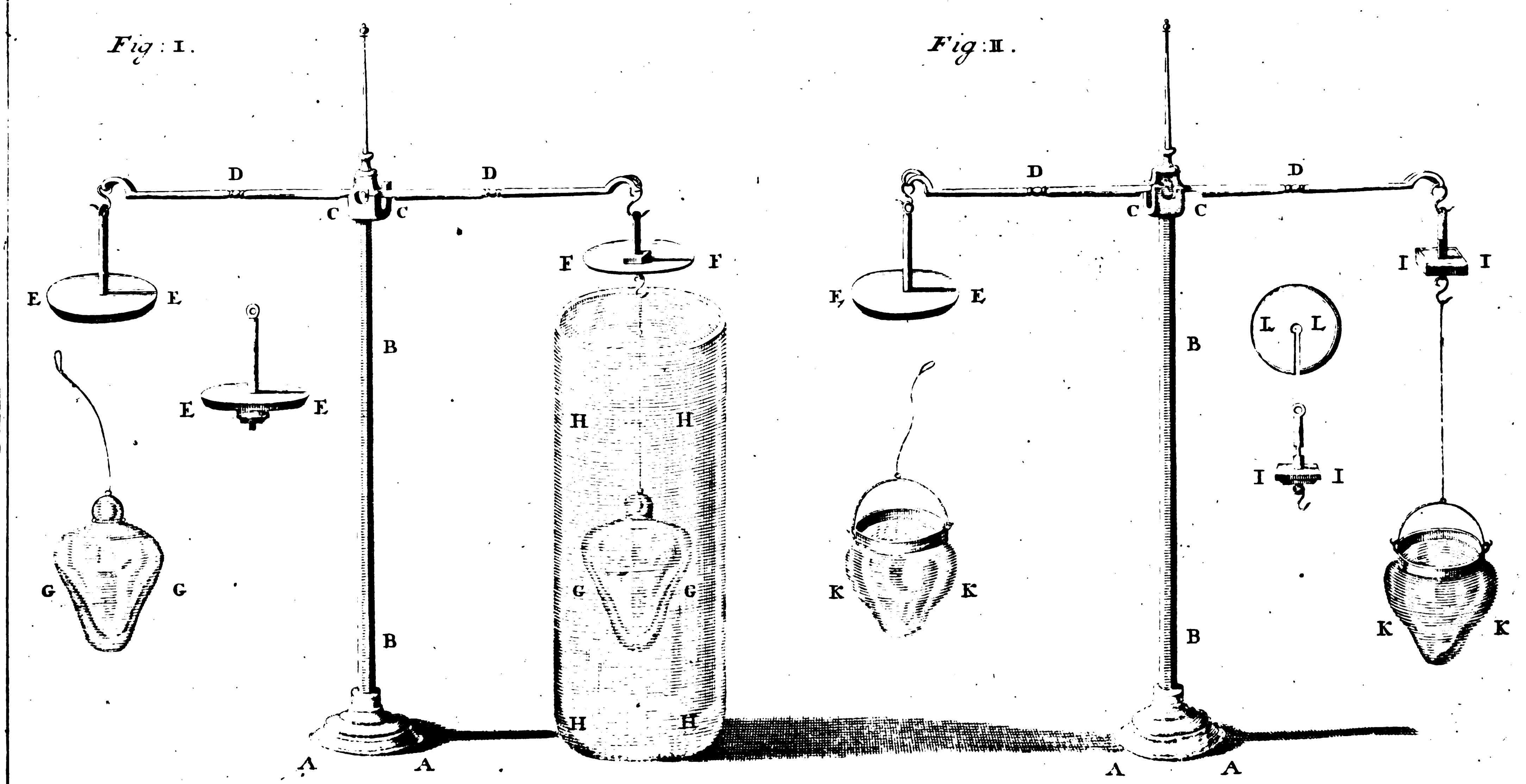
This must be placed at the Word Hydrostaticall Ballance.



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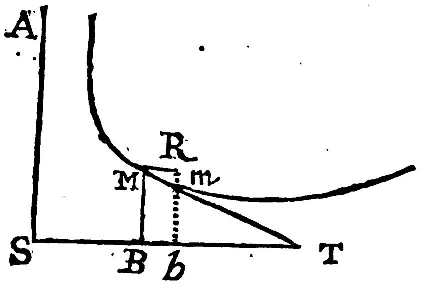
lick Cylindroid; and whose Bases, and all Sections parallel to them will be Circles. And in N. 53. of the *Transactions*, he applies it to the Grinding of *Hyperbolical Glasses*, and saith, they must be either form'd this way, or not at all.

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 Ordinate



MB, and another infinitely near, as *mb*. Let *p* be the Parameter of the Figure, let $SB = x$, and $MB = y$: $Rm = \dot y$, and $Bb = \dot x$. 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 similar; and therefore $\dot y : \dot x :: y : \frac{x\dot y}{\dot y}$ (= *BT*.) Now the proper Equation for the Curve is $\boxed{pp = xy}$; wherefore their Fluxions will be equal, *viz*, $o = \dot x y + \dot y x$; or $\dot x y = -\dot y x$: And dividing by *x*, it will be $\frac{\dot x y}{x} = -\dot y$. But from the Ordinate's continual decrease as the Abscissa increases, the $\frac{x\dot y}{\dot y}$ (= *BT*,) must be $\frac{x\dot y}{-\dot y}$, you have $BT = -x = SB$.

COROL. I.

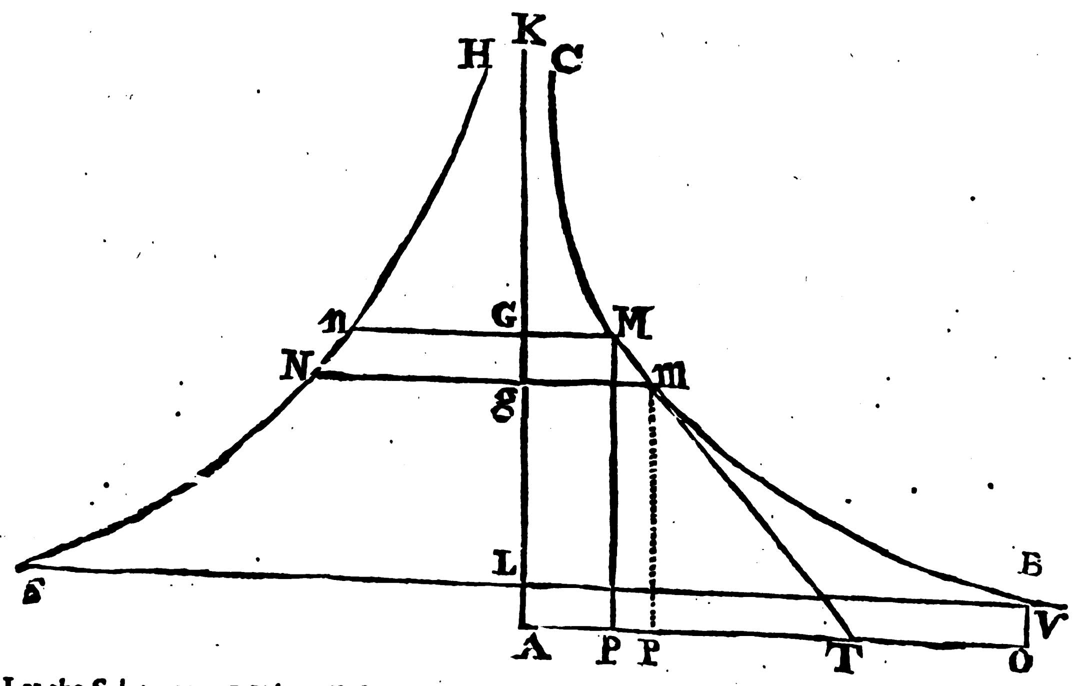
When the Value of the Sub-tangent *BT* comes out negative; then the Point *T* will fall, as here, on the contrary Side of the Ordinate, with regard to *S*, the beginning of *x*. But when it comes out positive, the Point *T* will be on the contrary Side; as in the *Parabola*.

COROL. II.

If you suppose the Parameter = 1, and *m* to be a Negative Number; then $y^m = x$ is an Expression for all *Hyperboli-form Figures*; and universally the Length of the Sub-tangent *BT*, $\left(= \frac{x\dot y}{\dot y}\right)$ = (because $y^m = x$ and consequently $my^{m-1}\dot y = \dot x$) I say, = to my^m = (bec. $y^m = x$) to mx; that is, *To the Exponent of the Power of the Ordinate multiplied into the Abscissa.*

To Investigate the Area's of all sorts of Hyperboliform Figures.

In the following Figure, let the Curve *CMmB* be an Hyperboloid; *AK* and *AO* the Asymptotes:



Let the Sub-tangent *PT* be called *t*, and the Ordinate $PM = y$. The General Equation for such Curves being $y^m = x$; and the Expression for the Sub-tangent *PT* being mx, as above. Let *Gn*, in the Figure, be always taken equal to *PT*: Then will $t\dot y = y\dot x$. And the Rectangles $NIGn = t\dot y$, will always be equal to the Rectangle $PRmp = y\dot x$: And if this be always done, the Figure *KAOBC* infinite towards *KC*, will

will be equal to Figure $KLSH$, equal to all the $\dot{t}y =$ (because $t = mx$) all the $mx\dot{y}$. But (supposing the Figure $KAOBC = b$; and the inscribed Rectangle $LBOA = d$) then will the Figure $KLBC = b - d =$ all the $x\dot{y}$ (because $IR = x$, and $RM = y$.) Whence all the Rectangles $mx\dot{y} =$ all the $y\dot{x} = b$, are to all the $x\dot{y} = b - d$, 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.

COROLLARY.

If m be greater than 1; then the Space, indeterminate towards K, may be measured: But if $m = 1$, then the second Term in the Analogy $m - 1 = 0$; and consequently, the Space $KAOBC$ is infinite towards K; and infinitely great in respect of the Rectangle LO. But if m be less than 1, that Space $KAOBC$ will be more than infinite.

Thus in the common *Apollonian Hyperbola*, whose Equation is $y^{\overline{-1}} = x$; or (supposing a the Parameter $= 1$) $aa = xy$; it appears that $m - 1 = 0$; and consequently, it appears that the Proportion between the Rectangle LO, and the said infinite Space is infinitely great: *See more of this in* Hayes's Fluxions, *p.* 61, *&c.*

HYPETHRE, in the Antient Architecture, was two Ranks of Pillars all about, and ten at each Face, of any Temple, *&c.* with a Peristile within of 6 Columns.

JACK

JACK, in a Ship, is that Flag which is hoisted up at the Sprit-Sail-Top-Mast-Head.

JACTIVUS, *Jativus*, a Latin Word, signifying in the Law, him that loseth by Default: *Placitum suum 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 *Th*; and signified *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. *Locke*) 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 *Yellow*, *White*, *Heat*, *Cold*, *Soft*, *Hard*, *Bitter*, *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*.

2. 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 *Consider* on, our Understanding thereby becomes furnish'd with another Set of *Idea's*, which could not be had from things without; and such is *Perception*, *Thinking*, *Doubting*, *Believing*, *Reasoning*, *Knowing*, *Willing*, *&c.* and all the different Actions of our Minds; which we being conscious of, and observing 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 *Internal Sensation*; is called very properly, by Mr. *Lock*, *Reflection*: And these two, *Sensation* and *Reflection*, he takes to be the only Originals from whence all our *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 not. The Objects of Sense will obtrude their *Idea'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 Sence*, 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.* *Heat*, *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 *Sensation* and *Reflection*; 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 distinguish 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 *Sensation* 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 *Number*. *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 insensible Parts in the Bodies themselves, which we call so.

There are several Faculties which the Mind hath 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 consists the Accuracy of Judgment,

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ment, and the avoiding all Confusions and Mistakes.

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* receiv'd 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 signifie 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 observ'd to Day in Chalk or Snow, which the Mind Yesterday received from *Milk* or *Ceruse*; 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 *Reflection*, 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 frame *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* signified by the Words *Triangle*, *Gratitude*, *Murther*, &c. and these *Modes*, as Mr. *Locke* calls them, are of two sorts.

1. Such as are only Variations, or different Combinations, of the same Simple *Idea*, without the Mixture of any other; as a *Dozen*, a *Score*, &c. 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*, *Theft*, &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 sort 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; such as *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*, *Cousins*, &c. There are also Relations by *Institution*, as *Prince* and *People*, *General* and *Army*, &c. *Moral Relations*, are the Conformity or Disagreement of Men's free Actions to Laws and Rules, whether *Divine* or *Human*.

It may be considered also further about our *Idea's*, that some are *clear* and *distinct*; others *obscure* and *confused*. 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 *retain* 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 *Obscurity* and *Confusion*.

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 considering 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 see 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 consists *Identity*; when the Idea's it is attributed to, vary not at all from what they were that moment, wherein we consider'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 *same* or not? It always refers to some thing that existed at such a time in such a place, which, 'twas certain, at that instant, was the same with it self and no other. From whence it follows, that *one thing* can't have *two Beginnings* of

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of Exiftence, nor *two* things *one*; it being impoffible for two things of the fame kind, to be or exift in the fame inftant, in the very fame place; or one and the fame thing in divers places. Whatever therefore had *one Beginning* is the fame thing; and that which had a different Beginning in Time and Place from *that*, is not the fame with that, but different from it.

We feem to have Idea's but of three forts of Subftances, G O D, *Finite Intelligences* or *Spirits*, and *Bodies*. Of G O D, 'tis demonftrable that He is without Beginning, Eternal, Unalterable, and Omniprefent; wherefore of His *Identity* there can be no doubt.

Finite Spirits having had each its determinate Time and Place of Beginning to *exift*; the Relation to that Time and Place, will always determine to each of them its *Identity*, as long as it *exifts*.

And the fame will hold of *Bodies*: And in every Particle of Matter, to which no Addition or Subftraction of Matter being made, it is the fame. And though thefe three forts of Subftances do not exclude *one another* out of the fame Place; yet we cannot conceive but that they muft neceffarily *each* of them exclude *any other of the fame kind*, out of the fame Place: or elfe the Notions and Names of *Identity* and *Diverfity* would be in vain; and there could be no fuch Diftinction of Subftances, or any thing elfe from one another. Thus, *v. gr.* if two Bodies or Particles of Matter could be in the fame place at the fame time; then take them, great or little, they muft be *one* and the *fame*; nay, thus all Bodies muft be one and the fame.

'Tis plain then that the fo much difputed *Principium Individuationis* is Exiftence it felf; which determines a Being of any fort to a particular Time and Place, incommunicable to two Beings of the fame kind.

And here it will do well to diftinguifh between dead and unactive Lumps of Matter, and fuch Bodies as thofe endow'd with Vegetable or Animal Life. If you confider 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 exift*, united together in the fame Mafs, it will ftill be the fame Body; but if one Atom be taken away, or any new one added, it is no longer the fame Mafs, or the fame Body. But in the State of Living Creatures, their *Identity* depends not on a Mafs of the fame *Particles*, but on fomething elfe; 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 Perfon, are ftill the fame; tho' in both Cafes there be a manifeft Change of Parts: For here 'tis fuch a peculiar Difpofition and Organization of Parts in one coherent Body, and partaking of one common Life, that conftitutes their *Identity*; and as long as that continues, it will be the fame Oak or Man. And fo it is in a Watch; as long as the Mechanifm of it continues the fame, and it goes and anfwers the End of its Organization, 'tis the fame Watch, tho' many Particles of Matter continually rub off and wear away. 'Tis clear therefore wherein confifts the *Identity* of any Animal or Vegetable.

But there is another fort of *Identity*, which hath not been improperly called *Perfonal*; which I think Mr. *Lock* truly determines to confift in the *Sameneſs of a Rational Being*: Since by *Perfon* we underftand an Intelligent Being, having Reafon and Reflection: And fince there is a *Confcioufnefs* which always accompanies Thinking; it is that which makes every one to be that, which he calls *himfelf*, thereby diftinguifhing him from all other Beings that think, and give him his *Perfonal Identity*. See *Effay of Human Underftanding*, Book 2. Ch. 27.

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 *Watling-ftreet* in Vol. II. It was called *Stratum Icenorum*, becaufe it took its Beginning from the *Iceni*, which were thofe that inhabited *Suffolk*, *Norfolk*, and *Cambridgefhire*.

ILLEVIABLE, is what cannot or may not be *levied*: And therefore *Nihil* is a Word fet upon a Debt that is *Illeviable*.

IMPARSONEE, in the Law, or a Parfon Imparfonee, is one that is Inducted into the Poffeffion of a Benefice. And *Dyer* faith, a Dean and Chapter are *Parfons Imparfonees* of a Benefice appropriate to them.

IMPEACHMENT *of Wafte*, *Impetitio vafti*, from *French Empefchment*, *Impedimentum*, fignifies in Law a Reftraint from committing Wafte on Lands and Tenements. And thus he that hath a Leafe without *Impeachment of Wafte*, hath by it a Property or Intereft given him in the Houfe and Trees, and may make *Wafte* in them, without being *Impeached* for it; that is, without being queftion'd or demanded any Recompence for the Wafte done.

IMPLEAD, in our Law, fignifies to Sue, Arreft or Profecute by Courfe 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 diftinguifhed from *Cuftom*; which is rather the Profit which the Queen makes of Wares exported: But they are frequently ufed promifcuoufly.

IMPOSTS in Architecture, are what are fome times called *Chaptrels*, being the Parts on which the Feet of Arches ftand: Or the Capitals of Pilafters that fupport Arches. Thefe Impofts conform to their proper Orders: The *Tufcan* hath a *Plinth* only: The *Dorick* two *Faces and a Round*: The *Ionick* a *Plancere* or Cavity between the two *Faces*; with, fome times, carved Mouldings; as the *Corinthian* and *Compofite* have their *Freifes*. But the *Sallies* of the *Impofts* muft not exceed the Body of the Pilafter. Sometimes the Entablature of the Order ferves for the Impoft of the Arch; and this looks very great and ftately.

IMPROPRIATION, is the Word for the Profits of an Ecclefiaftical Benefice, being in the Hands of a Lay-Man: As *Appropriation* is the Term, when 'tis in the Hands of a Bifhop, College, or Religious Houfe. Tho' thefe two Words are now often ufed promifcuoufly. It is faid there are 3845 Impropriation's in *England*. *Cowel's Interpreter*.

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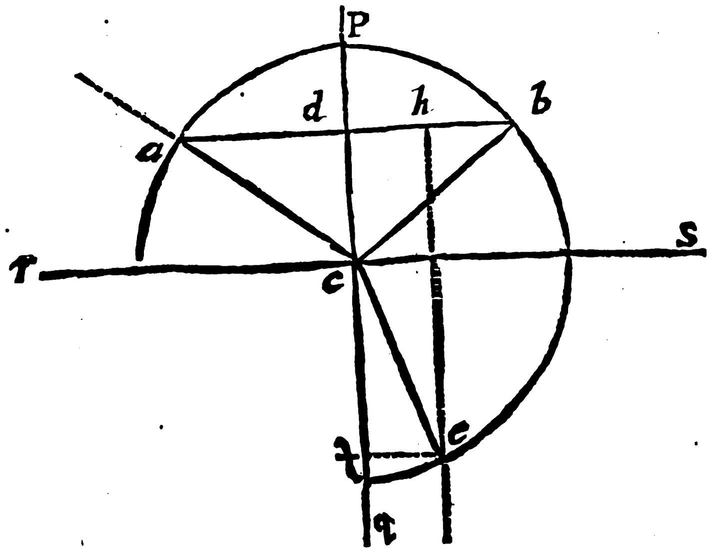
IN *Alto & Imo*; the same with *Alto & Basso*; which see.

INCIDENCE. Sir *Isaac Newton*, in his *Opticks*, Printed since the first Edition of this Book, saith, 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 consider'd.

To illustrate all this, Sir *If. Newton*, *Opt.* p. 5. gives this Example:

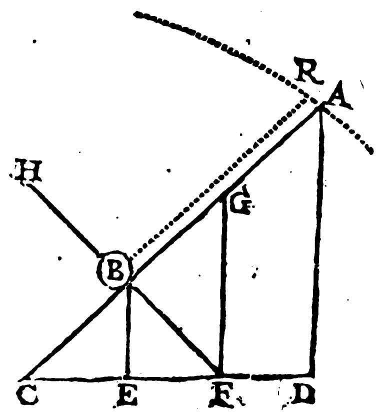
Let *r s* be the Surface of the Still Water, *c* the Point of *Incidence*, in which any Ray coming in the Air from *a* in the Line *a c*, is reflected or refracted: I would know whither this Ray shall go after such Reflexion or Refraction.

On the Surface of the Water *r s*, 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 sought, I produce *a d* to *b*, so that *d b* = *a d*, and draw *c b*, which shall be the Reflected 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 sought, I produce *a d* to *b*; so that *d b* 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 *a b e*, and in the Plane *a c p*, I draw the Line *b e* parallel to *p q*, and cutting the Circumference in *e*: Then drawing *c e*, that shall *be the Refracted Ray*. For if *e f* be let fall perpendicularly on the Line *p q*, it shall be the Sine of the Angle of Refraction of the Ray *c e*; and this Sine is equal *d b*, and consequently in proportion to the Sine of the Angle of *Incidence a d*, As 3 To 4.



INCIDENT, in the Law, signifies 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 *A C*. Then that Power *R*: Is to the Body or Weight *B* :: As the Sine of the Angle of the Plane's Inclination *A C B*: Is to the Radius *C A*. *C D*, *AD*, *G F*, *E D*, and *H F*, 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 *B E* perpendicular to the Horizon *C D*. 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 *B H* 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 *F B* or *B H*. And since these three Powers are all mutually *in Æquilibrio*, 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

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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. *Q. 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 Power.

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 sought. 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. $= 34°$. 9.747562.

$$Z - R = 3.747419 = 5590 \text{ Fere.}$$

INCOMBUSTIBLE *Cloth*, is a sort 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 found in many Places in *China*, *Italy*, and *Wales*; and I have had a very clean sort, 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*, *&c.* from the Places where 'tis found. This was of such esteem among the Ancients, as to be rank'd (as Dr. *Plot* tells us) with the most precious Pearls: And in *China* a piece of it but 23¼ Inches long was valued at 80 *Tale*, *i. e.* 36 *l.* 13 *s.* 4 *d.* *Pliny* tells us expresly, 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. Transf.* N. 72.) that causing a kind of Paper to be made of some of the *Amianthus* which he found there; it would abide longer in the Fire without being consumed than Plates of the hardest and most solid Metal; which would have scaled off in Flakes with a much less Heat. Mr. *Edward Lloyd* also, 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 consumed.

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* use 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*, assured him that they first dried this Mineral (found there in a certain Mountain) in the Sun; then pounded it in a Brass Mortar, to separate the Earthy part from it; and that afterwards 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 distinguished on their Tops, by their Numbers, in their natural Order; as 0, 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 he 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 there find its *least Divisor.* Thus for instance, in Table I. where the Lin'd mark'd with the Marginal

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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 5 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 *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.

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 black Stroke *under* it, in the Dividend's place in 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 Part* 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 further; 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 are 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 find 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-

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A TABLE OF Incomposit Numbers, Less than 100000.

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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	67	71	73
2	4	6	10	14	22	26	34	38	46	58	62	74	82	86	94	106	118	122	134	142	146
3	6	9	15	21	33	39	51	57	69	87	93	111	123	129	141	159	177	183	201	213	219
4	8	12	20	28	44	52	68	76	92	116	224	148	164	172	188	212	236	244	268	284	292
5	10	15	25	35	55	65	85	95	115	145	155	185	205	215	235	265	295	305	335	355	365
6	12	18	30	42	66	78	102	114	138	174	186	222	246	258	282	318	354	366	402	426	438
7	14	21	35	49	77	91	119	133	161	203	217	259	287	301	329	371	413	427	469	497	511
8	16	24	40	56	88	104	136	152	184	232	248	296	328	344	376	424	472	488	536	568	584
9	18	27	45	63	99	117	153	171	207	261	279	333	369	387	423	477	531	549	603	639	657

1	79	83	89	97	101	103	107	109	113	127	131	137	139	149	151	157
2	158	166	178	194	202	206	214	218	226	254	262	274	278	298	302	314
3	237	249	267	291	303	309	321	327	339	381	393	411	417	447	453	471
4	316	332	256	388	404	412	428	436	452	508	524	548	556	596	604	628
5	395	415	445	485	505	515	535	545	565	635	655	685	695	745	755	785
6	474	498	534	582	606	618	642	654	678	762	786	822	834	894	906	942
7	553	581	623	679	707	721	749	763	791	889	917	959	973	1043	1057	1099
8	632	664	712	776	808	824	856	872	904	1016	1048	1096	1112	1192	1208	1256
9	711	747	801	873	909	927	963	981	1017	1143	1179	1233	1251	1341	1359	1413

1	163	167	173	179	181	191	193	197	199	211	223	227	229	233
2	326	334	346	358	362	382	386	394	398	422	446	454	458	466
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	916	932
5	815	835	865	895	905	955	965	985	995	1055	1115	1135	1145	1165
6	978	1002	1038	1074	1086	1146	1158	1182	1194	1266	1338	1362	1374	1398
7	1141	1169	1211	1253	1267	1337	1351	1379	1393	1477	1561	1589	1603	1631
8	1304	1336	1384	1432	1448	1528	1544	1576	1592	1688	1784	1816	1832	1864
9	1467	1503	1557	1611	1629	1719	1737	1773	1791	1899	2007	2043	1061	2097

1	239	241	251	257	263	269	271	277	281	283	293	307	311	313
2	478	482	502	544	526	538	542	554	562	566	586	614	622	626
3	717	723	753	771	789	807	813	831	843	849	879	921	933	939
4	956	964	1004	1028	1052	1076	1084	1108	1124	1132	1172	1228	1244	1252
5	1195	1205	1255	1285	1315	1345	1355	1385	1405	1415	1465	1535	5555	1565
6	1434	1446	1506	1542	1578	1614	1626	1662	1686	1698	1758	1842	1866	1878
7	1673	1687	1757	1799	1841	1883	1897	1939	1967	1981	2051	2149	2177	2191
8	1912	1928	2008	2056	2104	2152	2168	2216	2248	2264	2344	2456	2488	2504
9	2151	2169	2259	2313	2367	2421	2439	2493	2529	2547	2637	2763	2799	2817

INCOMPOSITS.

Tab. I.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
01	1. p	p	3	7	p	3	p	p	3	17	7	3	p	p	3	19	p	3	p	p
03	p	p	7	3	13	p	3	19	11	3	17	p	3	p	23	3	7	13	3	11
07	p	p	3	p	11	3	p	7	3	p	19	3	17	p	3	11	p	3	13	p
09	3	p	11	3	p	p	3	p	p	3	p	p	3	7	p	3	p	p	3	23
11	p	3	p	p	3	7	13	3	p	p	3	11	7	3	17	p	3	29	p	3
13	p	p	3	p	7	3	p	23	3	11	p	3	p	13	3	17	p	3	7	p
17	p	3	7	p	3	11	p	3	19	7	3	p	p	3	13	37	3	17	23	3
19	p	7	3	11	p	3	p	p	3	p	p	3	23	p	3	7	p	3	17	19
21	3	11	13	3	p	p	3	7	p	3	p	19	3	p	7	3	p	p	3	17
23	p	3	p	17	3	p	7	3	p	13	3	p	p	3	p	p	3	p	p	3
27	3	p	p	3	7	17	3	p	p	3	13	7	3	p	p	3	p	11	3	41
29	p	3	p	7	3	23	17	3	p	p	3	p	p	3	p	11	3	7	31	3
31	p	p	p	p	p	3	p	17	3	7	p	3	p	11	3	p	7	3	p	p
33	3	7	3	3	p	13	3	p	7	3	p	11	3	31	p	3	23	p	3	p
37	p	p	p	p	19	3	7	11	3	p	17	3	p	7	3	29	p	3	11	13
39	3	p	3	3	p	7	3	p	p	3	p	17	3	13	p	3	11	37	3	7
41	p	3	p	11	3	p	p	3	29	p	3	7	17	3	11	23	3	p	7	3
43	p	11	3	7	p	3	p	p	3	23	7	3	11	17	3	p	31	3	19	29
47	p	3	13	p	3	p	p	3	7	p	3	31	29	3	p	7	3	p	p	3
49	7	p	3	p	p	3	11	7	3	13	p	3	p	19	3	p	17	3	43	p
51	3	p	p	3	11	19	3	p	23	3	p	p	3	7	p	3	13	17	3	p
53	p	3	11	p	3	7	p	3	p	p	3	p	7	3	p	p	3	p	17	3
57	3	p	p	3	p	p	3	p	p	3	7	13	3	23	31	3	p	7	3	19
59	p	3	7	p	3	13	p	3	p	7	3	19	p	3	p	p	3	p	11	3
61	p	7	3	19	p	3	p	p	3	31	p	3	13	p	3	7	11	3	p	37
63	3	p	p	3	p	p	3	7	p	3	p	p	3	29	7	3	p	41	3	13
67	p	p	3	p	p	3	23	13	3	p	11	3	7	p	3	p	p	3	p	7
69	3	13	p	3	7	p	3	p	11	3	p	7	3	37	13	3	p	29	3	11
71	p	3	p	7	3	p	11	3	13	p	3	p	31	3	p	p	3	7	p	3
73	p	p	3	p	11	3	p	p	3	7	29	3	19	p	3	11	7	3	p	p
77	7	3	p	13	3	p	p	7	p	p	3	11	p	3	7	19	3	p	p	3
79	p	p	3	p	p	3	7	19	3	11	13	3	p	7	3	p	23	3	p	p
81	3	p	p	3	13	7	3	11	p	3	23	p	3	p	p	3	41	13	3	7
83	p	3	p	p	3	11	p	3	p	p	3	7	p	3	p	p	3	p	7	3
87	3	11	7	3	p	p	3	p	p	3	p	p	3	19	p	3	7	p	3	p
89	p	3	17	p	3	19	13	3	7	23	3	29	p	3	p	7	3	p	p	3
91	7	p	3	17	p	3	p	7	3	p	p	3	p	13	3	37	19	3	31	11
93	3	p	p	3	17	p	3	13	19	3	p	p	3	7	p	3	p	11	3	p
97	p	p	3	p	7	3	17	p	3	p	p	3	p	11	3	p	p	3	7	p
99	3	p	13	3	p	p	3	17	29	3	7	11	3	p	p	3	p	7	3	p

INCOMPOSITS.

TAB. II.

	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
01	3	11	31	3	7	41	3	37	p	3	p	7	3	p	19	3	13	p	3	47
03	p	3	p	7	3	p	19	3	p	p	3	29	p	3	41	31	3	7	p	3
07	3	7	p	3	29	23	3	p	7	3	31	13	3	p	p	3	p	11	3	p
09	7	3	47	p	3	13	p	3	53	p	3	p	p	3	7	11	3	p	13	3
11	p	p	3	p	p	3	7	p	3	41	p	3	13	7	3	p	23	3	37	p
13	3	p	p	3	19	7	3	p	29	3	23	11	3	p	p	3	p	47	3	7
17	p	29	3	7	p	3	p	11	3	p	7	3	p	31	3	p	p	3	11	p
19	3	13	7	3	41	11	3	p	p	3	p	p	3	p	13	3	7	p	3	p
21	43	3	p	11	3	p	p	3	7	23	3	p	p	3	11	7	3	61	p	3
23	7	11	3	23	p	3	43	7	3	37	p	3	11	p	3	13	p	3	p	p
27	p	3	17	13	3	7	37	3	11	p	3	53	7	3	23	p	3	p	43	3
29	p	p	3	17	7	3	11	p	3	29	13	3	p	p	3	p	19	3	7	p
31	3	p	23	3	11	p	3	p	19	3	7	31	3	p	47	3	p	7	3	p
33	19	3	7	p	3	17	p	3	p	7	3	13	53	3	p	p	3	p	p	3
37	3	p	p	3	p	43	3	7	p	3	p	p	3	47	7	3	p	37	3	31
39	p	3	p	p	3	p	7	3	17	p	3	43	41	3	19	p	3	p	11	3
41	13	p	3	p	p	3	19	p	3	17	p	3	7	13	3	p	11	3	23	7
43	3	p	p	3	7	p	3	13	p	3	17	7	3	p	11	3	p	19	3	p
47	23	19	3	p	p	3	p	41	3	7	11	3	17	p	3	p	7	3	p	p
49	3	17	13	3	31	p	3	p	7	3	p	47	3	17	p	3	41	23	3	11
51	7	3	p	p	3	p	11	3	p	13	3	23	p	3	7	53	3	11	p	3
53	p	p	3	13	11	3	7	p	3	p	43	3	p	7	3	11	13	3	p	59
57	11	3	37	p	3	p	p	3	p	p	3	7	p	3	p	p	3	13	7	3
59	29	17	3	7	p	3	p	31	3	11	7	3	p	p	3	p	p	3	17	37
61	3	p	7	3	23	13	3	11	p	3	p	29	3	p	p	3	7	p	3	17
63	p	3	31	17	3	11	p	3	7	p	3	p	13	3	p	7	3	53	p	3
67	3	11	p	3	p	17	3	p	47	3	p	p	3	7	p	3	19	p	3	p
69	p	3	p	23	3	7	17	3	19	p	3	p	7	3	p	43	3	p	53	3
71	19	13	3	p	7	3	p	17	3	p	37	3	p	p	3	p	p	3	7	11
73	3	41	p	3	p	31	3	47	13	3	7	19	3	p	23	3	p	7	3	29
77	31	7	3	p	p	3	p	p	3	13	17	3	29	11	3	7	p	3	p	41
79	3	p	43	3	37	p	3	7	p	3	p	11	3	31	7	3	13	p	3	23
81	p	3	p	p	3	29	7	3	43	11	3	p	17	3	59	p	3	19	p	3
83	p	37	3	p	13	3	p	11	3	19	p	3	7	17	3	p	29	3	11	7
87	p	3	p	7	3	13	p	3	p	29	3	p	19	3	11	17	3	7	13	3
89	p	11	3	p	19	3	p	p	3	7	p	3	11	p	3	37	7	3	p	p
91	3	7	29	3	47	p	3	p	7	3	11	p	3	p	p	3	p	17	3	13
93	7	3	p	p	3	p	p	3	11	41	3	31	37	3	7	p	3	p	17	3
97	3	13	p	3	11	7	3	p	p	3	19	23	3	43	13	3	p	p	3	7
99	p	3	11	p	3	23	p	3	13	p	3	7	p	3	p	59	3	29	7	3

INCOMPOSITS.

TAB. III.

	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
01	p	3	p	11	3	7	43	3	p	13	3	p	7	3	11	p	3	p	p	3
03	p	11	3	13	7	3	p	p	3	p	p	3	11	p	3	p	13	3	7	p
07	p	3	7	59	3	p	17	3	11	7	3	p	41	3	p	p	3	13	p	3
09	19	7	3	31	p	3	11	17	3	p	p	3	p	p	3	7	71	3	37	19
11	3	p	p	3	11	13	3	7	17	3	p	19	3	47	7	3	31	p	3	23
13	p	3	11	19	3	p	7	3	p	17	3	p	13	3	p	37	3	29	p	3
17	3	23	p	3	7	p	3	53	p	3	29	7	3	13	p	3	41	p	3	61
19	p	3	p	7	3	p	31	3	61	p	3	p	17	3	p	p	3	7	11	3
21	p	13	3	29	p	3	p	p	3	7	p	3	23	17	3	p	7	3	p	31
23	3	7	41	3	p	p	3	p	7	3	p	47	3	p	11	3	p	59	3	p
27	p	p	3	p	19	3	7	29	3	13	11	3	p	7	3	p	17	3	p	p
29	3	p	p	3	43	7	3	p	11	3	47	23	3	73	61	3	13	17	3	7
31	29	3	p	61	3	23	11	3	p	p	3	7	p	3	p	p	3	11	7	3
33	37	p	3	7	11	3	41	p	3	p	7	3	p	p	3	11	43	3	19	17
37	11	3	19	p	3	13	p	3	7	p	3	11	p	3	p	7	3	p	13	3
39	7	p	3	p	23	3	p	7	3	11	p	3	13	19	3	29	p	3	p	p
41	3	41	p	3	p	19	3	11	47	3	71	53	3	7	p	3	p	p	3	13
43	13	3	p	43	3	7	p	3	29	p	3	37	7	3	p	23	3	p	p	3
47	3	11	31	3	p	p	3	47	37	3	7	p	3	p	13	3	p	7	3	19
49	p	3	7	p	3	p	p	3	13	7	3	19	29	3	p	31	3	p	p	3
51	p	7	3	19	p	3	p	p	3	p	p	3	59	p	3	7	p	3	p	11
53	3	p	p	3	61	29	3	7	23	3	31	p	3	53	7	3	p	11	3	p
57	p	p	3	p	p	3	p	67	3	p	13	3	7	11	3	p	p	3	p	7
59	3	p	p	3	7	47	3	p	43	3	p	7	3	23	53	3	p	13	3	59
61	31	3	p	7	3	p	59	3	p	11	3	13	p	3	43	67	3	7	p	3
63	17	23	3	p	p	3	p	11	3	7	61	3	19	31	3	p	7	3	11	67
67	7	3	17	11	3	p	13	3	31	p	3	p	23	3	7	19	3	73	p	3
69	13	11	3	17	41	3	7	19	3	p	37	3	11	7	3	p	p	3	p	47
71	3	43	p	3	17	7	3	13	p	3	11	p	3	41	p	3	53	29	3	7
73	p	3	p	p	3	17	p	3	11	p	3	7	p	3	13	p	3	23	7	3
77	3	p	7	3	11	23	3	17	p	3	p	31	3	19	p	3	7	53	3	43
79	p	3	11	29	3	19	p	3	7	13	3	p	p	3	p	p	3	p	p	3
81	7	37	3	13	p	3	31	7	3	17	p	3	p	p	3	p	13	3	p	p
83	3	47	p	3	p	p	3	p	19	3	13	71	3	7	p	3	p	p	3	31
87	61	53	3	41	7	3	43	p	3	p	p	3	17	p	3	37	11	3	7	p
89	3	59	p	3	67	13	3	p	p	3	7	p	3	17	11	3	p	7	3	53
91	p	3	7	p	3	p	p	3	67	7	3	29	11	3	17	p	3	p	43	3
93	p	7	p	23	p	3	13	p	3	p	11	3	67	p	3	7	p	3	71	13
97	17	3	3	p	3	p	7	3	59	19	3	p	p	3	23	29	3	11	p	3
99	p	13	p	53	11	3	37	p	3	p	p	3	7	p	3	11	41	3	17	7

INCOM-

INCOMPOSITS.

TAB. IV.

	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
01	17	p	3	p	37	3	7	p	3	67	p	3	19	7	3	13	11	3	29	p
03	3	17	p	3	19	7	3	p	p	3	47	p	3	69	11	3	p	p	3	7
07	p	31	3	7	43	3	p	19	3	p	7	3	p	p	3	p	p	3	37	p
09	3	41	7	3	13	23	3	p	11	3	43	p	3	p	31	3	7	13	3	11
11	p	3	p	p	3	17	11	3	7	p	3	13	p	3	p	7	3	11	73	3
13	7	p	3	59	11	3	17	7	3	31	p	3	p	71	3	11	23	3	13	41
17	11	3	p	p	3	7	13	3	17	p	3	11	7	3	p	p	3	p	p	3
19	13	29	3	71	7	3	p	p	3	11	p	3	p	13	3	73	19	3	7	p
21	3	p	p	3	p	p	3	11	19	3	7	p	3	p	41	3	p	7	3	89
23	19	3	7	p	3	11	37	3	p	7	3	17	31	3	13	p	3	p	p	3
27	3	11	13	3	p	61	3	7	p	3	p	p	3	17	7	3	29	p	3	p
29	p	3	p	p	3	p	7	3	p	13	3	p	p	3	17	p	3	59	p	3
31	37	p	3	13	59	3	19	53	3	29	79	3	7	p	3	17	13	3	41	7
33	3	p	23	3	7	47	3	p	p	3	13	7	3	p	p	3	17	11	3	p
37	p	17	3	p	41	3	p	p	3	7	31	3	p	11	3	p	7	3	17	p
39	3	7	17	3	47	13	3	23	7	3	p	11	3	41	43	3	p	71	3	17
41	7	3	79	17	3	31	29	3	p	11	3	37	13	3	7	p	3	p	p	3
43	p	p	3	p	17	3	7	11	3	53	p	3	p	7	3	19	p	3	11	13
47	p	3	p	11	3	p	17	3	41	p	3	7	p	3	11	p	3	61	7	3
49	23	11	3	7	p	3	61	17	3	p	7	3	11	p	3	p	p	3	47	p
51	3	p	7	3	p	p	3	43	13	3	11	p	3	p	p	3	7	23	3	p
53	p	3	13	p	3	p	p	3	7	17	3	23	p	3	29	7	3	p	p	3
57	3	47	p	3	11	79	3	29	p	3	p	17	3	7	p	3	13	p	3	73
59	73	3	11	p	3	7	p	3	19	p	3	p	7	3	p	p	3	p	29	3
61	11	61	3	p	7	3	p	p	3	p	23	3	53	17	3	p	47	3	7	19
63	3	p	p	3	23	p	3	p	p	3	7	13	3	37	17	3	79	7	3	p
67	p	7	3	p	29	3	59	67	3	p	37	3	13	53	3	7	11	3	p	31
69	3	31	p	3	p	p	3	7	p	3	p	67	3	p	7	3	p	17	3	13
71	13	3	p	23	3	p	7	3	p	p	3	71	11	3	31	67	3	19	17	3
73	p	p	3	p	p	3	p	13	3	19	11	3	7	73	3	p	p	3	p	7
77	59	3	p	7	3	p	11	3	13	p	3	p	19	3	p	p	3	7	p	3
79	p	37	3	p	11	3	p	p	3	7	p	3	29	47	3	11	7	3	p	79
81	3	7	11	3	p	p	3	p	7	3	73	43	3	11	p	3	p	31	3	23
83	7	3	61	13	3	29	41	3	p	p	3	11	p	3	7	p	3	43	p	3
87	3	23	p	3	13	7	3	11	71	3	19	p	3	83	p	3	p	13	3	7
89	p	3	19	p	3	11	p	3	83	29	3	7	37	3	p	p	3	p	7	3
91	p	41	3	7	p	3	p	p	3	p	7	3	23	19	3	p	p	3	13	61
93	3	11	7	3	43	19	3	p	61	3	41	p	3	p	59	3	7	p	3	p
97	7	p	3	p	73	3	37	7	3	p	47	3	p	13	3	71	43	3	53	11
99	3	p	p	3	67	p	3	13	p	3	31	23	3	7	p	3	p	11	3	19

INCOMPOSITS.

TAB. V.

	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
01	3	p	59	3	31	p	3	7	13	3	p	19	3	71	7	3	p	89	3	p
03	53	3	13	19	3	11	7	3	p	29	3	p	p	3	p	13	3	31	p	3
07	3	11	29	3	7	47	3	p	p	3	p	7	3	41	23	3	13	17	3	p
09	p	3	p	7	3	67	p	3	23	59	3	p	p	3	97	37	3	7	17	3
11	p	p	3	p	13	3	79	31	3	7	p	3	61	p	3	p	7	3	p	11
13	3	7	43	3	47	p	3	p	7	3	p	13	3	67	p	3	p	11	3	23
17	p	p	3	p	19	3	7	23	3	37	71	3	13	7	3	31	59	3	p	47
19	3	23	p	3	p	7	3	p	p	3	29	11	3	p	p	3	p	p	3	7
21	13	3	p	53	3	p	37	3	p	11	3	7	p	3	p	p	3	p	7	3
23	71	p	3	7	p	3	p	11	3	p	7	3	23	p	3	89	p	3	11	p
27	23	3	19	11	3	p	p	3	7	79	3	p	p	3	11	7	3	71	31	3
29	7	11	3	p	p	3	p	7	3	3	p	3	11	19	3	13	p	3	p	p
31	3	47	p	3	p	19	3	p	p	3	11	23	3	7	p	3	p	37	3	p
33	29	3	p	13	3	7	89	3	11	p	3	p	7	3	p	p	3	p	p	3
37	3	79	p	3	11	p	3	p	p	3	7	p	3	p	p	3	23	7	3	19
39	p	3	7	31	3	p	53	3	p	7	3	13	p	3	p	p	3	p	p	3
41	11	7	3	19	23	3	p	p	3	p	p	3	p	p	3	7	31	3	13	p
43	3	17	p	3	p	p	3	7	37	3	p	41	3	p	7	3	p	p	3	61
47	13	p	3	17	p	3	p	p	3	23	83	3	7	13	3	p	11	3	43	7
49	3	29	73	3	7	83	3	13	p	3	p	7	3	p	11	3	p	p	3	p
51	83	3	37	7	3	17	41	3	53	p	3	p	11	3	13	p	3	7	p	3
53	p	31	3	p	79	3	17	p	3	7	11	3	19	47	3	41	7	3	59	37
57	7	3	23	61	3	43	11	3	17	13	3	p	p	3	7	19	3	11	p	3
59	p	41	3	13	11	3	7	19	3	17	p	3	47	7	3	11	13	3	p	23
61	3	p	11	3	p	7	3	p	p	3	13	p	3	11	p	3	p	43	3	7
63	11	3	p	p	3	p	p	3	p	p	3	7	59	3	p	73	3	13	7	3
67	3	p	7	3	p	13	3	11	p	3	p	89	3	17	p	3	7	p	3	p
69	p	3	p	p	3	11	p	3	7	p	3	53	13	3	17	7	3	p	71	3
71	7	p	3	11	43	3	13	7	3	p	47	3	73	p	3	17	19	3	p	13
73	3	11	p	3	37	p	3	31	19	3	43	p	3	7	p	3	17	29	3	p
77	41	13	3	p	7	3	p	67	3	47	29	3	p	p	3	61	p	3	7	11
79	3	p	17	3	61	23	3	p	13	3	7	67	3	83	p	3	p	7	3	17
81	p	3	7	17	3	p	p	3	83	7	3	p	p	3	19	11	3	p	41	3
83	59	7	3	83	17	3	19	p	3	13	31	3	p	11	3	7	23	3	p	67
87	p	3	p	p	3	31	7	3	p	11	3	p	19	3	53	p	3	p	p	3
89	p	19	3	p	13	3	p	11	3	89	61	3	7	41	3	43	p	3	11	7
91	3	p	p	3	7	11	3	59	17	3	p	7	3	p	p	3	11	p	3	97
93	p	3	p	7	3	13	p	3	p	17	3	29	p	[illegible]	11	53	3	7	13	3
97	3	7	p	3	29	p	3	19	7	3	11	17	3	p	p	3	p	97	3	13
99	7	3	43	37	3	p	p	3	11	p	3	p	17	3	7	29	3	41	19	3

INCOMPOSITS.

Tab. VI.

	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
01	73	3	101	p	3	p	p	3	7	11	3	17	23	3	13	7	3	p	p	3
03	7	p	3	p	101	3	23	7	3	p	p	3	17	89	3	p	41	3	11	p
07	p	3	59	11	3	7	p	3	101	13	3	29	7	3	11	37	3	23	p	3
09	p	11	3	13	7	3	103	p	3	p	101	3	11	43	3	17	13	3	7	p
11	3	p	p	3	29	23	3	p	19	3	7	41	3	p	p	3	17	7	3	43
13	17	3	7	p	3	p	p	3	11	7	3	p	p	3	101	29	3	13	p	3
17	3	67	17	3	11	13	3	7	29	3	23	p	3	p	7	3	p	p	3	17
19	43	3	11	17	3	67	7	3	31	61	3	p	13	3	19	p	3	p	53	3
21	11	29	3	p	17	3	13	71	3	67	103	3	7	p	3	41	p	3	p	7
23	3	53	p	3	7	17	3	p	79	3	73	7	3	13	p	3	59	19	3	p
27	37	13	3	23	p	3	p	17	3	7	p	3	103	47	3	p	7	3	p	p
29	3	7	53	3	p	p	3	p	7	3	41	31	3	p	11	3	29	37	3	79
31	7	3	13	p	3	p	p	3	p	17	3	p	11	3	7	13	3	p	p	3
33	79	p	3	p	p	3	7	p	3	13	11	3	47	7	3	19	p	3	p	p
37	p	3	29	p	3	41	11	3	p	p	3	7	17	3	p	83	3	11	7	3
39	p	p	3	7	11	3	p	p	3	p	7	3	p	17	3	11	103	3	p	p
41	3	p	7	3	53	83	3	23	37	3	61	13	3	11	17	3	7	59	3	p
43	11	3	p	p	3	13	29	3	7	31	3	11	p	3	p	7	3	p	13	3
47	3	73	p	3	31	53	3	11	p	3	p	71	3	7	p	3	19	17	3	13
49	13	3	37	79	3	7	23	3	19	p	3	p	7	3	107	p	3	31	17	3
51	19	p	3	11	7	3	p	13	3	47	43	3	p	p	3	p	61	3	7	17
53	3	11	p	3	p	61	3	p	p	3	7	19	3	p	13	3	43	7	3	p
57	89	7	3	p	p	3	p	31	3	p	p	3	p	41	3	7	p	3	71	11
59	3	p	p	3	p	p	3	7	p	3	p	p	3	37	7	3	89	11	3	p
61	p	3	31	13	3	59	7	3	p	97	3	p	p	3	73	11	3	19	29	3
63	29	p	3	43	p	3	p	47	3	19	13	3	7	11	3	31	107	3	p	7
67	p	3	p	7	3	p	p	3	p	11	3	13	19	3	p	43	3	7	p	3
69	p	p	3	p	19	3	47	11	3	7	p	3	59	p	3	23	7	3	11	p
71	3	7	p	3	37	11	3	p	7	3	p	p	3	83	p	3	11	79	3	p
73	7	3	p	11	3	97	13	3	83	p	3	p	p	3	7	71	3	61	31	3
77	3	p	43	3	p	7	3	13	73	3	11	p	3	31	23	3	p	p	3	7
79	p	3	19	97	3	71	59	3	11	p	3	7	p	3	13	p	3	p	7	3
81	17	p	3	7	47	3	11	p	3	79	7	3	29	19	3	37	p	3	109	p
83	3	17	7	3	11	19	3	41	p	3	p	53	3	p	p	3	7	p	3	23
87	7	61	3	13	p	3	p	7	3	p	p	3	p	59	3	p	13	3	p	p
89	3	23	p	3	17	p	3	p	p	3	13	67	3	7	p	3	p	p	3	19
91	p	3	41	p	3	7	p	3	p	29	3	19	7	3	p	67	3	13	11	3
93	p	p	3	19	7	3	17	43	3	p	p	3	23	p	3	p	11	3	7	67
97	23	3	7	37	3	p	19	3	17	7	3	p	11	3	p	p	3	47	p	3
99	p	7	3	p	p	3	13	p	3	17	11	3	p	p	3	7	p	3	73	13

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INCOMPOSITS.

TAB. VII.

	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139
01	11	p	3	p	p	3	p	13	3	7	p	3	43	47	3	23	7	3	37	p
03	3	7	p	3	79	p	3	p	7	3	p	p	3	53	13	3	61	71	3	p
07	p	p	3	31	19	3	7	97	3	p	p	3	47	7	3	13	11	3	p	p
09	3	p	29	3	p	7	3	71	p	3	p	p	3	p	11	3	31	p	3	7
11	p	3	p	13	3	p	p	3	23	p	3	7	11	3	p	59	3	p	7	3
13	41	p	3	7	p	3	p	p	3	37	7	3	73	p	3	p	p	3	19	p
17	61	3	19	109	3	p	11	3	7	p	3	13	p	3	p	7	3	11	41	3
19	7	p	3	97	11	3	p	7	3	p	47	3	p	19	3	11	p	3	13	31
21	3	17	11	3	p	19	3	p	p	3	29	p	3	7	p	3	53	p	3	p
23	11	3	17	p	3	7	13	3	p	p	3	11	7	3	31	p	3	p	23	3
27	3	67	p	3	17	p	3	11	101	3	7	p	3	p	29	3	p	7	3	19
29	23	3	7	p	3	11	73	3	p	7	3	19	p	3	13	83	3	p	p	3
31	53	7	3	11	31	3	17	29	3	67	83	3	101	p	3	7	43	3	p	p
33	3	11	13	3	p	83	3	7	41	3	p	23	3	67	7	3	p	31	3	p
37	p	53	3	13	p	3	p	47	3	17	p	3	7	p	3	p	13	3	101	7
39	3	61	p	3	7	p	3	p	37	3	13	7	3	p	89	3	23	11	3	53
41	p	3	p	7	3	p	p	3	p	p	3	17	p	3	p	11	3	7	p	3
43	p	p	3	p	23	3	47	p	3	7	p	3	17	11	3	29	7	3	109	73
47	7	3	37	p	3	p	p	3	29	11	3	p	13	3	7	19	3	59	61	3
49	p	p	3	53	59	3	7	11	3	23	p	3	p	7	3	17	p	3	11	13
51	3	29	p	3	p	7	3	41	71	3	31	p	3	13	p	3	11	p	3	7
53	17	3	p	11	3	p	p	3	p	p	3	7	29	3	11	p	3	17	7	3
57	3	p	7	3	p	29	3	p	13	3	11	59	3	19	p	3	7	p	3	17
59	31	3	13	17	3	19	p	3	7	p	3	p	p	3	43	7	3	p	p	3
61	7	p	3	47	17	3	11	7	3	13	37	3	89	31	3	71	19	3	83	23
63	3	p	p	3	11	17	3	p	19	3	p	p	3	7	p	3	13	p	3	p
67	11	23	3	83	7	3	53	17	3	p	73	3	p	p	3	p	79	3	7	p
69	3	43	p	3	37	p	3	113	17	3	7	13	3	29	p	3	p	7	3	61
71	p	3	7	89	3	13	p	3	61	7	3	p	23	3	19	41	3	47	11	3
73	p	7	3	p	p	3	19	53	3	p	17	3	13	43	3	7	11	3	p	89
77	13	3	p	p	3	p	7	3	79	19	3	p	11	3	p	p	3	23	p	3
79	47	19	3	p	p	3	31	13	3	p	11	3	7	17	3	37	p	3	p	7
81	3	13	p	3	7	23	3	p	11	3	103	7	3	3	13	3	p	p	3	11
83	43	3	71	7	3	p	11	3	13	p	3	p	37	p	97	17	3	7	p	3
87	3	7	11	3	p	41	3	19	7	3	23	p	3	11	p	3	p	17	3	71
89	7	3	p	13	3	p	p	3	p	31	3	11	97	3	7	107	3	p	17	3
91	107	73	3	p	p	3	7	p	3	11	13	3	p	7	3	p	p	3	29	17
93	3	89	19	3	13	7	3	11	p	3	p	79	3	59	103	3	p	13	3	7
97	p	p	3	7	p	3	p	67	3	41	7	3	p	p	3	p	p	3	13	p
99	3	11	7	3	29	43	3	p	p	3	p	67	3	p	p	3	7	p	3	p

INCOMPOSITS.

TAB. VIII.

	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
01	3	59	11	3	p	17	3	61	19	3	7	p	3	11	p	3	p	7	3	p
03	11	3	7	p	3	p	17	3	113	7	3	11	23	3	73	37	3	41	p	3
07	3	p	p	3	p	89	3	7	13	3	43	p	3	p	7	3	p	113	3	p
09	p	3	13	41	3	11	7	3	59	17	3	29	67	3	19	13	3	23	p	3
11	p	103	3	11	p	3	19	47	3	13	17	3	7	61	3	p	67	3	97	7
13	3	11	61	3	7	23	3	p	p	3	p	7	3	p	p	3	13	19	3	p
17	107	19	3	103	13	3	47	p	3	7	p	3	p	17	3	59	7	3	p	11
19	3	7	59	3	p	p	3	41	7	3	23	13	3	p	17	3	p	11	3	p
21	7	3	p	p	3	13	p	3	p	43	3	p	31	3	7	11	3	79	13	3
23	37	29	3	p	p	3	7	p	3	p	83	3	13	7	3	19	17	3	p	p
27	13	3	41	p	3	73	p	3	p	11	3	7	p	3	p	p	3	p	7	3
29	p	71	3	7	47	3	p	11	3	p	7	3	97	p	3	53	p	3	11	17
31	3	13	7	3	p	11	3	p	p	3	p	p	3	p	13	3	7	p	3	89
33	p	3	43	11	3	p	p	3	7	109	3	37	p	3	11	7	3	p	71	3
37	3	67	23	3	p	p	3	p	37	3	11	p	3	7	43	3	19	p	3	p
39	101	3	29	13	3	7	p	3	11	p	3	p	7	3	p	41	3	p	47	3
41	19	79	3	p	7	3	11	p	3	67	13	3	p	23	3	p	p	3	7	19
43	3	p	p	3	11	p	3	23	p	3	7	19	3	67	p	3	p	7	3	107
47	11	7	3	p	p	3	97	p	3	p	41	3	79	103	3	7	p	3	13	37
49	3	p	p	3	p	p	3	7	31	3	101	p	3	p	7	3	p	p	3	41
51	p	3	p	113	3	p	7	3	p	p	3	109	101	3	p	p	3	19	11	3
53	13	p	3	31	97	3	p	p	3	19	p	3	7	13	3	103	11	3	83	7
57	p	3	53	7	3	p	p	3	83	p	3	23	11	3	13	47	3	7	101	3
59	17	p	3	83	19	3	107	p	3	7	11	3	p	p	3	p	7	3	p	p
61	3	7	13	3	p	p	3	29	7	3	p	p	3	p	p	3	p	p	3	11
63	7	3	17	53	3	p	11	3	89	13	3	59	p	3	7	79	3	11	29	3
67	3	31	11	3	17	7	3	p	p	3	13	29	3	11	p	3	p	p	3	7
69	11	3	19	p	3	17	p	3	p	p	3	7	p	3	31	p	3	13	7	3
71	p	37	3	7	29	3	17	p	3	11	7	3	p	19	3	23	p	3	59	p
73	3	p	7	3	41	13	3	11	73	3	p	p	3	p	p	3	7	p	3	p
77	7	p	3	11	31	3	13	7	3	17	p	3	p	p	3	37	61	3	p	13
79	3	11	109	3	p	61	3	p	p	3	17	43	3	7	23	3	p	31	3	19
81	p	3	p	73	3	7	53	3	23	71	3	17	7	3	113	p	3	43	p	3
83	p	13	3	19	7	3	p	p	3	p	p	3	17	p	3	p	p	3	7	11
87	p	3	7	p	3	29	19	3	p	7	3	p	p	3	17	11	3	p	p	3
89	73	7	3	p	p	3	37	23	3	13	79	3	p	11	3	7	29	3	p	59
91	3	23	31	3	43	p	3	7	p	3	p	11	3	p	7	3	13	p	3	p
93	17	3	p	37	3	p	7	3	53	11	3	p	41	3	p	31	3	17	23	3
97	3	p	17	3	7	11	3	p	p	3	31	7	3	89	p	3	11	p	3	17
99	23	3	79	7	3	13	p	3	47	53	3	p	p	3	11	19	3	7	13	3

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INCOMPOSITS.

TAB. IX.

	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179
01	p	3	17	p	3	29	13	3	53	p	3	7	103	3	p	11	3	31	7	3
03	13	p	3	7	47	3	p	p	3	p	7	3	p	11	3	23	29	3	19	p
07	p	3	19	23	3	17	p	3	7	11	3	p	p	3	13	7	3	p	p	3
09	7	89	3	47	61	3	17	7	3	37	73	3	p	19	3	p	p	3	11	p
11	3	p	13	3	p	11	3	17	p	3	p	71	3	7	23	3	11	89	3	p
13	67	3	31	11	3	7	37	3	17	13	3	109	7	3	11	83	3	p	47	3
17	3	71	p	3	p	83	3	73	67	3	7	p	3	p	p	3	79	7	3	19
19	83	3	7	p	3	p	p	3	11	7	3	17	67	3	p	p	3	13	103	3
21	37	7	3	19	p	3	11	43	3	p	p	3	17	p	3	7	67	3	71	p
23	3	23	p	3	11	13	3	7	p	3	29	p	3	17	7	3	p	37	3	p
27	11	p	3	29	p	3	13	43	3	p	p	3	7	p	3	17	p	3	p	7
29	3	127	p	3	7	p	3	p	p	3	p	7	3	13	29	3	17	p	3	p
31	17	3	p	7	3	61	p	3	p	p	3	37	p	3	p	47	3	7	11	3
33	p	13	3	p	p	3	p	29	3	7	p	3	19	p	3	89	7	3	17	79
37	7	3	13	17	3	23	127	3	113	p	3	p	11	3	7	13	3	p	p	3
39	43	p	3	p	17	3	7	19	3	13	11	3	p	7	3	p	31	3	p	p
41	3	p	109	3	41	7	3	p	11	3	p	61	3	p	107	3	13	113	3	7
43	61	3	37	59	3	71	11	3	p	p	3	7	43	3	p	53	3	11	7	3
47	3	67	7	3	p	p	3	p	17	3	p	13	3	11	73	3	7	p	3	131
49	11	3	p	p	3	13	p	3	7	17	3	11	47	3	p	7	3	p	13	3
51	7	31	3	83	p	3	p	7	3	11	17	3	13	p	3	p	19	3	p	29
53	3	29	p	3	p	p	3	11	19	3	p	17	3	7	31	3	127	41	3	13
57	p	107	3	11	7	3	p	13	3	31	7	3	p	17	3	97	p	3	7	p
59	3	11	71	3	109	29	3	p	23	3	37	p	3	p	13	3	p	7	3	p
61	p	3	7	p	3	p	p	3	13	7	3	131	41	3	19	17	3	p	53	3
63	p	7	3	p	101	3	19	p	3	p	113	3	61	97	3	7	17	3	p	11
67	p	3	p	13	3	p	7	3	101	19	3	p	31	3	p	11	3	109	17	3
69	p	19	3	p	43	3	79	41	3	71	13	3	7	11	3	p	p	3	107	7
71	3	103	53	3	7	73	3	31	p	3	43	7	3	29	p	3	41	13	3	p
73	p	3	p	7	3	p	p	3	47	11	3	13	23	3	101	p	3	7	61	3
77	3	7	41	3	p	11	3	19	7	3	p	89	3	p	p	3	11	29	3	p
79	7	3	73	11	3	59	13	3	p	p	3	41	37	3	7	p	3	23	19	3
81	13	11	3	p	p	3	7	97	3	p	19	3	11	7	3	p	p	3	p	p
83	3	p	19	3	53	7	3	13	p	3	11	p	3	p	p	3	p	p	3	7
87	p	p	3	7	p	3	11	p	3	p	7	3	59	p	3	43	23	3	31	p
89	3	p	7	3	11	53	3	103	p	3	23	p	3	p	p	3	7	p	3	p
91	p	3	11	37	3	47	p	3	7	13	3	p	p	3	p	7	3	p	p	3
93	7	p	3	13	p	3	7	7	3	p	p	3	p	p	3	73	13	3	29	19
97	p	3	43	19	3	7	59	3	61	23	3	29	7	3	p	p	3	13	11	3
99	17	97	3	23	7	3	p	107	3	89	p	3	p	127	3	p	11	3	7	41

INCOMPOSITIS.

TAB. X.

	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199
01	47	23	3	p	p	3	11	p	3	41	p	3	7	p	3	p	17	3	p	7
03	3	43	109	3	7	p	3	59	p	3	31	7	3	97	p	3	p	17	3	13
07	11	19	3	p	79	3	23	13	3	7	83	3	p	43	3	p	7	3	29	17
09	3	7	131	3	41	83	3	53	7	3	p	97	3	p	13	3	p	p	3	43
11	7	3	p	p	3	107	37	3	13	p	3	29	p	13	7	109	3	23	11	3
13	p	59	3	p	p	3	7	p	3	p	p	3	p	7	3	13	11	3	p	p
17	43	3	p	13	3	p	p	3	31	p	3	7	11	3	p	29	3	p	7	3
19	37	p	3	7	113	3	43	p	3	p	7	3	p	p	3	131	23	3	p	p
21	3	p	7	3	13	p	3	97	11	3	23	p	3	139	p	3	7	13	3	11
23	67	3	p	73	3	p	11	3	7	127	3	13	47	3	p	7	3	11	43	3
27	3	p	11	3	p	97	3	61	67	3	53	31	3	7	p	3	19	p	3	p
29	11	3	p	p	3	7	13	3	19	23	3	11	7	13	p	59	3	109	79	3
31	13	p	3	23	7	3	31	p	3	11	p	3	p	13	3	p	67	3	7	19
33	3	p	p	3	p	43	3	11	37	3	7	19	3	p	p	3	29	7	3	31
37	17	7	3	11	103	3	p	41	3	29	p	3	p	61	3	7	73	3	83	p
39	3	11	13	3	p	p	3	7	p	3	79	p	3	83	7	3	41	p	3	127
41	p	3	17	p	3	p	7	3	83	13	3	p	71	3	p	p	3	19	p	3
43	p	p	3	13	p	3	103	p	3	19	137	3	7	23	3	p	13	3	p	7
47	p	3	71	7	3	17	29	3	47	p	3	41	19	3	p	11	3	7	89	3
49	p	p	3	59	19	3	17	p	3	7	43	3	p	11	3	113	7	3	23	p
51	3	7	p	3	p	13	3	17	7	3	p	11	3	37	53	3	43	p	3	71
53	7	3	p	p	3	p	23	3	17	11	3	107	13	3	7	p	3	p	p	3
57	3	67	p	3	p	7	3	p	109	3	17	p	3	13	p	3	11	23	3	7
59	p	3	19	11	3	67	47	3	p	p	3	7	p	3	11	p	3	p	7	3
61	p	11	3	7	p	3	p	73	3	67	7	3	11	19	3	31	p	3	p	p
63	3	41	7	3	37	19	3	29	13	3	11	p	3	17	p	3	7	p	3	p
67	7	37	3	p	59	3	11	7	3	13	23	3	p	107	3	17	71	3	p	41
69	3	p	p	3	11	31	3	137	p	3	p	29	3	7	p	3	13	53	3	19
71	17	3	11	p	3	7	p	3	113	61	3	19	7	3	p	p	3	17	31	3
73	11	17	3	19	7	3	71	p	3	p	p	3	p	p	3	23	103	3	7	p
77	p	3	7	17	3	13	19	3	43	7	3	127	37	3	p	p	3	p	11	3
79	101	7	3	p	17	3	p	89	3	p	p	3	13	p	3	7	11	3	103	p
81	3	p	101	3	p	17	3	7	79	3	p	p	3	p	7	3	p	131	3	13
83	13	3	47	31	3	p	7	3	23	41	3	p	11	3	p	p	3	73	59	3
87	3	13	p	3	7	p	3	p	11	3	p	7	3	p	13	3	p	47	3	11
89	p	3	p	7	3	29	11	3	13	17	3	31	p	3	p	19	3	7	p	3
91	79	p	3	53	11	3	p	19	3	7	17	3	101	p	3	11	7	3	p	p
93	3	7	11	3	p	p	3	p	7	3	61	17	3	11	101	3	47	p	3	p
97	p	31	3	p	53	3	7	p	3	11	13	3	23	7	3	p	p	3	101	p
99	3	p	19	3	13	7	3	11	p	3	71	73	3	19	17	3	p	13	3	7

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INCOMPOSITS.

TAB. XI.

	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219
01	3	p	p	3	23	13	3	127	11	3	p	p	3	7	p	3	p	p	3	11
03	83	3	89	79	3	7	11	3	71	p	3	47	7	3	17	p	3	11	p	3
07	3	p	11	3	p	p	3	p	p	3	7	p	3	11	p	3	17	7	3	19
09	11	3	7	23	3	p	37	3	p	7	3	11	127	3	79	137	3	17	113	3
11	p	3	7	19	p	3	p	139	3	11	p	3	p	101	3	7	p	3	17	p
13	3	p	17	3	137	73	3	7	13	3	p	43	3	p	7	3	p	p	3	17
17	37	p	3	11	17	3	53	p	3	13	p	3	7	p	3	p	p	3	p	7
19	3	11	p	3	7	17	3	p	109	3	p	7	3	p	p	3	13	37	3	23
21	p	3	73	7	3	p	17	3	47	p	3	p	p	3	31	p	3	7	p	3
23	p	p	3	p	13	3	41	17	3	7	p	3	19	p	3	p	7	3	139	11
27	7	3	113	p	3	13	p	3	59	17	3	37	p	3	7	11	3	p	13	3
29	p	p	3	29	31	3	7	19	3	p	17	3	13	7	3	p	43	3	83	p
31	3	41	p	3	p	7	3	p	37	3	p	11	3	83	29	3	97	31	3	7
33	13	3	p	p	3	p	47	3	83	11	3	7	17	3	p	61	3	103	7	3
37	3	13	7	3	107	11	3	89	67	3	109	23	3	19	13	3	7	p	3	p
39	29	3	37	11	3	19	p	3	7	p	3	p	67	3	11	7	3	p	p	3
41	7	11	3	p	p	3	p	7	3	43	53	3	11	p	3	13	17	3	p	37
43	3	3	31	3	p	p	3	p	19	3	11	p	3	7	41	3	23	17	3	p
47	p	p	3	p	7	3	11	p	3	p	13	3	p	p	3	29	p	3	7	17
49	3	3	p	3	11	p	3	p	p	3	7	p	3	37	89	3	p	7	3	47
51	p	3	7	47	3	p	107	3	29	7	3	13	79	3	19	23	3	p	p	3
53	11	7	3	p	113	3	19	p	3	23	37	3	53	131	3	7	59	3	13	29
57	31	3	47	p	3	61	7	3	p	19	3	p	29	3	43	p	3	p	11	3
59	13	19	3	p	41	3	73	p	3	p	p	3	7	13	3	p	11	3	p	7
61	3	p	p	3	7	29	3	13	23	3	p	7	3	41	11	3	p	47	3	p
63	p	3	23	7	3	p	p	3	31	p	3	p	11	3	13	p	3	7	p	3
67	3	7	13	3	97	131	3	19	7	3	p	61	3	23	p	3	47	p	3	11
69	7	3	p	p	3	67	11	3	41	13	3	p	p	3	7	p	3	11	19	3
71	p	23	3	13	11	3	3	p	3	67	19	3	89	7	3	11	13	3	p	127
73	3	p	11	3	59	7	7	p	p	3	13	31	3	11	109	3	p	p	3	7
77	17	p	3	7	p	3	23	79	3	11	7	3	p	p	3	p	53	3	131	p
79	3	17	7	3	p	13	3	11	p	3	107	p	3	p	47	3	7	29	3	31
81	43	3	17	89	3	11	p	3	7	p	3	59	13	3	p	7	3	23	p	3
83	7	p	3	11	p	3	13	7	3	3	29	3	p	p	3	113	p	3	79	13
87	53	3	p	19	3	7	137	3	p	31	3	p	7	3	p	p	3	p	43	3
89	p	13	3	p	7	3	17	p	3	139	p	3	61	73	3	p	23	3	7	11
91	3	61	103	3	31	59	3	17	13	3	7	p	3	p	p	3	109	7	3	p
93	71	3	7	p	3	p	p	3	17	7	3	p	107	3	p	11	3	19	p	3
97	3	19	p	3	103	43	3	7	p	3	17	11	3	p	7	3	13	71	3	p
99	101	3	53	p	3	p	7	3	p	11	3	17	19	3	p	p	3	p	61	3

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TAB. XII.

	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
01	7	3	149	29	3	p	97	3	151	p	3	13	p	3	7	71	3	137	p	3
03	p	23	3	p	43	3	7	73	3	37	p	3	p	7	3	19	p	3	13	11
07	59	3	53	p	3	71	13	3	p	p	3	7	23	3	89	11	3	151	7	3
09	13	p	3	7	p	3	23	p	3	31	7	3	p	11	3	p	p	3	29	p
11	3	p	7	3	73	p	3	13	p	3	p	11	3	p	41	3	7	131	3	p
13	p	3	97	53	3	47	p	3	7	11	3	29	139	3	13	7	3	23	p	3
17	3	17	13	3	29	11	3	p	p	3	p	p	3	7	p	3	11	37	3	p
19	97	3	17	11	3	7	p	3	19	13	3	61	7	3	11	29	3	p	p	3
21	19	11	3	13	7	3	p	p	3	p	p	3	11	p	3	43	13	3	7	19
23	3	p	71	3	17	101	3	31	29	3	7	19	3	83	59	3	p	7	3	47
27	p	7	3	83	41	3	11	p	3	101	p	3	p	p	3	7	p	3	p	71
29	3	p	p	3	11	13	3	7	37	3	p	101	3	41	7	3	p	61	3	p
31	p	3	11	137	3	p	7	3	17	23	3	p	13	3	p	p	3	19	p	3
33	11	p	3	23	p	3	13	127	3	17	31	3	7	p	3	101	p	3	p	7
37	p	3	37	7	3	31	p	3	41	p	3	17	19	3	23	p	3	7	11	3
39	p	13	3	89	19	3	p	p	3	7	p	3	17	p	3	p	7	3	31	37
41	3	7	23	3	p	p	3	p	7	3	p	73	3	17	11	3	47	p	3	89
43	7	3	13	p	3	p	p	3	53	p	3	p	11	3	7	13	3	p	113	3
47	3	p	p	3	p	7	3	23	11	3	19	79	3	37	p	3	13	p	3	7
49	17	3	19	p	3	p	11	3	73	53	3	7	67	3	131	p	3	11	7	3
51	p	17	3	7	11	3	p	p	3	59	7	3	p	19	3	11	67	3	17	43
53	3	p	7	3	p	19	3	61	p	3	p	13	3	11	47	3	7	p	3	17
57	7	p	3	79	17	3	139	7	3	11	p	3	13	p	3	p	41	3	p	p
59	3	p	p	3	37	17	3	11	p	3	p	p	3	7	p	3	59	23	3	13
61	13	3	113	59	3	7	17	3	p	p	3	19	7	3	29	p	3	p	107	3
63	p	37	3	11	7	3	131	13	3	p	p	3	43	61	3	p	p	3	7	31
67	p	3	7	p	3	p	19	3	13	7	3	p	53	3	31	p	3	p	29	3
69	29	7	3	p	p	3	p	p	3	103	17	3	p	p	3	7	p	3	p	11
71	3	p	p	3	23	p	3	7	p	3	p	17	3	p	7	3	p	11	3	p
73	p	3	p	13	3	p	7	3	89	p	3	p	17	3	p	11	3	p	p	3
77	3	67	p	3	7	107	3	p	p	3	47	7	3	97	17	3	p	13	3	p
79	p	3	p	7	3	67	p	3	137	11	3	13	p	3	53	17	3	7	p	3
81	71	41	3	p	p	3	37	11	3	7	p	3	31	103	3	p	7	3	11	p
83	3	7	p	3	p	11	3	p	7	3	41	97	3	67	23	3	11	17	3	29
87	13	11	3	61	113	3	7	p	3	127	p	3	11	7	3	103	p	3	p	17
89	3	p	31	3	43	7	3	13	47	3	11	p	3	19	83	3	p	p	3	7
91	p	3	p	p	3	19	p	3	11	83	3	7	p	3	13	31	3	37	7	3
93	p	p	3	7	83	3	11	23	3	p	7	3	p	149	3	p	19	3	p	p
97	19	3	11	p	3	59	p	3	7	13	3	p	p	3	p	7	3	53	23	3
99	7	79	3	13	149	3	p	7	3	109	p	3	23	p	3	p	13	3	p	103

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INCOMPOSITS.

TAB. XIII.

	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259
01	p	7	3	19	13	3	73	17	3	37	23	3	11	p	3	7	p	3	p	59
03	3	p	p	3	23	107	3	7	17	3	11	13	3	p	7	3	p	p	3	p
07	p	p	3	109	p	3	11	31	3	p	17	3	7	p	3	23	29	3	131	7
09	3	p	43	3	7	p	3	p	p	3	89	7	3	p	p	3	p	47	3	13
11	73	3	11	7	3	127	p	3	43	29	3	p	17	3	p	97	3	7	53	3
13	11	p	3	41	p	3	151	13	3	7	p	3	19	17	3	31	7	3	83	p
17	7	3	61	p	3	p	103	3	13	p	3	p	151	3	p	17	3	p	11	3
19	p	89	3	83	p	3	7	19	3	p	127	3	p	7	3	13	11	3	p	p
21	3	p	53	3	p	7	3	59	p	3	131	p	3	p	11	3	p	17	3	7
23	p	3	p	13	3	137	p	3	103	p	3	7	11	3	p	p	3	29	7	3
27	3	23	7	3	13	p	3	79	11	3	29	p	3	19	47	3	7	13	3	11
29	p	3	p	p	3	19	11	3	7	97	3	13	p	3	59	7	3	11	23	3
31	7	59	3	29	11	3	p	7	3	107	p	3	23	73	3	11	19	3	13	p
33	3	p	11	3	53	p	3	p	19	3	p	41	3	7	29	3	p	p	3	p
37	13	p	3	p	7	3	71	29	3	11	p	3	p	13	3	p	31	3	7	37
39	3	101	p	3	p	53	3	11	59	3	7	23	3	p	p	3	p	7	3	p
41	29	3	7	101	3	11	41	3	p	7	3	31	43	3	13	p	3	p	p	3
43	p	7	3	11	p	3	19	109	3	p	79	3	p	p	3	7	p	3	43	p
47	139	3	p	97	3	p	7	3	p	13	3	p	p	3	p	59	3	p	p	3
49	p	19	3	13	23	3	157	p	3	61	37	3	7	p	3	29	13	3	p	7
51	3	p	p	3	7	p	3	53	p	3	13	7	3	101	31	3	113	11	3	p
53	67	3	79	7	3	43	89	3	29	p	3	p	p	3	p	11	3	7	103	3
57	3	7	127	3	37	13	3	19	7	3	p	11	3	p	p	3	p	43	3	101
59	7	3	17	p	3	41	p	3	p	11	3	139	13	3	7	61	3	p	19	3
61	p	37	3	17	61	3	7	11	3	109	19	3	p	7	3	p	67	3	11	13
63	3	73	19	3	17	7	3	p	23	3	71	p	3	13	p	3	11	p	3	7
67	41	11	3	7	43	3	17	p	3	p	7	3	11	p	3	37	p	3	p	23
69	3	p	7	3	p	79	3	17	13	3	11	p	3	23	p	3	7	73	3	p
71	p	3	13	p	3	p	p	3	7	p	3	p	37	3	p	7	3	p	41	3
73	7	23	3	p	p	3	11	7	3	13	p	3	127	p	3	107	p	3	p	19
77	p	3	11	19	3	7	p	3	p	p	3	17	7	3	73	p	3	149	113	3
79	11	p	3	p	7	3	23	71	3	p	31	3	17	41	3	p	p	3	7	83
81	3	p	p	3	p	47	3	p	139	3	7	13	3	17	83	3	61	7	3	p
83	p	3	7	37	3	13	p	3	149	7	3	p	131	3	17	p	3	19	11	3
87	3	19	149	3	47	23	3	7	41	3	p	89	3	53	7	3	17	107	3	13
89	13	3	107	29	3	67	7	3	p	p	3	p	11	3	71	p	3	17	p	3
91	p	17	3	p	19	3	p	13	3	67	11	3	7	p	3	157	23	3	17	7
93	3	13	17	3	7	p	3	p	11	3	23	7	3	67	13	3	p	p	3	11
97	p	p	3	31	11	3	p	137	3	7	p	3	41	109	3	11	7	3	19	p
99	3	7	11	3	p	17	3	p	7	3	19	113	3	11	43	3	31	p	3	p

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INCOMPOSITS.

Tab. XII.

	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
01	7	3	149	29	3	p	97	3	151	p	3	13	p	3	7	71	3	137	p	3
03	p	23	3	p	43	3	7	73	3	37	p	3	p	7	3	19	p	3	13	11
07	59	3	53	p	3	71	13	3	p	p	3	7	23	3	89	11	3	151	7	3
09	13	p	3	7	p	3	23	p	3	31	7	3	p	11	3	p	p	3	29	p
11	3	p	7	3	73	p	3	13	p	3	p	11	3	p	41	3	7	131	3	p
13	p	3	97	53	3	47	p	3	7	11	3	29	139	3	13	7	3	23	p	3
17	3	17	13	3	29	11	3	p	p	3	p	p	3	7	p	3	11	37	3	p
19	97	3	17	11	3	7	p	3	19	13	3	61	7	3	11	29	3	p	p	3
21	19	11	3	13	7	3	p	p	3	p	p	3	11	p	3	43	13	3	7	19
23	3	p	71	3	17	101	3	31	29	3	7	19	3	83	59	3	p	7	3	47
27	p	7	3	83	41	3	11	p	3	101	p	3	p	p	3	7	p	3	p	71
29	3	p	p	3	11	13	3	7	37	3	p	101	3	41	7	3	p	61	3	p
31	p	3	11	137	3	p	7	3	17	23	3	p	13	3	p	p	3	19	p	3
33	11	p	3	23	p	3	13	127	3	17	31	3	7	p	3	101	p	3	p	7
37	p	3	37	7	3	31	p	3	41	p	3	17	19	3	23	p	3	7	11	3
39	p	13	3	89	19	3	p	p	3	7	p	3	17	p	3	p	7	3	31	37
41	3	7	23	3	p	p	3	p	7	3	p	73	3	17	11	3	47	p	3	89
43	7	3	13	p	3	p	p	3	53	p	3	p	11	3	7	13	3	p	113	3
47	3	p	p	3	p	7	3	23	11	3	19	79	3	37	p	3	13	p	3	7
49	17	3	19	p	3	p	11	3	73	53	3	7	67	3	131	p	3	11	7	3
51	p	17	3	7	11	3	p	p	3	59	7	3	p	19	3	11	67	3	17	43
53	3	p	7	3	p	19	3	61	p	3	p	13	3	11	47	3	7	p	3	17
57	7	p	3	79	17	3	139	7	3	11	p	3	13	p	3	p	41	3	p	p
59	3	p	p	3	37	17	3	11	p	3	p	p	3	7	p	3	59	23	3	13
61	13	3	113	59	3	7	17	3	p	p	3	19	7	3	29	p	3	p	107	3
63	p	37	3	11	7	3	131	13	3	p	p	3	43	61	3	p	p	3	7	31
67	p	3	7	p	3	p	19	3	13	7	3	p	53	3	31	p	3	p	29	3
69	29	7	3	p	p	3	p	p	3	103	17	3	p	p	3	7	p	3	p	11
71	3	p	p	3	23	p	3	7	p	3	p	17	3	p	7	3	p	11	3	p
73	p	3	p	13	3	p	7	3	89	p	3	p	17	3	p	11	3	p	p	3
77	3	67	p	3	7	107	3	p	p	3	47	7	3	97	17	3	p	13	3	p
79	p	3	p	7	3	67	p	3	137	11	3	13	p	3	53	17	3	7	p	3
81	71	41	3	p	p	3	37	11	3	7	p	3	31	103	3	p	7	3	11	p
83	3	7	p	3	p	11	3	p	7	3	41	97	3	67	23	3	11	17	3	29
87	13	11	3	61	113	3	7	p	3	127	p	3	11	7	3	103	p	3	p	17
89	3	p	31	3	43	7	3	13	47	3	11	p	3	19	83	3	p	p	3	7
91	p	3	p	p	3	19	p	3	11	83	3	7	p	3	13	31	3	37	7	3
93	p	p	3	7	83	3	11	23	3	p	7	3	p	149	3	p	19	3	p	p
97	19	3	11	p	3	59	p	3	7	13	3	p	p	3	p	7	3	53	23	3
99	7	79	3	13	149	3	p	7	3	109	p	3	23	p	3	p	13	3	p	103

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INCOMPOSITS.

TAB. XIII.

	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259
01	p	7	3	19	13	3	73	17	3	37	23	3	11	p	3	7	p	3	p	59
03	3	p	p	3	23	107	3	7	17	3	11	13	3	p	7	3	p	p	3	p
07	p	p	3	109	p	3	11	31	3	p	17	3	7	p	3	23	29	3	131	7
09	3	p	43	3	7	p	3	p	p	3	89	7	3	p	p	3	p	47	3	13
11	73	3	11	7	3	127	p	3	43	29	3	p	17	3	p	97	3	7	53	3
13	11	p	3	41	p	3	151	13	3	7	p	3	19	17	3	31	7	3	83	p
17	7	3	61	p	3	p	103	3	13	p	3	p	151	3	p	17	3	p	11	3
19	p	89	3	83	p	3	7	19	3	p	127	3	p	7	3	13	11	3	p	p
21	3	p	53	3	p	7	3	59	p	3	131	p	3	p	11	3	p	17	3	7
23	p	3	p	13	3	137	p	3	103	p	3	7	11	3	p	p	3	29	7	3
27	3	23	7	3	13	p	3	79	11	3	29	p	3	19	47	3	7	13	3	11
29	p	3	p	p	3	19	11	3	7	97	3	13	p	3	59	7	3	11	23	3
31	7	59	3	29	11	3	p	7	3	107	p	3	23	73	3	11	19	3	13	p
33	3	p	11	3	53	p	3	p	19	3	p	41	3	7	29	3	p	p	3	p
37	13	p	3	p	7	3	71	29	3	11	p	3	p	13	3	p	31	3	7	37
39	3	101	p	3	p	53	3	11	59	3	7	23	3	p	p	3	p	7	3	p
41	29	3	7	101	3	11	41	3	p	7	3	31	43	3	13	p	3	p	p	3
43	p	7	3	11	p	3	19	109	3	p	79	3	p	p	3	7	p	3	43	p
47	139	3	p	97	3	p	7	3	p	13	3	p	p	3	p	59	3	p	p	3
49	p	19	3	13	23	3	157	p	3	61	37	3	7	p	3	29	13	3	p	7
51	3	p	p	3	7	p	3	53	p	3	13	7	3	101	31	3	113	11	3	p
53	67	3	79	7	3	43	89	3	29	p	3	p	p	3	p	11	3	7	103	3
57	3	7	127	3	37	13	3	19	7	3	p	11	3	p	p	3	p	43	3	101
59	7	3	17	p	3	41	p	3	p	11	3	139	13	3	7	61	3	p	19	3
61	p	37	3	17	61	3	7	11	3	109	19	3	p	7	3	p	67	3	11	13
63	3	73	19	3	17	7	3	p	23	3	71	p	3	13	p	3	11	p	3	7
67	41	11	3	7	43	3	17	p	3	p	7	3	11	p	3	37	p	3	p	23
69	3	p	7	3	p	79	3	17	13	3	11	p	3	23	p	3	7	73	3	p
71	p	3	13	p	3	p	p	3	7	p	3	p	37	3	p	7	3	p	41	3
73	7	23	3	p	p	3	11	7	3	13	p	3	127	p	3	107	p	3	p	19
77	p	3	11	19	3	7	p	3	p	p	3	17	7	3	73	p	3	149	113	3
79	11	p	3	p	7	3	23	71	3	p	31	3	17	41	3	p	p	3	7	83
81	3	p	p	3	p	47	3	p	139	3	7	13	3	17	83	3	61	7	3	p
83	p	3	7	37	3	13	p	3	149	7	3	p	131	3	17	p	3	19	11	3
87	3	19	149	3	47	23	3	7	41	3	p	89	3	53	7	3	17	107	3	13
89	13	3	107	29	3	67	7	3	p	p	3	p	11	3	71	p	3	17	p	3
91	p	17	3	p	19	3	p	13	3	67	11	3	7	p	3	157	23	3	17	7
93	3	13	17	3	7	p	3	p	11	3	23	7	3	67	13	3	p	p	3	11
97	p	p	3	31	11	3	p	137	3	7	p	3	41	109	3	11	7	3	19	p
99	3	7	11	3	p	17	3	p	7	3	19	113	3	11	43	3	31	p	3	p

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TAB. XIV.

	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279
01	3	43	7	3	17	p	3	p	p	3	13	41	3	23	11	3	7	p	3	p
03	p	3	p	29	3	17	37	3	7	p	3	p	11	3	67	7	3	13	p	3
07	3	p	73	3	p	13	3	17	11	3	113	p	3	7	p	3	19	103	3	11
09	31	3	p	p	3	7	11	3	17	71	3	p	7	3	p	p	3	11	p	3
11	19	p	3	83	7	3	13	p	3	17	p	3	p	31	3	11	p	3	7	13
13	3	p	11	3	61	p	3	p	p	3	7	19	3	11	79	3	53	7	3	103
17	p	7	3	p	p	3	43	p	3	11	p	3	17	59	3	7	p	3	p	p
19	3	p	157	3	29	23	3	7	13	3	41	47	3	17	p	3	71	53	3	p
21	p	3	13	p	3	11	7	3	p	p	3	37	163	3	17	13	3	19	43	3
23	53	151	3	11	p	3	79	p	3	13	61	3	7	89	3	17	23	3	p	7
27	17	3	p	7	3	41	p	3	139	p	3	p	19	3	p	p	3	7	p	3
29	p	17	3	113	13	3	31	p	3	7	151	3	73	p	3	p	7	3	17	11
31	3	7	17	3	p	43	3	p	7	3	p	13	3	151	p	3	p	11	3	17
33	7	3	37	17	3	13	p	3	p	23	3	43	131	3	7	11	3	p	13	3
37	3	59	p	3	p	7	3	p	47	3	19	11	3	p	p	3	29	p	3	7
39	13	3	19	p	3	p	17	3	p	11	3	7	p	3	23	p	3	p	7	3
41	p	p	3	7	137	3	p	11	3	29	7	3	p	19	3	p	131	3	11	p
43	3	13	7	3	31	11	3	47	17	3	p	p	3	37	13	3	7	p	3	p
47	7	11	3	p	53	3	p	7	3	p	17	3	11	23	3	13	p	3	p	p
49	3	79	p	3	p	139	3	23	p	3	11	17	3	7	p	3	43	p	3	19
51	109	3	p	13	3	7	29	3	11	p	3	19	7	3	97	p	3	p	p	3
53	p	p	3	19	7	3	11	31	3	p	13	3	p	17	3	59	p	3	7	p
57	71	3	7	p	3	p	19	3	107	7	3	13	97	3	p	17	3	41	89	3
59	11	7	3	43	p	3	53	p	3	p	p	3	p	109	3	7	17	3	13	73
61	3	p	p	3	47	p	3	7	p	3	p	157	3	p	7	3	139	17	3	p
63	67	3	p	41	3	101	7	3	p	59	3	23	137	3	29	43	3	p	11	3
67	3	137	p	3	7	31	3	13	67	3	p	7	3	p	11	3	73	p	3	p
69	131	3	109	7	3	163	p	3	97	149	3	101	11	3	13	19	3	7	29	3
71	29	p	3	p	103	3	149	19	3	7	11	3	p	101	3	79	7	3	47	83
73	3	7	13	3	23	p	3	41	7	3	p	29	3	31	83	3	p	p	3	11
77	89	p	3	13	11	3	7	p	3	53	p	3	p	7	3	11	13	3	61	101
79	3	47	11	3	p	7	3	61	p	3	13	p	3	11	p	3	89	p	3	7
81	11	3	41	23	3	19	p	3	p	p	3	7	p	3	p	p	3	13	7	3
83	p	p	3	7	71	3	p	p	3	11	7	3	p	139	3	p	19	3	p	p
87	19	3	97	p	3	11	p	3	7	p	3	31	13	3	p	7	3	37	79	3
89	7	p	3	11	p	3	13	7	3	137	103	3	29	61	3	47	p	3	167	13
91	3	11	61	3	59	p	3	73	p	3	p	p	3	7	37	3	p	p	3	23
93	97	3	p	p	3	7	p	3	p	p	3	71	7	3	19	41	3	p	p	3
97	3	17	p	3	p	p	3	127	13	3	7	p	3	p	31	3	p	7	3	p
99	p	3	7	p	3	67	p	3	37	7	3	59	p	3	107	11	3	p	23	3

INCOMPOSITS.

TAB. XV.

	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299
01	p	3	p	7	3	11	37	3	83	p	3	p	p	3	p	p	3	7	17	3
03	41	157	3	11	p	3	p	p	3	7	13	3	19	p	3	163	7	3	p	17
07	7	3	67	p	3	29	p	3	p	137	3	13	p	3	7	19	3	61	41	3
09	73	p	3	p	p	3	7	19	3	p	p	3	p	7	3	23	29	3	13	11
11	3	p	p	3	p	7	3	p	47	3	67	43	3	p	p	3	p	11	3	7
13	109	3	89	23	3	p	13	3	p	29	3	7	131	3	67	11	3	43	7	3
17	3	31	7	3	157	p	3	13	p	3	p	11	3	19	23	3	7	p	3	p
19	p	3	p	p	3	19	p	3	7	11	3	37	61	3	13	7	3	113	p	3
21	7	61	3	127	67	3	p	7	3	p	p	3	p	109	3	53	19	3	11	p
23	3	p	13	3	43	11	3	p	19	3	p	p	3	7	p	3	11	p	3	23
27	p	11	3	13	7	3	p	23	3	p	p	3	11	p	3	p	13	3	7	p
29	3	23	p	3	p	47	3	p	127	3	7	p	3	139	p	3	p	7	3	173
31	p	3	7	41	3	103	p	3	11	7	3	p	p	3	19	p	3	13	23	3
33	17	7	3	29	p	3	11	59	3	p	p	3	23	p	3	7	p	3	p	37
37	23	3	11	43	3	p	7	3	p	19	3	p	13	3	p	p	3	131	p	3
39	11	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	11	3	7	13	3	71	19	3
51	p	p	3	p	23	3	7	p	3	13	11	3	p	7	3	29	149	3	p	61
53	3	47	19	3	37	7	3	p	11	3	17	p	3	149	p	3	13	p	3	7
57	p	37	3	7	11	3	p	149	3	23	7	3	17	31	3	11	47	3	73	29
59	3	29	7	3	149	p	3	p	p	3	p	13	3	11	89	3	7	p	3	p
61	11	3	59	79	3	13	p	3	7	p	3	11	29	3	17	7	3	p	13	3
63	7	p	3	113	p	3	p	7	3	11	p	3	13	p	3	17	p	3	p	19
67	13	3	23	19	3	7	109	3	p	83	3	p	7	3	79	p	3	17	p	3
69	p	17	3	11	7	3	p	13	3	59	41	3	p	43	3	p	p	3	7	23
71	3	11	17	3	71	p	3	p	p	3	7	31	3	23	13	3	p	7	3	17
73	67	3	7	17	3	p	53	3	13	7	3	p	73	3	p	p	3	19	p	3
77	3	19	p	3	p	17	3	7	67	3	p	163	3	29	7	3	59	11	3	31
79	43	3	p	13	3	p	7	3	p	p	3	p	19	3	41	11	3	97	p	3
81	p	p	3	101	19	3	23	17	3	73	13	3	7	11	3	p	67	3	p	7
83	3	p	p	3	7	101	3	107	17	3	127	7	3	p	p	3	p	13	3	p
87	p	71	3	p	61	3	p	11	3	7	17	3	p	p	3	p	7	3	11	157
89	3	7	p	3	31	11	3	p	7	3	19	17	3	p	37	3	11	p	3	p
91	7	3	19	11	3	p	13	3	167	53	3	p	17	3	7	127	3	31	71	3
93	13	11	3	p	p	3	7	p	3	79	47	3	11	7	3	101	23	3	167	89
97	p	3	p	73	3	p	p	3	11	107	3	7	p	3	13	17	3	83	7	3
99	p	163	3	7	p	3	11	31	3	47	7	3	83	p	3	p	17	3	29	131

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INCOMPOSITS.

TAB. XVI.

	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
01	19	31	3	157	7	3	71	11	3	13	29	3	41	113	3	17	p	3	7	19
03	3	p	p	3	p	11	3	p	p	3	7	19	3	23	31	3	11	7	3	61
07	37	7	3	p	13	3	127	p	3	31	101	3	11	p	3	7	p	3	17	p
09	3	p	17	3	47	p	3	7	p	3	11	13	3	131	7	3	73	37	3	17
11	p	3	p	17	3	13	7	3	11	p	3	53	23	3	101	p	3	19	13	3
13	p	p	3	p	17	3	11	p	3	19	p	3	7	173	3	p	101	3	29	7
17	13	3	11	7	3	p	17	3	p	43	3	29	19	3	89	p	3	7	p	3
19	11	p	3	p	19	3	67	13	3	7	p	3	p	p	3	43	7	3	47	59
21	3	7	47	3	29	23	3	31	7	3	67	p	3	p	13	3	103	p	3	137
23	7	3	p	p	3	131	113	3	13	17	3	p	p	3	7	29	3	p	11	3
27	3	47	167	3	p	7	3	p	29	3	19	17	3	p	11	3	p	p	3	7
29	p	3	19	13	3	p	109	3	p	157	3	7	11	3	53	41	3	p	7	3
31	59	29	3	7	p	3	p	79	3	p	7	3	p	17	3	p	47	3	139	37
33	3	p	7	3	13	19	3	73	11	3	p	163	3	p	17	3	7	13	3	11
37	7	p	3	23	11	3	p	7	3	p	41	3	p	p	3	11	17	3	13	109
39	3	p	11	3	61	p	3	59	p	3	p	p	3	7	149	3	29	17	3	19
41	11	3	p	p	3	7	13	3	p	p	3	11	7	3	23	p	3	p	17	3
43	13	43	3	19	7	3	p	71	3	11	37	3	157	13	3	p	p	3	7	17
47	p	3	7	p	3	11	19	3	109	7	3	p	p	3	13	p	3	53	p	3
49	151	7	3	11	p	3	p	97	3	p	61	3	p	23	3	7	p	3	p	43
51	3	11	13	3	37	137	3	7	p	3	p	p	3	107	7	3	31	p	3	89
53	41	3	p	127	3	p	7	3	p	13	3	p	p	3	71	139	3	113	53	3
57	3	53	79	3	7	p	3	p	59	3	13	7	3	p	83	3	p	11	3	p
59	p	3	p	7	3	p	23	3	p	83	3	p	p	3	163	11	3	7	p	3
61	23	p	3	97	83	3	p	19	3	7	89	3	43	11	3	37	7	3	151	31
63	3	7	53	3	41	13	3	p	7	3	p	11	3	79	73	3	p	23	3	p
67	107	71	3	p	p	3	7	11	3	173	47	3	p	7	3	p	p	3	11	13
69	3	p	p	3	p	7	3	29	p	3	p	71	3	13	p	3	11	p	3	7
71	p	3	p	11	3	19	p	3	p	p	3	7	p	3	11	131	3	p	7	3
73	17	11	3	7	31	3	37	p	3	47	7	3	11	137	3	p	19	3	p	p
77	19	3	13	37	3	p	p	3	7	p	3	p	p	3	p	7	3	43	127	3
79	7	103	3	17	29	3	11	7	3	13	p	3	31	p	3	23	79	3	71	113
81	3	p	107	3	11	53	3	p	p	3	p	p	3	7	p	3	13	61	3	p
83	67	3	11	23	3	7	61	3	89	p	3	p	7	3	19	p	3	37	p	3
87	3	p	31	3	43	73	3	17	67	3	7	13	3	p	23	3	p	7	3	29
89	p	3	7	p	3	13	p	3	17	7	3	p	67	3	p	31	3	83	11	3
91	p	7	3	p	p	3	47	41	3	17	p	3	13	p	3	7	11	3	p	p
93	3	109	p	3	p	p	3	7	p	3	17	p	3	p	7	3	41	p	3	13
97	p	p	3	113	p	3	p	13	3	139	11	3	7	p	3	19	29	3	167	7
99	3	13	41	3	7	37	3	19	11	3	137	7	3	17	13	3	p	p	3	11

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TAB. XVII.

	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339
01	3	47	13	3	p	7	3	53	p	3	61	79	3	p	127	3	p	67	3	7
03	p	3	p	p	3	p	p	3	p	13	3	7	p	3	p	p	3	p	7	3
07	3	97	7	3	23	p	3	p	53	3	13	p	3	19	11	3	7	37	3	41
09	p	3	31	p	3	19	p	3	7	p	3	113	11	3	47	7	3	13	p	3
11	7	163	3	79	p	3	p	7	3	p	11	3	p	p	3	23	19	3	p	p
13	3	17	p	3	p	13	3	p	11	3	p	p	3	7	p	3	p	p	3	11
17	101	p	3	17	7	3	13	p	3	p	137	3	59	p	3	11	p	3	7	13
19	3	p	11	3	17	31	3	p	37	3	7	p	3	11	23	3	p	7	3	107
21	11	3	7	p	3	17	p	3	23	7	3	11	139	3	19	p	3	p	31	3
23	31	7	3	p	p	3	17	43	3	11	p	3	p	47	3	7	p	3	149	p
27	p	3	13	p	3	11	7	3	17	19	3	157	149	3	p	13	3	29	p	3
29	p	19	3	11	p	3	67	23	3	13	p	3	7	p	3	p	p	3	p	7
31	3	11	167	3	7	p	3	71	p	3	17	7	3	p	101	3	13	89	3	p
33	103	3	p	7	3	p	p	3	p	p	3	17	167	3	67	p	3	7	23	3
37	3	7	p	3	163	p	3	19	7	3	p	13	3	17	29	3	p	11	3	p
39	7	3	103	73	3	13	127	3	p	p	3	31	43	3	7	11	3	p	13	3
41	179	p	3	p	p	3	7	29	3	p	19	3	13	7	3	17	p	3	43	p
43	3	p	19	3	p	7	3	137	p	3	173	11	3	p	53	3	17	41	3	7
47	73	17	3	7	71	3	p	11	3	47	p	3	p	p	3	p	p	3	11	83
49	3	13	7	3	37	11	3	p	107	3	7	p	3	p	13	3	7	p	3	17
51	p	3	p	11	3	43	103	3	7	83	3	p	41	3	[illegible]	7	3	p	p	3
53	7	11	3	p	17	3	p	7	3	31	p	3	11	p	3	13	73	3	97	19
57	p	3	p	13	3	7	17	3	11	p	3	71	7	3	p	23	3	p	p	3
59	p	p	3	p	7	3	11	17	3	23	13	3	9	p	3	37	97	3	7	29
61	3	29	p	3	11	p	3	181	17	3	7	p	3	73	p	3	41	7	3	p
63	p	3	7	p	3	p	89	3	59	7	3	13	29	3	109	p	3	19	p	3
67	3	19	41	3	p	29	3	7	23	3	43	17	3	61	7	3	131	p	3	p
69	p	3	23	p	3	p	7	3	p	p	3	41	17	3	p	p	3	p	11	3
71	13	53	3	p	19	3	37	p	3	p	p	3	7	13	3	59	11	3	p	7
73	3	p	59	3	7	p	3	13	71	3	p	7	3	23	11	3	151	p	3	53
77	p	23	3	p	47	3	41	73	3	7	11	3	107	p	3	p	7	3	19	61
79	3	7	13	3	p	p	3	p	7	3	19	p	3	29	p	3	p	17	3	11
81	7	3	19	p	3	31	11	3	131	13	3	p	23	3	7	p	3	11	17	3
83	p	p	3	13	11	3	7	p	3	p	p	3	83	7	3	11	13	3	31	17
87	11	3	83	139	3	p	p	3	p	p	3	7	p	3	p	p	3	13	7	3
89	p	p	3	7	53	3	97	p	3	11	7	3	p	173	3	p	59	3	p	41
91	3	p	7	3	p	13	3	11	31	3	p	p	3	p	107	7	3	p	3	19
93	67	3	43	29	3	11	p	3	7	p	3	19	13	3	p	3	3	47	p	3
97	3	11	p	3	p	37	3	p	67	3	23	89	3	7	19	3	31	p	3	p
99	p	3	p	179	3	7	19	3	167	p	3	p	7	3	139	p	3	73	109	3

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TAB. XVIII.

	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359
01	11	3	23	p	3	p	7	3	13	17	3	11	p	3	p	131	3	19	p	3
03	37	67	3	p	p	3	p	p	3	11	17	3	7	43	3	13	p	3	p	7
07	31	3	79	7	3	11	p	3	p	67	3	p	17	3	p	p	3	7	61	3
09	71	23	3	11	19	3	53	61	3	7	13	3	137	17	3	p	7	3	p	149
11	3	7	p	3	13	p	3	103	7	3	157	p	3	p	17	3	149	13	3	p
13	7	3	p	p	3	p	p	3	31	p	3	13	23	3	7	17	3	71	59	3
17	3	109	p	3	127	7	3	149	37	3	19	p	3	p	107	3	p	11	3	7
19	p	3	19	p	3	p	13	3	p	p	3	7	41	3	p	11	3	23	7	3
21	13	149	3	7	p	3	89	p	3	47	7	3	p	11	3	p	179	3	113	17
23	3	p	7	3	29	19	3	13	97	3	p	11	3	p	p	3	7	139	3	p
27	7	p	3	p	173	3	31	7	3	53	p	3	p	p	3	p	23	3	11	37
29	3	p	13	3	p	11	3	p	29	3	23	p	3	7	71	3	11	p	3	19
31	p	3	p	11	3	7	p	3	61	13	3	19	p	3	11	p	3	p	p	3
33	p	11	3	13	7	3	59	47	3	181	53	3	11	89	3	p	13	3	7	p
37	101	3	7	p	3	p	19	3	11	7	3	41	167	3	p	p	3	13	p	3
39	p	7	3	23	p	3	11	p	3	p	37	3	131	p	3	7	157	3	p	83
41	3	p	97	3	11	13	3	7	p	3	67	p	3	59	7	3	29	103	3	127
43	59	3	11	61	3	p	7	3	p	83	3	113	13	3	23	p	3	31	73	3
47	3	p	23	3	7	179	3	p	p	3	101	7	3	13	p	3	43	p	3	103
49	79	3	29	7	3	p	p	3	p	p	3	p	101	3	p	19	3	7	11	3
51	17	13	3	p	47	3	p	19	3	7	p	3	p	23	3	73	7	3	p	p
53	3	7	p	3	131	109	3	23	7	3	p	p	3	p	11	3	101	p	3	157
57	p	p	3	17	p	3	7	p	3	13	11	3	p	7	3	31	181	3	23	41
59	3	p	p	3	17	7	3	p	11	3	p	p	3	19	59	3	13	p	3	7
61	p	3	p	p	3	17	11	3	71	p	3	7	37	3	p	43	3	11	7	3
63	23	127	3	7	11	3	17	p	3	p	7	3	179	p	3	11	19	3	p	p
67	11	3	p	p	3	13	p	3	7	73	3	11	p	3	29	7	3	47	13	3
69	7	47	3	p	p	3	37	7	3	11	p	3	13	113	3	p	53	3	p	p
71	3	p	43	3	p	181	3	11	p	3	17	p	3	7	79	3	p	p	3	13
73	13	3	p	37	3	7	p	3	43	41	3	17	7	3	19	p	3	83	29	3
77	3	11	151	3	23	71	3	83	p	3	7	29	3	17	13	3	p	7	3	p
79	53	3	7	31	3	151	p	3	13	7	3	127	p	3	17	47	3	37	p	3
81	173	7	3	p	29	3	79	p	3	p	p	3	p	p	3	7	31	3	53	11
83	3	p	p	3	p	p	3	7	p	3	p	151	3	41	7	3	17	11	3	p
87	89	17	3	137	p	3	p	43	3	59	13	3	7	11	3	19	127	3	17	7
89	7	179	17	3	7	p	3	19	139	3	p	7	3	43	23	3	89	13	3	17
91	73	3	53	7	3	p	113	3	23	11	3	13	p	3	p	p	3	7	19	3
93	103	31	3	163	17	3	p	11	3	7	19	3	29	p	3	p	7	3	11	p
97	3	3	p	11	3	29	13	3	p	79	3	61	47	3	7	p	3	p	p	3
99	13	11	3	41	p	3	7	17	3	31	p	3	11	7	3	97	29	3	p	p

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INCOMPOSITS.

Tab. XIX.

	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379
01	7	13	3	31	89	3	17	7	3	p	163	3	p	11	3	p	19	3	103	151
03	3	79	41	3	59	173	3	17	13	3	p	11	3	7	113	3	31	37	3	29
07	p	p	3	p	7	3	p	11	3	13	23	3	29	p	3	p	p	3	7	p
09	3	p	p	3	23	11	3	p	p	3	7	43	3	p	p	3	11	7	3	167
11	p	3	7	11	3	29	31	3	131	7	3	17	127	3	11	p	3	43	p	3
13	p	7	3	p	13	3	19	p	3	p	p	3	11	p	3	7	29	3	p	31
17	p	3	p	23	3	13	7	3	11	19	3	p	p	3	17	p	3	p	13	3
19	181	19	3	p	79	3	11	73	3	p	p	3	7	67	3	17	p	3	59	7
21	3	41	29	3	7	59	3	p	p	3	p	7	3	p	23	3	17	67	3	13
23	13	3	11	7	3	p	53	3	23	p	3	p	p	3	p	157	3	7	109	3
27	3	7	17	3	73	p	3	19	7	3	61	137	3	163	13	3	191	31	3	17
29	7	3	p	17	3	p	p	3	13	p	3	107	59	3	7	p	3	29	11	3
31	137	p	3	47	17	3	7	23	3	p	19	3	31	7	3	13	11	3	p	83
33	3	23	19	3	p	7	3	109	p	3	29	71	3	37	11	3	p	97	3	7
37	p	p	3	7	83	3	p	17	3	43	7	3	23	p	3	p	61	3	157	59
39	3	71	7	3	13	61	3	p	11	3	p	p	3	p	29	3	7	13	3	11
41	23	3	p	p	3	p	11	3	7	17	3	13	167	3	p	7	3	11	79	3
43	7	47	3	p	11	3	p	7	3	p	17	3	p	107	3	11	p	3	13	19
47	11	3	67	19	3	7	13	3	p	p	3	11	7	3	p	p	3	p	p	3
49	13	37	3	163	7	3	67	p	3	11	p	3	193	13	3	p	p	3	7	137
51	3	p	p	3	p	p	3	11	43	3	7	97	3	41	17	3	23	7	3	p
53	31	3	7	p	3	11	p	3	137	7	3	53	p	3	13	17	3	19	p	3
57	3	11	13	3	p	139	3	7	p	3	p	73	3	p	7	3	p	17	3	p
59	107	3	101	103	3	p	7	3	29	13	3	p	19	3	47	23	3	61	17	3
61	p	p	3	13	19	3	61	p	3	23	p	3	7	p	3	p	13	3	p	7
63	3	29	p	3	7	p	3	97	191	3	13	7	3	p	p	3	p	11	3	p
67	p	59	3	41	p	3	37	p	3	7	101	3	83	11	3	p	7	3	19	p
69	3	7	p	3	p	13	3	83	7	3	19	11	3	p	89	3	139	179	3	43
71	7	3	19	37	3	p	p	3	p	11	3	p	13	3	7	p	3	107	p	3
73	p	61	3	p	p	3	7	11	3	p	131	3	p	7	3	p	101	3	11	13
77	43	3	p	11	3	79	p	3	p	103	3	7	p	3	11	53	3	37	7	3
79	109	11	3	7	p	3	43	p	3	p	7	3	11	p	3	p	41	3	p	163
81	3	97	7	3	191	157	3	p	13	3	11	p	3	29	37	3	7	p	3	19
83	p	3	13	p	3	p	p	3	7	31	3	19	23	3	p	13	3	p	43	3
87	3	p	131	3	11	p	3	p	p	3	p	41	3	7	19	3	13	29	3	p
89	151	3	11	p	3	7	19	3	37	47	3	p	7	3	p	p	3	23	p	3
91	11	p	3	151	7	3	p	p	3	71	29	3	89	139	3	p	p	3	7	p
93	3	17	p	3	p	23	3	p	79	3	7	13	3	61	p	3	p	7	3	p
97	p	7	3	17	p	3	p	31	3	p	p	3	13	p	3	7	11	3	p	p
99	3	53	p	3	17	p	3	7	p	3	23	p	3	149	7	3	p	p	3	13

INCOM-

INCOMPOSITS.

Tab. XX.

	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399
01	3	7	p	3	11	p	3	13	7	3	43	61	3	p	31	3	199	29	3	p
03	7	3	11	p	3	139	p	3	p	p	3	p	197	3	7	p	3	p	53	3
07	3	53	13	3	193	7	3	p	151	3	19	p	3	23	157	3	p	59	3	7
09	191	3	19	29	3	97	p	3	197	13	3	7	p	3	p	p	3	p	7	3
11	p	23	3	7	71	3	p	p	3	167	7	3	113	19	3	p	11	3	41	107
13	3	p	7	3	107	19	3	p	37	3	13	p	3	p	11	3	7	151	3	167
17	7	47	3	p	41	3	23	7	3	p	11	3	p	p	3	43	173	3	29	179
19	3	p	p	3	103	13	3	31	11	3	p	p	3	7	p	3	p	p	3	11
21	193	3	37	p	3	7	11	3	p	p	3	19	7	3	79	p	3	11	p	3
23	47	67	3	19	7	3	13	p	3	p	p	3	61	p	3	11	p	3	7	13
27	11	3	7	p	3	59	19	3	41	7	3	11	p	3	89	29	3	p	p	3
29	17	7	3	p	83	3	p	p	3	11	31	3	p	67	3	7	23	3	p	p
31	3	17	p	3	p	53	3	7	13	3	23	109	3	37	7	3	p	67	3	73
33	73	3	13	p	3	11	7	3	p	p	3	p	p	3	47	13	3	p	61	3
37	3	11	p	3	7	89	3	p	71	3	103	7	3	139	113	3	13	79	3	p
39	p	3	p	7	3	17	p	3	p	23	3	p	p	3	p	19	3	7	p	3
41	109	43	3	23	13	3	17	19	3	7	p	3	p	p	3	p	7	3	p	11
43	3	7	167	3	37	p	3	17	7	3	p	13	3	p	p	3	29	11	3	59
47	p	37	3	31	p	3	7	p	3	17	p	3	13	7	3	71	41	3	p	43
49	3	p	23	3	p	7	3	p	53	3	17	11	3	19	103	3	31	p	3	7
51	13	p	29	p	3	19	p	3	p	11	3	7	p	3	p	p	3	127	7	3
53	p	3	3	7	p	3	p	11	3	p	7	3	17	23	3	37	19	3	11	p
57	19	p	67	11	3	p	29	3	7	163	3	p	37	3	11	7	3	83	p	3
59	7	11	3	89	p	3	67	7	3	p	139	3	11	p	3	13	p	3	23	31
61	3	31	p	3	p	p	3	83	p	3	11	p	3	7	p	3	17	p	3	89
63	17	3	83	13	3	7	23	3	11	47	3	p	7	3	19	p	3	17	p	3
67	3	p	17	3	11	p	3	p	p	3	7	53	3	p	61	3	p	7	3	17
69	p	3	7	17	3	p	p	3	47	7	3	13	107	3	29	p	3	p	p	3
71	11	7	3	p	17	3	p	137	3	p	89	3	173	p	3	7	p	3	13	p
73	3	59	p	3	79	17	3	7	p	3	41	43	3	p	7	3	97	31	3	71
77	13	p	3	p	109	3	p	17	3	p	23	3	7	13	3	19	11	3	p	7
79	3	73	101	3	7	173	3	13	17	3	p	7	3	53	11	3	p	p	3	p
81	113	3	p	7	3	41	47	3	59	17	3	p	11	3	13	p	3	7	19	3
83	p	p	3	131	29	3	101	p	3	7	11	3	163	p	3	23	7	3	p	p
87	7	3	p	23	3	47	11	3	37	13	3	149	17	3	7	31	3	11	p	3
89	41	p	3	13	11	3	7	79	3	127	p	3	101	7	3	11	13	3	113	p
91	3	181	11	3	61	7	3	p	p	3	13	p	3	11	17	3	19	p	3	7
93	11	3	149	p	3	p	p	3	19	p	3	7	p	3	73	17	3	13	7	3
97	3	p	7	3	137	13	3	11	97	3	p	19	3	p	127	3	7	17	3	23
99	31	3	p	19	3	11	p	3	7	59	3	p	13	3	p	7	3	p	17	3

INCOMPOSITS.

TAB. XXI.

	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419
01	13	3	7	191	3	101	11	3	p	7	3	23	p	3	19	47	3	11	p	3
03	109	7	3	41	11	3	19	13	3	p	131	3	p	103	3	7	p	3	17	p
07	11	3	31	17	3	p	7	3	13	19	3	11	89	3	47	p	3	179	97	3
09	p	19	3	173	17	3	p	p	3	11	23	3	7	101	3	13	p	3	p	7
11	3	p	75	3	7	17	3	11	37	3	p	7	3	109	p	3	p	53	3	p
13	p	3	p	7	3	11	17	3	p	163	3	p	p	3	p	p	3	7	p	3
17	3	7	131	3	13	31	3	19	7	3	p	p	3	79	83	3	p	13	3	167
19	7	3	37	23	3	p	151	3	p	17	3	13	47	3	7	p	3	p	19	3
21	31	53	3	61	83	3	7	43	3	151	17	3	p	7	3	p	p	3	13	11
23	3	p	19	3	p	7	3	193	p	3	p	17	3	31	23	3	107	11	3	7
27	13	p	3	7	p	3	p	139	3	p	7	3	p	11	3	131	p	3	151	p
29	3	p	7	3	p	p	3	13	p	3	89	11	3	37	17	3	7	p	3	23
31	p	3	p	31	3	p	41	3	7	11	3	p	p	3	13	7	3	29	59	3
33	7	67	3	53	p	3	179	7	3	p	37	3	p	p	3	41	17	3	11	19
37	p	3	p	11	3	7	p	3	97	13	3	31	7	3	11	73	3	p	17	3
39	p	11	3	13	7	3	p	p	3	p	p	3	11	67	3	p	13	3	7	17
41	3	137	p	3	37	71	3	131	p	3	7	p	3	p	29	3	p	7	3	p
43	23	3	7	p	3	p	97	3	11	7	3	p	p	3	p	p	3	13	p	3
47	3	19	167	3	11	13	3	7	p	3	p	23	3	173	7	3	p	109	3	p
49	19	3	11	157	3	23	7	3	p	p	3	p	13	3	181	p	3	83	p	3
51	11	p	3	p	19	3	13	p	3	31	p	3	7	p	3	37	p	3	p	7
53	3	p	p	3	7	107	3	83	p	3	61	7	3	13	p	3	23	43	3	p
57	41	13	3	p	23	3	109	53	3	7	p	3	p	p	3	29	7	3	19	p
59	3	7	127	3	p	p	3	3	7	3	19	79	3	59	11	3	p	p	3	p
61	7	3	13	p	3	47	73	3	29	p	3	p	11	3	7	13	3	p	41	3
63	p	p	3	181	43	3	7	p	3	13	11	3	p	7	3	89	61	3	p	29
67	103	3	67	37	3	113	11	3	p	71	3	7	29	3	p	197	3	11	7	3
69	17	p	3	7	11	3	67	59	3	53	7	3	p	41	3	11	p	3	149	p
71	3	17	7	3	p	29	3	p	23	3	67	13	3	11	113	3	7	p	3	19
73	11	3	17	47	3	13	89	3	7	p	3	11	149	3	67	7	3	37	13	3
77	3	p	p	3	17	p	3	11	41	3	p	p	3	7	19	3	71	p	3	13
79	13	3	47	149	3	7	19	3	p	43	3	p	7	3	p	p	3	41	p	3
81	149	23	3	11	7	3	17	13	3	107	p	3	p	p	3	41	p	3	7	p
83	3	11	p	3	p	p	3	17	p	3	7	p	3	29	13	3	73	7	3	p
87	p	7	3	p	p	3	23	p	3	17	181	3	19	p	3	7	p	3	p	11
89	3	p	p	3	19	37	3	7	31	3	17	p	3	p	7	3	47	11	3	199
91	47	3	43	13	3	p	7	3	103	179	3	17	157	3	p	11	3	23	163	3
93	p	p	3	31	p	3	p	19	3	p	13	3	7	11	3	p	173	3	p	7
97	101	3	59	7	3	p	p	3	p	11	3	13	61	3	17	p	3	7	p	3
99	p	61	3	71	p	p	p	11	3	7	73	3	p	p	3	17	7	3	11	p

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INCOMPOSITS.

Tab. XXII.

	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439
01	97	p	3	7	109	3	13	p	3	p	7	3	p	19	3	41	59	3	p	11
03	3	71	7	3	p	19	3	p	23	3	p	p	3	13	p	3	7	11	3	43
07	7	13	3	p	p	3	137	7	3	107	29	3	p	11	3	139	p	3	71	23
09	3	17	p	3	p	p	3	p	13	3	41	11	3	7	83	3	p	109	3	19
11	43	3	13	29	3	7	p	3	31	11	3	19	7	3	p	13	3	p	193	3
13	p	23	3	17	7	3	43	11	3	13	p	3	79	p	3	53	p	3	7	p
17	p	3	7	11	3	17	19	3	47	7	3	p	23	3	11	p	3	p	43	3
19	p	7	3	101	13	3	17	p	3	167	p	3	11	p	3	7	53	3	29	37
21	3	73	p	3	59	101	3	7	p	3	11	13	3	p	7	3	181	p	3	167
23	p	3	p	p	3	13	7	3	11	p	3	29	p	3	173	71	3	23	13	3
27	3	103	p	3	7	23	3	p	113	3	17	7	3	37	p	3	p	73	3	13
29	13	3	11	7	3	71	47	3	p	p	3	17	139	3	137	19	3	7	41	3
31	11	p	3	p	151	3	89	13	3	7	37	3	17	p	3	101	7	3	53	197
33	3	7	157	3	p	p	3	151	7	3	23	p	3	17	13	3	p	101	3	p
37	127	29	3	p	p	3	7	p	3	p	p	3	p	7	3	13	11	3	59	53
39	3	p	p	3	31	7	3	79	p	3	193	179	3	19	11	3	17	191	3	7
41	17	3	53	13	3	19	p	3	p	23	3	7	11	3	p	p	3	17	7	3
43	p	17	3	7	p	3	p	p	3	p	7	3	83	89	3	p	19	3	17	p
47	19	3	83	17	3	157	11	3	7	67	3	13	59	3	23	7	3	11	163	3
49	7	113	3	p	11	3	p	7	3	29	p	3	61	67	3	11	p	3	13	71
51	3	61	11	3	p	17	3	p	73	3	p	p	3	7	p	3	p	67	3	p
53	11	3	29	41	3	7	13	3	p	p	3	11	7	3	19	97	3	p	p	3
57	3	p	p	3	p	p	3	11	17	3	7	103	3	191	p	3	149	7	3	113
59	137	3	7	p	3	11	29	3	p	7	3	p	181	3	13	43	3	p	61	3
61	p	7	3	11	p	3	37	61	3	p	17	3	p	131	3	7	p	3	23	p
63	3	11	13	3	p	31	3	7	p	3	p	17	3	103	7	3	47	107	3	p
67	23	149	3	13	p	3	p	p	3	p	p	3	7	17	3	19	13	3	p	7
69	3	p	43	3	7	p	3	19	163	3	13	7	3	31	17	3	p	11	3	p
71	p	3	41	7	3	p	71	3	43	97	3	23	p	3	29	11	3	7	19	3
73	p	181	3	p	p	3	139	p	3	7	19	3	109	11	3	p	7	3	73	p
77	7	3	67	31	3	p	p	3	53	11	3	p	13	3	7	p	3	p	17	3
79	29	p	3	p	107	3	7	11	3	p	23	3	113	7	3	p	31	3	11	13
81	3	p	p	3	23	7	3	179	137	3	67	29	3	13	p	3	11	p	3	7
83	p	3	p	11	3	97	p	3	19	53	3	7	p	3	11	41	3	p	7	3
87	3	p	7	3	p	37	3	p	13	3	11	19	3	43	p	3	7	p	3	p
89	p	3	13	19	3	p	p	3	7	p	3	p	73	3	157	7	3	p	p	3
91	7	31	3	p	p	3	11	7	3	13	41	3	p	p	3	p	p	3	p	p
93	3	p	p	3	11	191	3	p	59	3	p	47	3	7	23	3	13	p	3	29
97	11	p	3	p	7	3	p	p	3	19	71	3	29	p	3	p	37	3	7	p
99	3	19	p	3	p	41	3	127	p	3	7	13	3	p	p	3	89	7	3	23

INCOMPOSITS.

Tab. XXIII.

	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
01	3	p	p	3	7	p	3	p	71	3	11	7	3	89	83	3	31	23	3	197
03	79	3	p	7	3	191	13	3	11	83	3	23	17	3	p	p	3	7	163	3
07	3	7	p	3	11	p	3	13	7	3	p	43	3	p	17	3	59	p	3	29
09	7	3	11	59	3	47	31	3	p	p	3	79	53	3	7	47	3	43	19	3
11	11	p	3	73	89	3	7	p	3	97	19	3	29	7	3	71	17	3	61	31
13	3	31	13	3	23	7	3	61	41	3	p	197	3	113	p	3	p	17	3	7
17	p	157	3	7	p	3	p	97	3	p	7	3	103	p	3	23	11	3	p	17
19	3	p	7	3	43	p	3	197	p	3	13	p	3	p	11	3	7	131	3	47
21	p	3	p	23	3	211	p	3	7	29	3	p	11	3	53	7	3	13	p	3
23	7	p	3	127	31	3	p	7	3	167	11	3	41	61	3	p	43	3	p	19
27	p	3	47	19	3	7	11	3	23	p	3	p	7	3	p	53	3	11	p	3
29	p	p	3	97	7	3	13	p	3	179	37	3	31	p	3	11	103	3	7	13
31	3	p	11	3	157	p	3	41	127	3	7	p	3	11	181	3	p	7	3	23
33	11	3	7	43	3	p	p	3	107	7	3	11	p	3	p	p	3	19	p	3
37	3	19	31	3	37	p	3	7	13	3	29	p	3	p	7	3	47	p	3	71
39	47	3	13	101	3	11	7	3	p	p	3	p	19	3	p	13	3	53	23	3
41	p	37	3	11	19	3	p	p	3	13	73	3	7	p	3	p	p	3	p	7
43	3	11	151	3	7	p	3	101	p	3	31	7	3	p	29	3	13	149	3	p
47	17	131	3	61	13	3	p	29	3	7	107	3	p	137	3	37	7	3	19	11
49	3	7	p	3	p	p	3	73	7	3	19	13	3	101	47	3	191	11	3	p
51	7	3	17	p	3	13	p	3	p	79	3	163	37	3	7	11	3	p	13	3
53	p	67	3	17	p	3	7	p	3	p	p	3	13	7	3	p	71	3	p	p
57	13	3	p	p	3	17	p	3	31	11	3	7	167	3	131	p	3	p	7	3
59	p	p	3	7	23	3	17	11	3	p	7	3	p	67	3	29	p	3	11	p
61	3	13	7	3	173	11	3	17	113	3	p	p	3	p	13	3	7	67	3	19
63	139	3	p	11	3	p	59	3	7	p	3	19	p	3	11	7	3	p	p	3
67	3	29	p	3	53	41	3	89	p	3	11	31	3	7	19	3	p	p	3	43
69	127	3	p	13	3	7	19	3	11	193	3	17	7	3	41	p	3	37	p	3
71	p	p	3	p	7	3	11	p	3	p	13	3	17	59	3	199	109	3	7	p
73	3	163	p	3	11	29	3	p	23	3	7	199	3	17	37	3	p	7	3	31
77	11	7	3	199	79	3	43	p	3	41	p	3	19	p	3	7	p	3	13	23
79	3	p	p	3	19	p	3	7	p	3	61	p	3	23	7	3	17	p	3	p
81	17	3	p	p	3	109	7	3	37	31	3	p	p	3	p	19	3	17	11	3
83	13	17	3	p	p	3	p	19	3	p	p	3	7	13	3	79	11	3	17	7
87	p	3	67	7	3	p	p	3	p	p	3	73	11	3	13	p	3	7	p	3
89	p	p	3	p	17	3	23	p	3	7	11	3	p	p	3	p	7	3	109	p
91	3	7	13	3	p	17	3	47	7	3	67	p	3	19	p	3	p	29	3	11
93	7	3	p	103	3	19	11	3	p	13	3	43	p	3	7	127	3	11	p	3
97	3	193	11	3	p	7	3	p	17	3	13	p	3	11	p	3	p	41	3	7
99	11	3	31	29	3	103	p	3	59	17	3	7	97	3	173	p	3	13	7	3

INCOMPOSITS.

TAB. XXIV.

	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479
01	157	3	47	p	3	7	p	3	17	p	3	19	7	3	107	p	3	p	13	3
03	179	p	3	19	7	3	29	p	3	17	11	3	13	p	3	67	181	3	7	p
07	13	3	7	p	3	p	11	3	p	7	3	17	p	3	p	p	3	11	p	3
09	139	7	3	p	11	3	127	13	3	61	29	3	17	p	3	7	p	3	p	23
11	3	13	11	3	p	p	3	7	p	3	53	p	3	11	7	3	47	p	3	p
13	11	3	37	29	3	193	7	3	13	49	3	11	31	3	17	p	3	p	137	3
17	3	107	113	3	7	181	3	11	p	3	p	7	3	p	p	3	17	p	3	p
19	17	3	p	7	3	11	p	3	p	p	3	p	23	3	p	19	3	7	p	3
21	p	17	3	11	61	3	23	19	3	7	13	3	p	79	3	p	7	3	17	173
23	3	7	17	3	13	p	3	p	7	3	59	p	3	37	47	3	p	13	3	17
27	p	193	3	p	17	3	7	p	3	167	31	3	83	7	3	p	97	3	13	11
29	3	163	p	3	29	7	3	83	p	3	131	p	3	19	43	3	p	11	3	7
31	191	3	83	107	3	19	13	3	p	71	3	7	73	3	p	11	3	59	7	3
33	13	p	3	7	59	3	p	17	3	p	7	3	149	11	3	p	19	3	31	p
37	19	3	p	p	3	173	149	3	7	11	3	p	p	3	13	7	3	p	p	3
39	7	29	3	149	p	3	p	7	3	73	17	3	97	p	3	137	p	3	11	p
41	3	p	13	3	p	11	3	43	31	3	p	17	3	7	p	3	11	p	3	191
43	41	3	131	11	3	7	p	3	139	13	3	p	7	3	11	p	3	p	p	3
47	3	p	103	3	p	89	3	p	79	3	7	p	3	113	17	3	29	7	3	p
49	p	3	7	p	3	p	p	3	11	7	3	p	37	3	23	17	3	13	59	3
51	p	7	3	p	p	3	11	p	3	29	p	3	p	p	3	7	17	3	109	p
53	3	p	23	3	11	13	3	7	p	3	211	61	3	p	7	3	p	17	3	79
57	11	101	3	151	p	3	13	p	3	p	p	3	7	23	3	19	p	3	p	7
59	3	31	167	3	7	p	3	19	47	3	p	7	3	13	p	3	p	163	3	199
61	p	3	p	7	3	101	29	3	p	151	3	p	167	3	31	199	3	7	11	3
63	73	13	3	71	97	3	p	101	3	7	19	3	151	p	3	p	7	3	23	p
67	7	3	13	199	3	p	23	3	p	67	3	101	11	3	7	13	3	37	151	3
69	23	137	3	89	31	3	7	p	3	13	11	3	p	7	3	p	73	3	p	p
71	3	p	p	3	p	7	3	p	11	3	103	43	3	127	37	3	13	23	3	7
73	p	3	p	79	3	p	11	3	19	107	3	7	41	3	29	113	3	11	7	3
77	3	61	7	3	p	47	3	29	p	3	179	13	3	11	197	33	7	p	3	p
79	11	3	p	19	3	13	p	3	7	109	3	11	p	3	79	7	3	p	13	3
81	7	p	3	p	53	3	p	7	3	11	23	3	13	p	3	p	p	3	p	p
83	3	p	31	3	23	37	3	11	173	3	197	29	3	7	103	3	41	71	3	13
87	17	p	3	11	7	3	p	13	3	19	p	3	p	p	3	23	43	3	7	47
89	3	11	41	3	p	p	3	71	p	3	7	p	3	p	13	3	103	7	3	37
91	p	3	7	23	3	p	p	3	13	7	3	41	19	3	p	p	3	p	83	3
93	p	7	3	17	19	3	53	73	3	p	p	3	p	83	3	7	37	3	47	11
97	31	3	67	13	3	17	7	3	23	p	3	109	p	3	I	11	3	p	211	3
99	p	73	3	p	p	3	17	53	3	43	13	3	7	11	3	p	p	3	19	7

INCOMPOSITS.

Tab. XXV.

	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499
01	23	103	3	11	29	3	7	31	3	79	19	3	p	7	3	59	193	3	p	139
03	3	11	19	3	97	7	3	113	37	3	p	p	3	47	127	3	p	23	3	7
07	61	73	3	7	p	3	13	53	3	p	7	3	p	p	3	31	113	3	p	11
09	3	p	7	3	p	179	3	67	p	3	p	p	3	13	p	3	7	11	3	29
11	41	3	37	p	3	139	p	3	7	59	3	67	p	3	p	7	3	p	p	3
13	7	13	3	p	p	3	173	7	3	41	23	3	29	11	3	67	p	3	109	19
17	p	3	13	19	3	7	61	3	p	11	3	p	7	3	p	13	3	83	31	3
19	31	p	3	211	7	3	p	11	3	13	p	3	83	149	3	23	29	3	7	p
21	3	p	p	3	41	11	3	83	p	3	7	p	3	31	73	3	11	7	3	p
23	p	3	7	11	3	p	p	3	p	7	3	p	p	3	11	p	3	19	p	3
27	3	17	29	3	79	p	3	7	157	3	11	13	3	107	7	3	p	p	3	p
29	p	3	17	31	3	13	7	3	11	113	3	73	19	3	p	p	3	223	13	3
31	43	p	3	17	19	3	11	p	3	167	p	3	7	p	3	p	31	3	p	7
33	3	127	139	3	7	p	3	p	47	3	p	7	3	p	p	3	p	41	3	13
37	11	37	3	p	p	3	17	13	3	7	p	3	53	103	3	p	7	3	19	p
39	3	7	p	3	59	p	3	17	7	3	19	p	3	p	13	3	p	p	3	p
41	7	3	19	p	3	p	127	3	13	109	3	157	41	3	7	107	3	p	11	3
43	107	31	3	29	193	3	7	79	3	17	p	3	23	7	3	13	11	3	p	p
47	23	3	p	13	3	43	p	3	p	p	3	7	11	3	197	p	3	p	7	3
49	p	89	3	7	p	3	p	29	3	31	7	3	17	61	3	p	131	3	79	199
51	3	179	7	3	13	47	3	p	11	3	181	23	3	17	p	3	7	13	3	11
53	29	3	73	p	3	23	11	3	7	p	3	13	p	3	17	7	3	11	p	3
57	3	p	11	3	47	59	3	p	p	3	p	p	3	7	19	3	17	p	3	p
59	11	3	p	37	3	7	13	3	p	173	3	11	7	3	p	p	3	17	73	3
61	13	17	3	137	7	3	p	p	3	11	71	3	p	13	3	29	53	3	7	47
63	3	p	17	3	p	p	3	11	131	3	7	211	3	p	p	3	p	7	3	17
67	71	7	3	11	17	3	41	p	3	23	139	3	19	p	3	7	p	3	47	29
69	3	11	13	3	19	17	3	7	p	3	p	p	3	p	7	3	p	157	3	107
71	53	3	p	p	3	p	7	3	p	13	3	p	29	3	61	19	3	71	p	3
73	p	67	3	13	p	3	p	17	3	p	31	3	7	97	3	89	13	3	53	7
77	131	3	23	7	3	31	p	3	37	17	3	p	p	3	p	11	3	7	p	3
79	p	p	3	101	p	3	p	p	3	7	17	3	p	11	3	43	7	3	31	23
81	3	7	p	3	p	13	3	p	7	3	p	11	3	19	p	3	p	67	3	151
83	7	3	53	p	3	19	89	3	p	11	3	137	13	3	7	179	3	p	83	3
87	3	p	109	3	p	7	3	p	19	3	191	101	3	13	17	3	11	p	3	7
89	19	3	43	11	3	p	181	3	p	p	3	7	23	3	11	17	3	p	7	3
91	p	11	3	7	p	3	23	97	3	p	7	3	11	p	3	101	17	3	p	p
93	3	p	7	3	71	p	3	59	13	3	11	p	3	p	43	3	7	17	3	p
97	7	p	3	p	p	3	11	7	3	13	29	3	p	47	3	p	p	3	41	17
99	3	157	p	3	11	23	3	p	107	3	37	p	3	7	p	3	13	19	3	p

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INCOMPOSITS.

TAB. XXVI.

	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519
01	3	p	17	3	13	11	3	7	37	3	p	137	3	29	7	3	11	13	3	17
03	31	3	61	11	3	p	7	3	101	109	3	13	p	3	11	p	3	149	p	3
07	3	89	p	3	7	17	3	p	23	3	11	7	3	p	p	3	p	29	3	p
09	43	3	23	7	3	53	13	3	11	p	3	p	41	3	101	19	3	7	103	3
11	13	p	3	p	p	3	11	17	3	7	29	3	83	13	3	p	7	3	197	23
13	3	7	149	3	11	p	3	13	7	3	139	79	3	23	p	3	p	p	3	p
17	11	23	3	67	p	3	7	41	3	59	17	3	p	7	3	p	71	3	p	193
19	3	p	13	3	127	7	3	67	89	3	163	17	3	19	p	3	41	p	3	7
21	p	3	p	p	3	19	223	3	p	13	3	7	17	3	p	p	3	p	7	3
23	p	p	3	7	p	3	23	p	3	p	7	3	181	17	3	67	11	3	29	137
27	19	3	p	59	3	p	p	3	7	127	3	29	11	3	p	7	3	13	p	3
29	7	p	3	p	211	3	197	7	3	p	11	3	p	p	3	227	17	3	p	p
31	3	p	p	3	29	13	3	97	11	3	p	p	3	7	p	3	p	17	3	11
33	p	3	191	p	3	7	11	3	p	31	3	p	7	3	19	29	3	11	17	3
37	3	181	11	3	31	97	3	113	29	3	7	p	3	11	p	3	p	7	3	167
39	11	3	7	71	3	p	79	3	p	7	3	11	p	3	p	p	3	31	p	3
41	163	7	3	p	p	3	89	p	3	11	43	3	p	p	3	7	113	3	47	p
43	3	41	47	3	73	p	3	7	13	3	p	199	3	p	7	3	43	59	3	127
47	p	p	3	11	61	3	p	31	3	13	p	3	7	p	3	19	p	3	139	7
49	3	11	109	3	7	p	3	19	p	3	71	7	3	p	p	3	13	p	3	p
51	p	3	31	7	3	p	p	3	211	p	3	p	53	3	23	p	3	7	19	3
53	p	p	3	43	13	3	37	p	3	7	19	3	107	89	3	31	7	3	p	11
57	7	3	29	37	3	13	179	3	p	p	3	p	p	3	7	11	3	73	13	3
59	113	p	3	p	p	3	7	193	3	131	p	3	13	7	3	47	p	3	p	223
61	3	103	p	3	p	7	3	23	181	3	p	11	3	p	p	3	19	191	3	7
63	13	3	p	p	3	59	29	3	19	11	3	7	p	3	53	p	3	37	7	3
67	3	13	7	3	109	11	3	p	p	3	223	19	3	31	13	3	7	p	3	157
69	p	3	17	11	3	61	23	3	7	p	3	p	167	3	11	7	3	p	p	3
71	7	11	3	17	41	3	p	7	3	p	p	3	11	47	3	13	163	3	p	p
73	3	131	p	3	17	103	3	p	p	3	11	73	3	7	p	3	p	23	3	p
77	p	p	3	p	7	3	11	p	3	19	13	3	47	83	3	p	31	3	7	p
79	3	19	137	3	11	37	3	17	83	3	7	61	3	191	p	3	p	7	3	59
81	61	3	7	83	3	p	59	3	17	7	3	13	19	3	p	p	3	53	29	3
83	11	7	3	p	19	3	p	43	3	17	23	3	p	p	3	7	p	3	13	227
87	p	3	p	p	3	p	7	3	151	67	3	17	p	3	p	79	3	p	11	3
89	13	31	3	41	29	3	173	p	3	p	47	3	7	13	3	23	11	3	19	7
91	3	53	p	3	7	p	3	13	p	3	19	7	3	17	11	3	p	67	3	p
93	p	3	19	7	3	p	163	3	p	p	3	p	11	3	13	p	3	7	p	3
97	3	7	13	3	p	19	3	79	7	3	37	p	3	103	23	3	17	p	3	11
99	7	3	179	101	3	p	11	3	23	13	3	p	43	3	7	p	3	11	p	3

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INCOMPOSITS.
TAB. XXVII.

	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539
01	149	3	p	p	3	p	23	3	7	p	3	p	p	3	p	7	3	83	11	3
03	7	p	3	193	13	3	41	7	3	p	p	3	83	151	3	p	11	3	173	19
07	131	3	17	19	3	7	31	3	p	191	3	23	7	3	p	p	3	43	13	3
09	p	107	3	17	7	3	p	p	3	157	11	3	13	p	3	73	p	3	7	31
11	3	31	109	3	17	p	3	p	11	3	7	173	3	89	p	3	p	7	3	11
13	13	3	7	p	3	17	11	3	p	7	3	p	127	3	31	59	3	11	p	3
17	3	13	11	3	23	p	3	7	p	3	p	p	3	11	7	3	p	p	3	p
19	11	3	79	113	3	29	7	3	13	p	3	11	19	3	p	109	3	p	p	3
21	p	p	3	p	19	3	101	p	3	11	37	3	7	71	3	13	29	3	107	7
23	3	47	p	3	7	53	3	11	101	3	17	7	3	p	41	3	p	31	3	p
27	p	p	3	11	103	3	p	p	3	7	13	3	17	p	3	p	7	3	19	p
29	3	7	29	3	13	p	3	67	7	3	19	p	3	17	23	3	p	13	3	199
31	7	3	19	43	3	131	p	3	23	41	3	13	p	3	7	199	3	p	p	3
33	61	37	3	59	p	3	7	p	3	43	181	3	p	7	3	17	p	3	13	11
37	17	3	p	199	3	107	13	3	p	p	3	7	139	3	p	11	3	17	7	3
39	13	17	3	7	41	3	p	23	3	167	7	3	p	11	3	37	p	3	17	p
41	3	23	7	3	229	p	3	13	53	3	29	11	3	41	p	3	7	61	3	13
43	71	3	89	17	3	p	61	3	7	11	3	19	37	3	13	7	3	223	23	3
47	3	p	13	3	179	11	3	p	43	3	p	p	3	7	19	3	11	71	3	73
49	23	3	p	11	3	7	17	3	41	13	3	p	7	3	11	p	3	59	p	3
51	p	11	3	13	7	3	37	17	3	p	p	3	11	31	3	p	13	3	7	p
53	3	p	p	3	p	p	3	71	17	3	7	23	3	p	p	3	p	7	3	163
57	p	7	3	41	p	3	11	p	3	p	17	3	19	229	3	7	p	3	p	79
59	3	43	p	3	11	13	3	7	p	3	97	17	3	p	7	3	23	p	3	p
61	79	3	11	p	3	p	7	3	p	211	3	p	13	3	193	19	3	37	p	3
63	11	p	3	p	23	3	13	19	3	p	47	3	7	17	3	29	103	3	61	7
67	p	3	p	7	3	p	p	3	29	p	3	79	p	3	127	17	3	7	11	3
69	p	13	3	p	71	3	31	p	3	7	p	3	p	83	3	p	7	3	103	29
71	3	7	167	3	137	p	3	113	7	3	73	p	3	19	11	3	191	17	3	31
73	7	3	13	83	3	19	p	3	37	p	3	p	11	3	7	13	3	p	17	3
77	3	p	61	3	97	7	3	89	11	3	p	41	3	p	53	3	13	p	3	7
79	19	3	23	p	3	p	11	3	p	31	3	7	p	3	p	131	3	11	7	3
81	p	p	3	7	11	3	139	47	3	p	7	3	p	p	3	11	p	3	p	23
83	3	p	7	3	31	p	3	p	p	3	109	13	3	11	79	3	7	p	3	37
87	7	23	3	p	73	3	19	7	3	11	p	3	13	197	3	41	37	3	p	p
89	3	p	p	3	p	43	3	11	p	3	p	p	3	7	89	3	53	19	3	13
91	13	3	p	p	3	7	p	3	227	19	3	43	7	3	149	p	3	p	p	3
93	113	19	3	11	7	3	23	13	3	197	p	3	137	107	3	p	p	3	7	p
97	59	3	7	151	3	149	p	3	13	7	3	p	223	3	61	p	3	23	p	3
99	53	7	3	61	47	3	151	37	3	p	29	3	p	67	3	7	p	3	p	11

INCOMPOSITS.

Tab. XXVIII.

	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559
01	p	p	3	13	p	3	p	19	3	7	p	3	p	17	3	p	7	3	41	p
03	3	7	67	3	p	p	3	11	7	3	13	p	3	29	17	3	p	53	3	p
07	53	61	3	11	41	3	7	227	3	p	67	3	p	7	3	47	17	3	p	37
09	3	11	151	3	p	7	3	p	23	3	p	p	3	19	67	3	3	17	3	7
11	p	3	23	p	3	19	97	3	59	43	3	7	13	3	p	p	3	p	7	3
13	p	53	3	7	p	3	13	p	3	89	7	3	p	p	3	43	19	3	p	11
17	19	3	p	29	3	p	p	3	7	p	3	p	p	3	151	7	3	p	p	3
19	7	13	3	p	p	3	193	7	3	p	37	3	p	11	3	59	p	3	p	199
21	3	p	59	3	p	p	3	p	13	3	p	11	3	7	157	3	p	p	3	p
23	89	3	13	p	3	7	p	3	73	11	3	199	7	3	19	13	3	103	p	3
27	3	113	211	3	37	11	3	p	109	3	7	p	3	61	43	3	11	7	3	p
29	97	3	7	11	3	31	p	3	p	7	3	29	p	3	11	p	3	23	p	3
31	71	7	3	p	13	3	p	229	3	163	113	3	11	p	3	7	p	3	31	p
33	3	p	193	3	29	23	3	7	p	3	11	13	3	p	7	3	p	p	3	p
37	p	43	3	67	p	3	11	127	3	137	47	3	7	p	3	19	23	3	p	7
39	3	p	73	3	7	p	3	19	29	3	23	7	3	p	p	3	p	139	3	13
41	13	3	11	7	3	p	101	3	173	p	3	67	37	3	p	p	3	7	19	3
43	11	29	3	31	p	3	53	13	3	7	19	3	p	p	3	67	7	3	p	43
47	7	3	17	p	3	p	p	3	13	23	3	p	101	3	7	p	3	107	11	3
49	p	173	3	17	71	3	7	53	3	p	p	3	p	7	3	13	11	3	p	p
51	3	p	p	3	17	7	3	p	p	3	p	131	3	p	11	3	19	197	3	7
53	191	3	227	13	3	17	31	3	19	179	3	7	11	3	23	73	3	127	7	3
57	3	31	7	3	13	89	3	17	11	3	p	19	3	197	p	3	7	13	3	11
59	p	3	29	19	3	p	11	3	7	p	3	13	p	3	31	7	3	11	83	3
61	7	41	3	p	11	3	47	7	3	17	p	3	73	23	3	11	p	3	13	107
63	3	p	11	3	107	p	3	23	83	3	17	p	3	7	37	3	p	p	3	191
67	13	p	3	p	7	3	p	p	3	11	53	3	17	13	3	181	p	3	7	p
69	3	19	p	3	p	197	3	11	p	3	7	43	3	17	p	3	179	7	3	97
71	139	3	7	p	3	11	23	3	37	7	3	p	19	3	13	61	3	43	p	3
73	23	7	3	11	19	3	p	p	3	p	p	3	31	p	3	7	p	3	59	223
77	17	3	p	p	3	p	7	3	p	13	3	23	167	3	29	149	3	17	71	3
79	41	17	3	13	157	3	p	p	3	p	p	3	7	79	3	p	13	3	17	7
81	3	p	17	3	7	p	3	29	p	3	13	7	3	p	109	3	p	11	3	17
83	p	3	19	7	3	p	149	3	71	p	3	139	59	3	113	11	3	7	29	3
87	3	7	p	3	23	13	3	p	7	3	31	11	3	97	p	3	233	p	3	p
89	7	3	233	137	3	79	17	3	131	11	3	229	13	3	7	p	3	47	p	3
91	p	47	3	109	29	3	7	11	3	127	89	3	p	7	3	23	p	3	11	13
93	3	p	p	3	p	7	3	157	17	3	37	97	3	13	211	3	11	p	3	7
97	47	11	3	7	p	3	83	37	3	43	7	3	11	31	3	53	p	3	p	p
99	3	83	7	3	p	71	3	p	13	3	11	17	3	p	19	3	7	p	3	29

INCOMPOSITS.

Tab. XXIX.

	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579
01	3	p	43	3	p	p	3	p	79	3	7	11	3	p	61	3	p	7	3	p
03	p	3	7	13	3	p	23	3	43	7	3	17	p	3	137	p	3	19	p	3
07	3	19	p	3	13	11	3	7	p	3	109	p	3	17	7	3	11	13	3	79
09	p	3	p	11	3	p	7	3	p	p	3	13	19	3	11	131	3	p	p	3
11	79	11	3	p	19	3	p	p	3	p	47	3	7	223	3	17	53	3	13	7
13	3	p	67	3	7	31	3	p	p	3	11	7	3	37	p	3	17	p	3	29
17	13	17	3	199	p	3	11	43	3	7	23	3	29	13	3	113	7	3	17	p
19	3	7	17	3	11	p	3	13	7	3	19	p	3	31	67	3	157	p	3	17
21	7	3	11	17	3	29	41	3	p	p	3	239	p	3	7	97	3	197	67	3
23	11	p	3	151	17	3	7	131	3	p	127	3	p	7	3	23	29	3	53	p
27	179	3	59	23	3	p	17	3	p	13	3	7	89	3	p	p	3	p	7	3
29	43	37	3	7	73	3	p	17	3	p	7	3	151	p	3	p	11	3	p	53
31	3	p	7	3	p	p	3	p	17	3	13	p	3	p	11	3	7	p	3	19
33	137	3	53	p	3	p	p	3	7	17	3	19	11	3	79	7	3	13	151	3
37	3	73	p	3	p	13	3	p	11	3	p	17	3	7	19	3	p	p	3	11
39	p	3	p	53	3	7	11	3	113	97	3	p	7	3	71	163	3	11	p	3
41	p	31	3	103	7	3	13	23	3	p	p	3	p	17	3	11	p	3	7	13
43	3	23	11	3	p	p	3	179	p	3	7	p	3	11	17	3	59	7	3	p
47	41	7	3	29	47	3	37	p	3	11	p	3	19	p	3	7	17	3	p	p
49	3	p	p	3	19	193	3	7	13	3	89	p	3	p	7	3	p	17	3	167
51	23	3	13	37	3	11	7	3	139	p	3	67	p	3	73	13	3	p	17	3
53	p	233	3	11	p	3	181	19	3	13	59	3	7	83	3	67	p	3	p	7
57	29	3	101	7	3	23	53	3	p	p	3	61	31	3	p	p	3	7	47	3
59	61	89	3	p	13	3	p	211	3	7	p	3	p	41	3	p	7	3	p	11
61	3	7	127	3	131	163	3	31	7	3	43	13	3	19	37	3	23	11	3	149
63	7	3	p	157	3	13	p	3	101	p	3	p	173	3	7	11	3	47	13	3
67	3	p	p	3	p	7	3	p	19	3	149	11	3	p	p	3	p	61	3	7
69	13	3	p	p	3	p	61	3	29	11	3	7	p	3	101	23	3	41	7	3
71	47	p	3	7	149	3	p	11	3	23	7	3	p	103	3	p	101	3	11	29
73	3	13	7	3	p	11	3	p	p	3	p	p	3	p	13	3	7	p	3	p
77	7	11	3	p	p	3	19	7	3	227	p	3	11	181	3	13	137	3	31	p
79	3	p	167	3	p	29	3	p	23	3	11	p	3	7	229	3	p	19	3	37
81	p	3	23	13	3	7	p	3	11	19	3	211	7	3	47	71	3	p	p	3
83	17	19	3	p	7	3	11	p	3	p	13	3	p	p	3	89	37	3	7	23
87	p	3	7	113	3	71	p	3	163	7	3	13	p	3	p	p	3	p	107	3
89	11	7	3	17	p	3	83	109	3	p	p	3	59	p	3	7	p	3	13	103
91	3	83	181	3	17	p	3	7	p	3	37	p	3	29	7	3	31	p	3	p
93	p	3	41	p	3	17	7	3	p	p	3	p	23	3	p	p	3	p	11	3
97	3	p	19	3	7	p	3	13	p	3	p	7	3	p	11	3	p	29	3	59
99	p	3	p	7	3	p	31	3	17	p	3	47	11	3	13	239	3	7	p	3

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TAB. XXX.

	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599
01	31	3	11	173	3	19	p	3	127	p	3	7	53	3	191	13	3	227	7	3
03	11	97	3	7	p	3	p	47	3	13	7	3	73	31	3	157	19	3	79	37
07	19	3	p	199	3	41	103	3	7	p	3	p	p	3	p	7	3	p	11	3
09	7	p	3	p	13	3	29	7	3	p	p	3	p	127	3	p	11	3	p	139
11	3	p	p	3	p	p	3	p	23	3	p	13	3	7	11	3	p	29	3	181
13	p	3	23	p	3	7	p	3	103	p	3	p	7	3	19	p	3	211	13	3
17	3	89	p	3	p	163	3	71	11	3	7	31	3	23	p	3	p	7	3	11
19	13	3	7	29	3	139	11	3	131	7	3	p	p	3	p	53	3	11	41	3
21	17	7	3	p	11	3	31	13	3	p	p	3	p	137	3	7	p	3	163	p
23	3	13	11	3	37	43	3	7	59	3	p	p	3	11	7	3	109	p	3	37
27	p	37	3	17	p	3	23	p	3	11	67	3	7	41	3	13	p	3	29	7
29	3	p	p	3	7	107	3	11	89	3	p	7	3	79	67	3	p	p	3	p
31	p	3	p	7	3	11	p	3	p	31	3	29	161	3	103	59	3	7	19	3
33	131	61	3	11	71	3	17	p	3	7	13	3	p	p	3	37	7	3	p	73
37	7	3	p	p	3	p	191	3	17	3	3	13	37	3	7	29	3	31	53	3
39	127	47	3	227	p	3	7	151	3	17	43	3	p	7	3	p	23	3	13	11
41	3	53	139	3	p	7	3	p	29	3	17	p	3	p	p	3	19	11	3	7
43	p	3	p	41	3	p	13	3	19	p	3	7	p	3	p	11	3	p	7	3
47	3	p	7	3	211	127	3	13	83	3	137	11	3	17	p	3	7	p	3	151
49	p	3	31	19	3	p	223	3	7	11	3	p	179	3	13	7	3	149	97	3
51	7	p	3	23	p	3	89	7	3	167	p	3	193	p	3	17	p	3	11	p
53	3	p	13	3	p	11	3	41	229	3	p	149	3	7	p	3	11	p	3	167
57	p	11	3	13	7	3	p	p	3	19	73	3	11	p	3	p	13	3	7	p
59	3	19	17	3	53	31	3	67	71	3	7	p	3	p	37	3	p	7	3	17
61	p	3	7	17	3	157	p	3	11	7	3	67	19	3	97	p	3	13	31	3
63	31	7	3	p	17	3	11	p	3	p	p	3	p	23	3	7	p	3	p	61
67	p	3	11	p	3	p	7	3	37	p	3	p	13	3	p	p	3	59	131	3
69	11	p	3	p	59	3	13	17	3	109	p	3	7	p	3	71	p	3	19	7
71	3	p	p	3	7	37	3	p	17	3	19	7	3	13	p	3	p	p	3	p
73	p	3	19	7	3	p	23	3	113	17	3	47	p	3	p	41	3	7	11	3
77	3	7	101	3	p	19	3	53	7	3	p	17	3	p	11	3	83	23	3	37
79	7	3	13	p	3	p	p	3	97	p	3	23	11	3	7	13	3	p	p	3
81	241	73	3	79	p	3	7	43	3	13	11	3	p	7	3	p	37	3	233	p
83	3	83	167	3	233	7	3	29	11	3	p	p	3	43	17	3	13	191	3	7
87	29	31	3	7	11	3	p	p	3	61	7	3	101	p	3	11	17	3	p	223
89	3	p	7	3	23	41	3	p	p	3	37	13	3	11	19	3	7	17	3	239
91	11	3	71	p	3	13	19	3	7	p	3	11	211	3	41	7	3	p	13	3
93	7	p	3	p	29	3	p	7	3	11	p	3	13	p	3	23	p	3	101	17
97	13	3	97	23	3	7	79	3	p	p	3	p	7	3	p	61	3	p	89	3
99	p	p	3	11	7	3	p	13	3	41	113	3	19	p	3	107	p	3	7	p

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INCOMPOSITS.

TAB. XXXI.

	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619
01	29	p	3	47	11	3	p	101	3	p	p	3	7	59	3	11	229	3	23	7
03	3	p	11	3	7	17	3	p	41	3	53	7	3	11	p	3	p	p	3	103
07	23	p	3	13	29	3	p	17	3	7	p	3	97	101	3	p	7	3	19	31
09	3	7	p	3	193	p	3	11	7	3	13	53	3	37	p	3	p	23	3	p
11	7	3	19	41	3	11	p	3	p	17	3	23	p	3	7	p	3	13	113	3
13	p	47	3	11	p	3	7	109	3	p	17	3	41	7	3	137	p	3	p	101
17	p	3	p	p	3	73	p	3	61	p	3	7	13	3	p	227	3	p	7	3
19	47	79	3	7	31	3	13	p	3	p	7	3	29	17	3	p	43	3	p	11
21	3	59	7	3	23	p	3	41	p	3	139	p	3	13	17	3	7	11	3	19
23	193	3	p	179	3	29	p	3	7	p	3	19	p	3	239	7	3	p	211	3
27	3	p	229	3	p	p	3	p	13	3	p	11	3	7	19	3	p	17	3	p
29	p	3	13	23	3	7	19	3	59	11	3	p	7	3	47	13	3	p	17	3
31	173	157	3	p	7	3	p	11	3	13	p	3	p	p	3	37	p	3	7	17
33	3	p	29	3	223	11	3	p	127	3	7	113	3	p	23	3	11	7	3	p
37	p	7	3	p	13	3	p	p	3	p	67	3	11	83	3	7	p	3	p	241
39	3	p	59	3	19	p	3	7	83	3	11	13	3	p	7	3	53	107	3	23
41	p	3	107	83	3	13	7	3	11	149	3	p	47	3	p	19	3	29	13	3
43	97	137	3	p	p	3	11	19	3	p	p	3	7	p	3	p	p	3	p	7
47	13	3	11	7	3	191	p	3	71	59	3	47	73	3	43	p	3	7	23	3
49	11	p	3	29	p	3	p	13	3	7	41	3	23	31	3	61	7	3	127	p
51	3	7	p	3	61	151	3	79	7	3	p	p	3	19	13	3	p	p	3	41
53	7	3	89	p	3	19	131	3	13	p	3	p	p	3	7	p	3	37	11	3
57	3	43	p	3	p	7	3	p	19	3	p	23	3	p	11	3	p	p	3	7
59	19	3	p	13	3	23	p	3	p	47	3	7	11	3	41	p	3	151	7	3
61	17	p	3	7	103	3	p	p	3	p	7	3	p	43	3	p	197	3	p	p
63	3	17	7	3	13	71	3	p	11	3	227	31	3	p	p	3	7	13	3	11
67	7	p	3	17	11	3	19	7	3	41	79	3	197	109	3	11	p	3	13	p
69	3	p	11	3	17	37	3	67	p	3	173	p	3	7	p	3	83	19	3	31
71	11	3	p	73	3	7	13	3	29	19	3	11	7	3	p	23	3	223	p	3
73	13	19	3	p	7	3	17	p	3	11	157	3	71	13	3	67	p	3	7	29
77	p	3	7	173	3	11	47	3	17	7	3	131	29	3	13	139	3	163	43	3
79	73	7	3	11	197	3	p	p	3	17	103	3	233	p	3	7	37	3	p	p
81	3	11	13	3	31	29	3	7	23	13	17	193	3	p	7	3	p	p	3	p
83	p	3	23	p	3	47	7	3	107	3	3	17	p	3	p	p	3	31	19	3
87	3	139	19	3	7	43	3	89	p	3	13	7	3	17	p	3	p	11	3	p
89	p	3	p	7	3	p	p	3	p	71	3	43	167	3	17	11	3	7	199	3
91	p	23	3	131	241	3	137	31	3	7	p	3	p	11	3	17	7	3	59	p
93	3	7	p	3	p	13	3	p	7	3	199	11	3	29	p	3	17	61	3	47
97	19	17	3	p	p	3	7	11	3	181	107	3	p	7	3	31	103	3	11	13
99	3	37	17	3	101	7	3	163	p	3	p	19	3	13	89	3	11	29	3	7

INCOMPOSITS.

TAB. XXXII.

	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639
01	3	13	p	3	p	p	3	p	p	3	251	89	3	7	13	3	p	11	3	p
03	p	3	17	p	3	7	p	3	13	p	3	p	7	3	19	11	3	p	p	3
07	3	173	p	3	17	p	3	73	181	3	7	11	3	29	163	3	p	7	3	p
09	59	3	7	13	3	17	137	3	107	7	3	223	31	3	p	41	3	p	p	3
11	p	7	3	p	139	3	17	11	3	53	13	3	p	p	3	7	p	3	11	79
13	3	179	p	3	13	11	3	7	23	3	61	p	3	p	7	3	11	13	3	p
17	p	11	3	101	p	3	p	59	3	17	29	3	7	p	3	19	p	3	13	7
19	3	p	p	3	7	101	3	19	p	3	11	7	3	23	p	3	113	p	3	41
21	109	3	43	7	3	103	13	3	11	p	3	17	191	3	p	p	3	7	19	3
23	13	23	3	p	p	3	11	p	3	7	19	3	17	13	3	139	7	3	p	97
27	7	3	11	p	3	31	p	3	p	p	3	p	23	3	7	p	3	p	83	3
29	11	p	3	157	163	3	7	149	3	p	p	3	53	7	3	17	p	3	29	p
31	3	p	13	3	149	7	3	3	83	3	p	p	3	p	137	3	17	101	3	7
33	17	3	p	83	3	p	p	p	19	13	3	7	37	3	229	p	3	17	7	3
37	3	p	7	3	29	23	3	43	31	3	13	19	3	p	11	3	7	p	3	17
39	p	3	109	17	3	p	p	3	7	p	3	103	11	3	p	7	3	13	p	3
41	7	p	3	31	17	3	37	7	3	113	11	3	p	97	3	p	23	3	p	43
43	3	p	67	3	41	13	3	p	11	3	23	233	3	7	p	3	31	p	3	11
47	p	29	3	p	7	3	13	17	3	19	67	3	p	p	3	11	p	3	7	13
49	3	19	11	3	197	p	3	131	17	3	7	p	3	11	67	3	p	7	3	p
51	11	3	7	p	3	71	31	3	p	7	3	11	19	3	107	103	3	37	67	3
53	p	7	3	23	19	3	p	p	3	11	17	3	43	p	3	7	53	3	p	31
57	p	3	13	127	3	11	7	3	239	157	3	137	17	3	23	13	3	103	p	3
59	229	61	3	11	p	3	p	97	3	13	p	3	7	17	3	p	p	3	19	7
61	3	11	23	3	7	73	3	p	p	3	19	7	3	p	17	3	13	p	3	167
63	53	3	19	7	3	p	223	3	37	79	3	83	41	3	p	17	3	7	p	3
67	3	7	71	3	p	19	3	23	7	3	p	13	3	p	p	3	p	11	3	47
69	7	3	73	47	3	13	29	3	p	p	3	181	151	3	7	11	3	43	13	3
71	p	p	3	97	179	3	7	41	3	p	59	3	13	7	3	151	p	3	23	17
73	3	79	p	3	p	7	3	p	p	3	p	11	3	127	p	3	41	p	3	7
77	23	97	3	7	p	3	233	11	3	71	7	3	p	p	3	p	37	3	11	p
79	3	13	7	3	43	11	3	67	227	3	p	p	3	61	13	3	7	23	3	137
81	p	3	61	11	3	p	19	3	7	p	3	23	p	3	11	7	3	p	127	3
83	7	11	3	p	p	3	p	7	3	p	199	3	11	241	3	13	43	3	193	109
87	47	3	199	13	3	7	p	3	11	p	3	179	7	3	p	p	3	227	29	3
89	29	p	3	89	7	3	11	37	3	p	13	3	19	p	3	p	p	3	7	61
91	3	p	167	3	11	p	3	p	61	3	7	29	3	p	173	3	p	7	3	89
93	31	3	7	43	3	53	71	3	109	7	3	13	167	3	p	19	3	p	181	3
97	3	37	p	3	p	p	3	7	p	3	p	p	3	p	7	3	p	131	3	p
99	p	3	p	23	3	59	7	3	31	73	3	p	p	3	p	p	3	p	11	3

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INCOMPOSITS.

Tab. XXXIII.

	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659
01	7	3	19	p	3	53	p	3	11	p	3	p	113	3	7	17	3	p	29	3
03	29	13	3	p	p	3	7	89	3	41	p	3	p	7	3	31	17	3	23	59
07	p	3	11	107	3	251	23	3	229	47	3	7	197	3	p	13	3	p	7	3
09	11	p	3	7	29	3	p	p	3	13	7	3	61	p	3	109	p	3	p	17
11	3	61	7	3	41	31	3	163	p	3	p	p	3	241	149	3	7	23	3	19
13	p	3	157	73	3	p	p	3	7	139	3	19	p	3	p	7	3	p	11	3
17	3	97	p	3	37	149	3	p	p	3	79	13	3	7	11	3	p	p	3	29
19	p	3	149	p	3	7	19	3	53	p	3	p	7	3	p	p	3	p	13	3
21	73	37	3	131	7	3	p	61	3	p	11	3	13	83	3	p	211	3	7	p
23	3	p	p	3	23	113	3	59	11	3	7	p	3	p	p	3	137	7	3	11
27	43	7	3	p	11	3	p	13	3	p	p	3	19	p	3	7	29	3	p	p
29	3	13	11	3	19	173	3	7	241	3	p	p	3	11	7	3	p	p	3	p
31	11	3	p	23	3	47	7	3	13	29	3	11	37	3	59	19	3	p	p	3
33	p	59	3	p	p	3	p	19	3	11	p	3	7	79	3	13	p	3	43	7
37	p	3	p	7	3	11	109	3	23	p	3	53	89	3	p	p	3	7	p	3
39	17	31	3	11	p	3	37	41	3	7	13	3	p	223	3	p	7	3	p	233
41	3	7	227	3	13	233	3	101	7	3	193	p	3	19	31	3	41	13	3	23
43	7	3	17	37	3	19	127	3	61	101	3	13	53	3	7	p	3	29	p	3
47	3	23	41	3	17	7	3	p	19	3	29	p	3	101	p	3	p	11	3	7
49	19	3	47	229	3	17	13	3	p	107	3	7	71	3	p	11	3	37	7	3
51	13	p	3	7	p	3	17	73	3	p	7	3	23	11	3	p	p	3	p	p
53	3	p	7	3	p	p	3	13	p	3	p	11	3	p	29	3	7	47	3	101
57	7	p	3	139	43	3	19	7	3	17	67	3	p	p	3	p	p	3	11	p
59	3	83	13	3	73	11	3	31	79	3	17	23	3	7	67	3	11	19	3	71
61	29	3	179	11	3	7	p	3	37	13	3	17	7	3	11	53	3	p	67	3
63	p	11	3	13	7	3	p	p	3	167	p	3	11	163	3	p	13	3	7	p
67	p	3	7	191	3	p	p	3	11	7	3	p	p	3	17	173	3	13	p	3
69	79	7	3	59	23	3	11	239	3	p	31	3	p	131	3	7	97	3	199	41
71	3	p	p	3	11	13	3	7	p	3	p	p	3	p	7	3	17	89	3	37
73	17	3	11	p	3	31	7	3	29	43	3	p	13	3	233	23	3	17	19	3
77	3	29	17	3	7	p	3	211	p	3	59	7	3	13	41	3	p	p	3	17
79	139	3	p	7	3	p	p	3	p	181	3	p	29	3	3	p	3	7	11	3
81	p	13	3	p	17	3	71	p	3	7	151	3	97	p	3	p	7	3	p	p
83	3	7	p	3	p	17	3	p	7	3	37	p	3	151	11	3	19	157	3	p
87	19	p	3	31	59	3	7	17	3	13	11	3	p	7	3	p	p	3	41	19
89	3	p	53	3	p	7	3	67	11	3	p	19	3	23	43	3	13	p	3	7
91	p	3	239	19	3	p	11	3	p	17	3	7	109	3	79	107	3	11	7	3
93	107	23	3	7	11	3	p	p	3	103	7	3	p	p	3	11	179	3	131	p
97	11	3	113	71	3	13	31	3	7	p	3	11	17	3	p	7	3	19	13	3
99	7	43	3	p	13	3	23	7	3	11	p	3	13	17	3	p	p	3	p	31

INCOMPOSITS.

TAB. XXXIV.

	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679
01	13	7	3	p	23	3	p	p	3	149	11	3	17	13	3	7	p	3	p	p
03	3	p	239	3	p	73	3	7	11	3	p	p	3	17	7	3	67	79	3	11
07	149	p	3	61	11	3	43	41	3	23	37	3	7	p	3	11	p	3	p	7
09	3	p	11	3	7	p	3	19	p	3	113	7	3	11	p	3	17	p	3	59
11	11	3	73	7	3	227	59	3	71	13	3	11	p	3	p	p	3	7	19	3
13	251	17	3	13	p	3	29	p	3	7	19	3	p	83	3	181	7	3	17	113
17	7	3	23	17	3	11	p	3	109	61	3	41	p	3	7	107	3	13	73	3
19	1C7	37	3	11	17	3	7	137	3	p	29	3	p	7	3	251	p	3	p	23
21	3	11	p	3	127	7	3	p	p	3	p	p	3	23	p	3	19	241	3	7
23	103	3	47	29	3	p	17	3	19	p	3	7	13	3	191	p	3	p	7	3
27	3	89	7	3	181	71	3	53	17	3	97	19	3	13	p	3	7	11	3	p
29	p	3	103	19	3	p	p	3	7	17	3	p	23	3	p	7	3	89	p	3
31	7	13	3	113	p	3	23	7	3	p	17	3	p	11	3	p	p	3	29	p
33	3	41	107	3	31	p	3	p	13	3	p	11	3	7	p	3	47	p	3	p
37	p	p	3	p	7	3	37	11	3	13	43	3	71	17	3	p	239	3	7	41
39	3	19	p	3	29	11	3	p	89	3	7	p	3	p	17	3	11	7	3	p
41	p	3	7	11	3	p	103	3	p	7	3	p	19	3	11	17	3	p	179	3
43	211	7	3	p	13	3	p	31	3	p	p	3	11	p	3	7	17	3	p	p
47	p	3	31	p	3	13	7	3	11	p	3	83	p	3	p	p	3	37	13	3
49	257	29	3	43	p	3	11	p	3	p	p	3	7	p	3	31	61	3	19	7
51	3	83	97	3	7	61	3	p	p	3	19	7	3	47	37	3	p	p	3	13
53	13	3	11	7	3	p	p	3	p	23	3	p	109	3	p	43	3	7	p	3
57	3	7	59	3	p	19	3	241	7	3	p	p	3	193	13	3	29	p	3	p
59	7	3	173	p	3	101	191	3	13	p	3	239	103	3	7	p	3	p	11	3
61	31	p	3	p	41	3	7	101	3	29	p	3	p	7	3	13	11	3	79	p
63	3	109	23	3	p	7	3	p	p	3	199	47	3	31	11	3	71	p	3	7
67	p	127	3	7	p	3	163	179	3	167	7	3	137	23	3	p	157	3	p	p
69	3	p	7	3	13	p	3	23	11	3	47	p	3	p	19	3	7	13	3	11
71	p	3	p	31	3	p	11	3	7	193	3	13	p	3	109	7	3	11	67	3
73	7	p	3	p	11	3	61	7	3	p	p	3	p	89	3	11	31	3	13	101
77	11	3	191	p	3	7	13	3	p	p	3	11	7	3	p	p	3	p	103	3
79	13	p	3	41	7	3	131	43	3	11	p	3	19	13	3	p	p	3	7	p
81	3	17	79	3	19	139	3	11	47	3	7	p	3	43	p	3	53	7	3	157
83	p	3	7	p	3	11	p	3	p	7	3	23	61	3	13	19	3	p	p	3
87	3	11	13	3	17	p	3	7	211	3	73	p	3	79	7	3	113	53	3	p
89	p	3	151	197	3	17	7	3	p	13	3	p	p	3	p	p	3	p	29	3
91	29	p	3	13	p	3	17	p	3	31	23	3	7	p	3	257	13	3	p	7
93	3	37	p	3	7	p	3	17	151	3	13	3	3	19	p	3	139	11	3	1
97	157	53	3	67	29	3	p	p	3	7	229	3	173	11	3	23	7	3	43	97
99	3	7	167	3	p	13	3	67	7	3	17	11	3	p	p	3	p	151	3	53

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INCOMPOSITS.

TAB. XXXV.

.	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699
01	3	11	7	3	73	p	3	23	107	3	p	43	3	37	p		7	47	3	13
03	13	3	241	167	3	61	31	3	7	p	3	19	p	3	p	7	3	43	29	3
07	3	13	p	3	67	p	3	127	83	3	151	29	3	7	13	3	47	11	3	53
09	47	3	p	83	3	7	19	3	13	p	3	p	7	3	31	11	3	p	p	3
11	23	p	3	p	7	3	p	p	3	137	p	3	67	11	3	13	151	3	7	p
13	3	p	p	3	37	131	3	p	p	3	7	11	3	p	41	3	67	7	3	151
17	17	7	3	53	31	3	59	11	3	p	13	3	19	p	3	7	43	3	11	139
19	3	17	p	3	13	11	3	7	p	3	p	p	3	103	7	3	11	13	3	29
21	251	3	17	11	3	p	7	3	p	41	3	13	p	3	11	19	3	113	p	3
23	p	11	3	17	53	3	163	19	3	157	23	3	7	181	3	37	p	3	13	7
27	59	3	p	7	3	17	13	3	11	p	3	p	37	3	p	251	3	7	p	3
29	13	193	3	p	41	3	11	p	3	7	p	3	107	13	3	23	7	3	p	p
31	3	7	31	3	11	p	3	13	7	3	p	73	3	19	p	3	179	103	3	p
33	7	3	11	23	3	19	p	3	17	29	3	257	p	3	7	31	3	137	p	3
37	3	61	13	3	p	7	3	p	19	3	17	47	3	p	23	3	83	p	3	7
39	19	3	p	37	3	p	p	3	23	13	3	7	p	3	p	p	3	p	7	3
41	p	p	3	7	89	3	83	53	3	71	7	3	17	p	3	197	11	3	211	p
43	3	83	7	3	p	p	3	p	43	3	13	p	3	17	11	3	7	97	3	23
47	7	p	3	41	p	3	19	7	3	p	11	3	p	31	3	17	257	3	p	113
49	3	23	139	3	p	13	3	p	11	3	29	p	3	7	37	3	17	19	3	11
51	17	3	131	p	3	7	11	3	31	19	3	p	7	3	199	157	3	11	23	3
53	p	17	3	29	7	3	13	197	3	53	199	3	23	223	3	11	p	3	7	13
57	11	3	7	17	3	179	71	3	37	7	3	11	p	3	p	p	3	79	p	3
59	p	7	3	197	17	3	p	29	3	11	53	3	p	43	3	7	41	3	p	p
61	3	p	p	3	223	17	3	7	13	3	p	23	3	139	7	3	p	p	3	43
63	29	3	13	137	3	11	7	3	p	p	3	p	p	3	p	13	3	p	19	3
67	3	11	19	3	7	p	3	p	17	3	p	7	3	71	p	3	13	p	3	31
69	43	3	233	7	3	191	p	3	61	17	3	263	113	3	127	73	3	7	109	3
71	p	p	3	p	13	3	43	p	3	7	17	3	53	p	3	29	7	3	107	11
73	3	7	67	3	p	47	3	97	7	3	p	13	3	173	p	3	19	11	3	167
77	19	79	3	101	p	3	7	p	3	23	67	3	13	7	3	41	p	3	p	19
79	3	29	p	3	31	7	3	109	p	3	37	11	3	p	17	3	59	p	3	7
81	13	3	p	19	3	p	173	3	p	11	3	7	29	3	p	17	3	31	7	3
83	103	41	3	7	p	3	p	11	3	101	7	3	79	p	3	149	17	3	11	47
87	p	3	23	11	3	107	p	3	7	149	3	43	193	3	11	7	3	19	17	3
89	7	11	3	p	p	3	149	7	3	19	59	3	11	p	3	13	227	3	47	17
91	3	19	47	3	p	113	3	p	p	3	11	p	3	7	p	3	p	101	3	p
93	149	3	31	13	3	7	73	3	11	p	3	p	7	3	p	p	3	71	37	3
97	3	47	163	3	11	p	3	89	p	3	7	p	3	29	p	3	p	7	3	p
99	p	3	7	p	3	181	p	3	p	7	3	13	23	3	p	79	3	223	p	3

INCOMPOSITS.

Tab. XXXVI.

	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719
01	p	3	p	7	3	p	17	3	101	p	3	97	13	3	11	127	3	7	19	3
03	p	11	3	229	23	3	13	17	3	7	19	3	11	113	3	p	7	3	59	13
07	7	3	p	167	3	p	p	3	11	17	3	211	31	3	7	23	3	p	p	3
09	p	13	3	p	181	3	7	p	3	23	17	3	p	7	3	43	101	3	p	p
11	3	p	61	3	11	7	3	31	13	3	p	17	3	29	p	3	19	p	3	7
13	53	3	11	p	3	107	241	3	19	p	3	7	17	3	p	13	3	p	7	3
17	3	p	7	3	67	151	3	p	23	3	47	19	3	p	17	3	7	29	3	p
19	p	3	23	19	3	97	p	3	7	p	3	p	229	3	p	7	3	p	11	3
21	7	p	3	p	13	3	p	7	3	p	29	3	67	73	3	37	11	3	p	23
23	3	p	p	3	p	109	3	197	p	3	p	13	3	7	11	3	67	17	3	71
27	239	23	3	p	7	3	p	107	3	19	11	3	13	p	3	p	41	3	7	17
29	3	19	p	3	p	p	3	p	11	3	7	p	3	p	p	3	83	7	3	11
31	13	3	7	53	3	251	11	3	193	7	3	83	19	3	61	233	3	11	109	3
33	59	7	3	61	11	3	23	13	3	89	251	3	p	p	3	7	p	3	29	p
37	11	3	p	37	3	p	7	3	13	p	3	11	p	3	p	p	3	23	p	3
39	p	p	3	31	p	3	p	127	3	11	p	3	7	p	3	13	71	3	19	7
41	3	p	3	3	7	23	3	11	p	3	19	7	3	p	199	3	31	p	3	p
43	89	3	19	7	3	11	41	3	p	61	3	p	191	3	p	29	3	7	p	3
47	3	7	199	3	13	19	3	263	7	3	23	p	3	p	37	3	p	13	3	p
49	7	3	p	103	3	p	31	3	p	p	3	13	p	3	7	p	3	157	p	3
51	p	29	3	p	p	3	7	139	3	p	227	3	43	7	3	p	137	3	13	11
53	3	31	163	3	47	7	3	p	p	3	41	p	3	p	p	3	79	11	3	7
57	13	p	3	7	p	3	p	173	3	p	7	3	p	11	3	163	131	3	181	47
59	3	17	7	3	p	37	3	13	59	3	p	11	3	p	19	3	7	73	3	227
61	p	3	17	71	3	41	19	3	7	11	3	p	p	3	13	7	3	p	p	3
63	7	p	3	17	31	3	p	7	3	29	179	3	p	p	3	p	p	3	11	p
67	p	3	29	11	3	7	p	3	p	13	3	p	7	3	11	59	3	43	p	3
69	41	11	3	13	7	3	17	p	3	p	p	3	11	23	3	p	13	3	7	79
71	3	47	p	3	19	p	3	17	131	3	7	p	3	149	p	3	p	7	3	p
73	79	3	7	p	3	p	29	3	11	7	3	103	263	3	p	19	3	13	41	3
77	3	p	31	3	11	13	3	7	p	3	17	109	3	137	7	3	229	p	3	167
79	p	3	11	p	3	163	7	3	p	p	3	17	13	3	p	31	3	179	p	3
81	11	p	3	p	p	3	13	37	3	p	p	3	7	41	3	47	43	3	p	7
83	3	p	67	3	7	p	3	p	73	3	31	7	3	13	p	3	97	23	3	p
87	109	13	3	59	p	3	p	71	3	7	67	3	p	p	3	17	7	3	p	p
89	3	7	p	3	p	p	3	29	7	3	p	257	3	p	11	3	17	p	3	193
91	7	3	13	43	3	73	223	3	p	p	3	p	11	3	7	13	3	17	29	3
93	29	17	3	p	157	3	7	p	3	13	11	3	p	7	3	p	p	3	17	p
97	191	3	p	17	3	227	11	3	31	p	3	7	83	3	19	p	3	11	7	3
99	p	p	3	7	11	3	19	83	3	p	7	3	37	p	3	11	p	3	p	p

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INCOMPOSITS.

TAB. XXXVII.

	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739
01	89	p	3	17	7	3	79	p	3	p	37	3	71	23	3	31	11	3	7	67
03	3	p	103	3	17	p	3	23	47	3	7	41	3	p	11	3	89	7	3	263
07	13	7	3	p	61	3	17	p	3	p	11	3	19	13	3	7	p	3	23	p
09	3	p	163	3	19	31	3	7	11	3	p	29	3	p	7	3	p	p	3	11
11	107	3	p	167	3	59	7	3	17	p	3	113	179	3	13	19	3	11	31	3
13	23	37	3	p	11	3	p	19	3	17	p	3	7	167	3	11	p	3	223	7
17	11	3	257	7	3	127	p	3	p	13	3	11	211	3	p	p	3	7	97	3
19	p	41	3	13	139	3	101	p	3	7	p	3	17	157	3	37	7	3	p	193
21	3	7	p	3	p	47	3	11	7	3	13	p	3	17	p	3	83	p	3	29
23	7	3	p	31	3	11	p	3	p	p	3	83	37	3	7	p	3	13	p	3
27	3	11	p	3	23	7	3	p	19	3	103	p	3	p	101	3	17	p	3	7
29	17	3	p	151	3	29	59	3	67	233	3	7	13	3	97	p	3	17	7	3
31	p	17	3	7	p	3	13	257	3	p	7	3	67	p	3	23	29	3	17	11
33	3	53	7	3	113	p	3	p	173	3	199	p	3	13	p	3	7	11	3	17
37	7	13	3	p	17	3	19	7	3	p	p	3	p	11	3	151	p	3	47	107
39	3	p	29	3	107	17	3	p	13	3	p	11	3	7	23	3	211	19	3	p
41	61	3	13	p	3	7	17	3	23	11	3	p	7	3	271	13	3	37	41	3
43	p	19	3	73	7	3	p	11	3	13	p	3	p	71	3	251	p	3	7	p
47	p	3	7	11	3	p	p	3	97	7	3	193	89	3	11	p	3	29	p	3
49	109	7	3	71	13	3	p	23	3	p	17	3	11	41	3	7	47	3	p	73
51	3	23	p	3	53	p	3	7	263	3	11	13	3	p	7	3	p	p	3	p
53	p	3	p	p	3	13	7	3	11	p	3	191	17	3	p	p	3	131	13	3
57	3	59	19	3	7	37	3	31	41	3	43	7	3	109	17	3	73	p	3	13
59	13	3	11	7	3	p	113	3	p	p	3	149	p	3	p	17	3	7	p	3
61	11	p	3	269	p	3	p	13	3	7	p	3	61	p	3	p	7	3	233	p
63	3	7	127	3	233	149	3	p	7	3	p	23	3	p	13	3	19	17	3	37
67	19	p	3	p	p	3	7	p	3	131	31	3	41	7	3	13	11	3	p	17
69	3	p	p	3	p	7	3	53	p	3	89	19	3	p	11	3	23	71	3	7
71	97	3	p	13	3	31	p	3	p	43	3	7	11	3	p	p	3	p	7	3
73	p	p	3	7	23	3	p	61	3	p	7	3	47	239	3	29	p	3	31	p
77	p	3	p	157	3	p	11	3	7	p	3	13	p	3	p	7	3	11	p	3
79	7	89	3	p	11	3	p	7	3	19	p	3	127	p	3	11	p	3	13	29
81	3	19	11	3	p	181	3	73	31	3	107	p	3	7	197	3	p	89	3	167
83	11	3	41	p	3	7	13	3	p	59	3	11	7	3	p	p	3	p	p	3
87	3	37	p	3	173	29	3	11	23	3	7	163	3	p	43	3	31	7	3	241
89	p	3	7	191	3	11	p	3	p	7	3	p	83	3	13	p	3	113	37	3
91	p	7	3	11	71	3	157	83	3	47	p	3	p	79	3	7	59	3	19	23
93	3	11	13	3	p	229	3	7	p	3	19	53	3	23	7	3	p	109	3	61
97	17	23	3	13	p	3	139	p	3	p	67	3	7	19	3	p	13	3	p	7
99	3	17	197	3	7	19	3	43	269	3	13	7	3	29	67	3	p	11	3	p

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INCOMPOSITS.

TAB. XXXVIII.

	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759
01	3	p	p	3	47	7	3	11	131	3	179	13	3	257	p	3	19	17	3	7
03	43	3	p	67	3	11	61	3	19	p	3	7	157	3	p	p	3	p	7	3
07	3	11	7	3	37	p	3	p	239	3	107	19	3	p	p	3	7	p	3	13
09	13	3	p	19	3	p	p	3	7	173	3	p	p	3	73	7	3	p	41	3
11	7	37	3	p	p	3	p	7	3	23	p	3	p	127	3	p	p	3	47	11
13	3	13	47	3	p	269	3	p	79	3	p	31	3	7	13	3	83	11	3	p
17	p	137	3	p	7	3	29	p	3	19	p	3	p	11	3	13	p	3	7	89
19	3	19	p	3	p	43	3	p	23	3	7	11	3	109	53	3	p	7	3	31
21	p	3	7	13	3	p	71	3	p	7	3	43	19	3	199	p	3	p	p	3
23	79	7	3	p	19	3	p	11	3	p	13	3	p	p	3	7	47	3	11	23
27	p	3	199	11	3	p	7	3	p	31	3	13	p	3	11	p	3	41	191	3
29	181	11	3	239	263	3	37	p	3	p	p	3	7	p	3	47	p	3	13	7
31	3	p	p	3	7	p	3	p	p	3	11	7	3	71	p	3	53	p	3	p
33	101	3	19	7	3	73	13	3	11	p	3	p	23	3	241	p	3	7	p	3
37	3	7	61	3	11	19	3	13	7	3	p	227	3	p	p	3	43	53	3	p
39	7	3	11	79	3	131	101	3	67	137	3	29	p	3	7	p	3	23	181	3
41	11	151	3	17	p	3	7	31	3	p	p	3	67	7	3	p	p	3	149	p
43	3	p	13	3	17	7	3	41	p	3	101	163	3	59	37	3	67	p	3	7
47	p	53	3	7	109	3	17	p	3	149	7	3	47	p	3	31	11	3	73	173
49	3	p	7	3	p	127	3	17	29	3	13	p	3	151	11	3	7	211	3	53
51	p	3	41	149	3	p	19	3	7	241	3	223	11	3	197	7	3	13	101	3
53	7	29	3	p	p	3	p	7	3	17	11	3	p	p	3	p	151	3	p	151
57	103	3	p	p	3	7	11	3	p	23	3	17	7	3	61	p	3	11	31	3
59	31	p	3	23	7	3	13	p	3	p	47	3	17	179	3	11	p	3	7	13
61	3	p	11	3	19	p	3	p	p	3	7	p	3	11	59	3	29	7	3	37
63	11	3	7	p	3	173	197	3	43	7	3	11	73	3	17	19	3	239	107	3
67	3	p	23	3	113	p	3	7	13	3	271	p	3	p	7	3	17	p	3	p
69	17	3	13	31	3	11	7	3	p	61	3	p	p	3	163	13	3	17	p	3
71	p	17	3	11	p	3	89	p	3	13	41	3	7	23	3	p	31	3	17	7
73	3	11	17	3	7	p	3	23	p	3	37	7	3	19	71	3	13	p	3	17
77	p	p	3	p	13	3	53	37	3	7	193	3	p	p	3	p	7	3	23	11
79	3	7	p	3	71	17	3	p	7	3	p	13	3	43	p	3	p	11	3	p
81	7	3	59	p	3	13	17	3	103	97	3	p	83	3	7	11	3	p	13	3
83	23	31	3	p	211	3	7	17	3	167	p	3	13	7	3	p	p	3	p	p
87	13	3	p	73	3	p	p	3	p	11	3	7	79	3	19	131	3	p	7	3
89	47	p	3	7	p	3	19	11	3	31	7	3	p	p	3	269	p	3	11	p
91	3	13	7	3	163	11	3	29	p	3	61	17	3	p	13	3	7	19	3	p
93	p	3	p	11	3	97	113	3	7	19	3	p	17	3	11	7	3	p	29	3
97	3	p	p	3	23	p	3	p	p	3	11	29	3	7	17	3	59	p	3	p
99	p	3	191	13	3	7	p	3	11	37	3	139	7	3	103	17	3	229	71	3

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INCOMPOSITS.

TAB. XXXIX.

	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779
01	p	3	181	41	3	113	7	3	p	11	3	p	p	3	17	19	3	13	p	3
03	p	p	3	p	p	3	p	11	3	53	p	3	7	23	3	17	71	3	11	7
07	17	3	p	7	3	p	p	3	89	p	3	83	13	3	11	179	3	7	29	3
09	29	11	3	137	109	3	13	79	3	7	53	3	11	97	3	p	7	3	17	13
11	3	7	17	3	43	p	3	41	7	3	11	29	3	13	199	3	p	p	3	17
13	7	3	p	17	3	19	23	3	11	p	3	59	p	3	7	p	3	p	p	3
17	3	103	199	3	11	7	3	p	13	3	p	67	3	p	p	3	p	23	3	7
19	19	3	11	167	3	p	17	3	p	p	3	7	37	3	p	13	3	p	7	3
21	11	163	3	7	p	3	193	17	3	13	7	3	31	167	3	p	p	3	59	67
23	3	p	7	3	p	59	3	73	17	3	p	233	3	p	139	3	7	p	3	29
27	7	269	3	127	13	3	19	7	3	43	17	3	29	53	3	p	11	3	223	149
29	3	p	31	3	23	103	3	277	p	3	p	13	3	7	11	3	149	19	3	p
31	p	3	p	37	3	7	p	3	p	19	3	137	7	3	p	31	3	p	13	3
33	139	19	3	p	7	3	197	p	3	107	11	3	13	17	3	23	29	3	7	p
37	13	3	7	23	3	p	11	3	p	7	3	p	p	3	211	17	3	11	277	3
39	p	7	3	97	11	3	173	13	3	47	41	3	p	p	3	7	17	3	p	59
41	3	13	11	3	p	p	3	7	43	3	p	p	3	11	7	3	p	17	3	41
43	11	3	p	p	3	p	7	3	13	p	3	11	p	3	43	p	3	p	17	3
47	3	p	19	3	7	41	3	11	p	3	p	7	3	p	p	3	p	p	3	23
49	113	3	p	7	3	11	p	3	31	p	3	179	p	3	41	p	3	7	p	3
51	59	271	3	11	89	3	p	23	3	7	13	3	67	p	3	p	7	3	127	p
53	3	7	p	3	13	37	3	p	7	3	29	p	3	103	73	3	19	13	3	137
57	19	p	3	29	101	3	7	p	3	41	251	3	23	7	3	p	79	3	13	11
59	3	p	p	3	157	7	3	59	151	3	263	19	3	p	29	3	p	11	3	7
61	23	3	p	19	3	p	13	3	101	p	3	7	p	3	71	11	3	p	7	3
63	13	p	3	7	p	3	31	29	3	p	7	3	p	11	3	p	37	3	p	53
67	29	3	53	p	3	23	p	3	7	11	3	p	p	3	13	7	3	19	p	3
69	7	59	3	p	47	3	43	7	3	19	p	3	p	p	3	p	101	3	11	p
71	3	19	13	3	p	11	3	p	p	3	37	p	3	7	p	3	11	83	3	103
73	127	3	89	11	3	7	p	3	p	13	3	229	7	3	11	p	3	p	43	3
77	3	17	83	3	31	73	3	p	59	3	7	71	3	p	p	3	173	7	3	p
79	p	3	7	p	3	p	p	3	11	7	3	113	p	3	p	23	3	13	47	3
81	p	7	3	17	p	3	11	p	3	23	p	3	109	223	3	7	p	3	19	29
83	3	29	p	3	11	13	3	7	p	3	19	79	3	p	7	3	131	p	3	p
87	11	47	3	p	p	3	13	31	3	167	157	3	7	19	3	p	p	3	71	7
89	3	61	p	3	7	19	3	17	23	3	127	7	3	13	p	3	p	107	3	167
91	p	3	23	7	3	191	53	3	17	p	3	p	p	3	p	p	3	7	11	3
93	47	13	3	79	p	3	271	41	3	7	p	3	37	193	3	31	7	3	p	23
97	7	3	13	241	3	p	p	3	131	37	3	17	11	3	7	13	3	p	61	3
99	p	23	3	19	227	3	7	61	3	13	11	3	17	7	3	73	p	3	p	p

INCOMPOSITS.

TAB. XL.

	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799
01	7	p	3	p	p	3	83	7	3	p	13	3	p	p	3	107	p	3	p	p
03	3	83	p	3	13	29	3	211	p	3	199	p	3	7	271	3	23	13	3	p
07	p	37	3	p	7	3	p	p	3	19	41	3	103	71	3	43	11	3	7	p
09	3	19	197	3	89	p	3	31	p	3	7	239	3	p	11	3	p	7	3	41
11	181	3	7	p	3	p	13	3	53	7	3	p	11	3	p	23	3	79	p	3
13	13	7	3	71	19	3	127	p	3	23	11	3	113	13	3	7	p	3	p	157
17	p	3	17	p	3	p	7	3	269	53	3	61	37	3	13	131	3	11	p	3
19	61	191	3	17	11	3	29	223	3	p	31	3	7	p	3	11	103	3	19	7
21	3	3	11	3	7	233	3	p	23	3	19	7	3	11	43	3	p	29	3	229
23	11	p	19	7	3	17	p	3	p	13	3	11	227	3	p	281	3	7	p	3
27	3	7	137	3	p	19	3	11	7	3	13	67	3	23	p	3	p	61	3	257
29	7	3	p	29	3	11	61	3	17	p	3	53	p	3	7	67	3	13	p	3
31	p	23	3	11	107	3	7	131	3	17	p	3	p	7	3	p	p	3	97	67
33	3	11	p	3	41	7	3	43	31	3	17	p	3	p	p	3	p	71	3	7
37	73	p	3	7	p	3	13	p	3	193	7	3	17	p	3	p	97	3	29	11
39	3	p	7	3	p	p	3	71	p	3	p	p	3	13	19	3	7	11	3	p
41	p	3	p	p	3	p	19	3	7	p	3	29	p	3	17	7	3	23	p	3
43	7	13	3	157	47	3	p	7	3	89	p	3	109	11	3	17	73	3	p	p
47	17	3	13	p	3	7	31	3	37	11	3	p	7	3	53	13	3	17	p	3
49	p	17	3	47	7	3	p	11	3	13	137	3	19	p	3	p	23	3	7	31
51	3	31	17	3	19	11	3	61	29	3	7	p	3	73	p	3	11	7	3	17
53	89	3	7	11	3	p	p	3	p	7	3	p	41	3	11	19	3	173	47	3
57	3	p	139	3	67	17	3	7	p	3	11	13	3	p	7	3	p	p	3	37
59	p	3	p	127	3	13	7	3	11	23	3	p	p	3	181	p	3	47	13	3
61	251	47	3	23	31	3	11	17	3	281	173	3	7	61	3	p	37	3	p	7
63	3	p	61	3	7	251	3	79	17	3	p	7	3	19	229	3	29	31	3	13
67	11	p	3	p	p	3	97	13	3	7	17	3	31	p	3	251	7	3	p	p
69	3	7	23	3	131	p	3	227	7	3	37	17	3	139	13	3	p	p	3	211
71	7	3	29	109	3	p	151	3	13	157	3	41	17	3	7	47	3	241	11	3
73	101	p	3	181	97	3	7	37	3	151	107	3	p	7	3	13	11	3	p	p
77	163	3	p	13	3	p	29	3	p	p	3	7	11	3	19	17	3	p	7	3
79	p	p	3	7	p	3	19	p	3	p	7	3	p	p	3	p	17	3	23	p
81	3	37	7	3	13	179	3	p	11	3	31	p	3	163	p	3	7	13	3	11
83	113	3	p	103	3	p	11	3	7	19	3	13	p	3	61	7	3	11	17	3
87	3	41	11	3	p	89	3	p	p	3	p	p	3	7	101	3	p	23	3	p
89	11	3	79	43	3	7	13	3	p	p	3	11	7	3	29	p	3	73	p	3
91	13	p	3	277	7	3	p	p	3	11	139	3	37	13	3	19	p	3	7	41
93	3	p	59	3	53	p	3	11	p	3	7	p	3	p	p	3	p	7	3	167
97	29	7	3	11	p	3	p	p	3	197	19	3	179	p	3	7	p	3	109	p
99	3	11	13	3	23	53	3	7	257	3	83	29	3	p	7	3	p	199	3	p

INCOMPOSITS.

TAB. XLI.

	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819
01	3	7	11	3	37	79	3	p	7	3	p	p	3	11	p	3	13	p	3	p
03	7	3	139	131	3	19	p	3	p	17	3	11	p	3	7	149	3	p	179	3
07	3	p	p	3	p	7	3	11	19	3	59	13	3	p	127	3	79	p	3	7
09	19	3	p	p	3	11	149	3	p	p	3	7	17	3	p	p	3	101	7	3
11	29	p	3	7	191	3	p	43	3	p	7	3	13	17	3	37	p	3	23	101
13	3	11	7	3	97	p	3	p	211	3	p	29	3	31	17	3	7	41	3	13
17	7	113	3	p	29	3	19	7	3	p	p	3	241	233	3	p	17	3	p	11
19	3	13	97	3	137	73	3	53	p	3	p	p	3	7	13	3	p	11	3	p
21	p	3	p	31	3	7	p	3	13	19	3	23	7	3	p	11	3	71	17	3
23	43	19	3	47	7	3	37	89	3	p	p	3	p	11	3	13	31	3	7	17
27	79	3	7	13	3	p	p	3	131	7	3	31	43	3	107	p	3	p	47	3
29	191	7	3	p	p	3	p	11	3	p	13	3	29	167	3	7	p	3	11	p
31	3	227	p	3	13	11	3	7	p	3	p	p	3	p	7	3	11	13	3	p
33	163	3	p	11	3	29	7	3	p	p	3	13	p	3	11	p	3	37	19	3
37	3	127	19	3	7	p	3	p	229	3	11	7	3	163	31	3	p	p	3	p
39	p	3	p	7	3	43	13	3	11	29	3	41	p	3	p	67	3	7	p	3
41	13	p	3	p	257	3	11	263	3	7	p	3	137	13	3	73	7	3	223	67
43	3	7	29	3	11	239	3	13	7	3	p	53	3	p	23	3	19	43	3	p
47	11	p	3	p	p	3	7	p	3	61	p	3	113	7	3	p	p	3	p	19
49	3	p	13	3	p	7	3	p	p	3	p	19	3	p	79	3	p	p	3	7
51	p	3	p	19	3	109	p	3	233	13	3	7	31	3	47	p	3	29	7	3
53	17	p	3	7	43	3	59	23	3	p	7	3	193	p	3	p	11	3	p	p
57	223	3	17	107	3	p	p	3	7	73	3	p	11	3	p	7	3	13	23	3
59	7	71	3	17	61	3	79	7	3	19	11	3	23	p	3	p	37	3	109	41
61	3	19	83	3	17	17	3	p	11	3	103	227	3	7	29	3	127	p	3	11
63	23	3	p	p	3	7	11	3	p	p	3	p	7	3	p	p	3	11	71	3
67	3	p	11	3	67	p	3	17	193	3	7	23	3	11	41	3	p	7	3	p
69	11	3	7	p	3	23	p	3	17	7	3	11	181	3	257	p	3	p	p	3
71	p	7	3	179	p	3	p	37	3	11	p	3	67	p	3	7	p	3	19	p
73	3	p	p	3	p	197	3	7	13	3	17	p	3	p	7	3	23	p	3	p
77	p	p	3	11	23	3	p	p	3	13	p	3	7	19	3	29	p	3	41	7
79	3	11	p	3	7	19	3	p	31	3	89	7	3	17	59	3	13	53	3	73
81	73	3	43	7	3	61	p	3	29	47	3	p	p	3	17	23	3	7	37	3
83	53	181	3	31	13	3	p	p	3	7	p	3	p	97	3	17	7	3	p	11
87	7	3	p	p	3	13	p	3	47	109	3	19	29	3	7	11	3	17	13	3
89	283	17	3	19	p	3	7	p	3	p	131	3	13	7	3	83	p	3	17	163
91	3	p	17	3	p	7	3	173	23	3	83	11	3	199	19	3	151	89	3	7
93	13	3	23	17	3	83	19	3	41	11	3	7	p	3	227	139	3	263	7	3
97	3	13	7	3	101	11	3	43	p	3	p	p	3	23	13	3	7	157	3	167
99	173	3	59	11	3	p	17	3	7	107	3	p	p	3	11	7	3	p	p	3

INCOMPOSITS.

TAB. XLII.

	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839
01	43	3	7	p	3	17	p	3	31	7	3	p	19	3	p	11	3	p	47	3
03	p	7	3	13	19	3	17	191	3	p	p	3	p	11	3	7	13	3	181	p
07	p	3	p	p	3	p	7	3	17	11	3	41	p	3	p	113	3	13	43	3
09	p	47	3	53	23	3	p	11	3	17	p	3	7	227	3	37	p	3	11	7
11	3	157	229	3	7	11	3	107	p	3	17	7	3	p	239	3	11	97	3	p
13	p	3	19	7	3	109	p	3	p	p	3	17	13	3	11	23	3	7	p	3
17	3	7	p	3	73	19	3	181	7	3	11	p	3	13	p	3	p	p	3	31
19	7	3	p	263	3	179	p	3	11	283	3	43	p	3	7	47	3	p	79	3
21	p	13	3	191	p	3	7	p	3	101	61	3	p	7	3	17	p	3	109	p
23	3	41	p	3	11	7	3	p	13	3	p	101	3	97	p	3	17	29	3	7
27	11	17	3	7	139	3	53	p	3	13	7	3	p	103	3	101	241	3	17	23
29	3	p	7	3	31	p	3	p	113	3	79	97	3	23	19	3	7	101	3	17
31	p	3	p	17	3	p	19	3	7	127	3	59	p	3	p	7	3	31	11	3
33	7	23	3	281	13	3	p	7	3	239	43	3	p	167	3	103	11	3	p	p
37	p	3	p	137	3	7	17	3	p	197	3	p	7	3	p	p	3	p	13	3
39	p	p	3	p	7	3	23	17	3	p	11	3	13	p	3	139	p	3	7	p
41	3	p	p	3	19	59	3	97	11	3	7	71	3	p	181	3	p	7	3	11
43	13	3	7	67	3	197	11	3	37	7	3	29	p	3	p	19	3	11	p	3
47	3	13	11	3	29	23	3	7	p	3	p	17	3	11	7	3	233	83	3	127
49	11	3	233	p	3	p	7	3	13	109	3	11	17	3	p	29	3	89	191	3
51	p	113	3	p	41	3	p	83	3	11	53	3	7	17	3	13	23	3	71	7
53	3	p	83	3	7	31	3	11	29	3	23	7	3	19	17	3	p	61	3	37
57	31	29	3	11	p	3	p	p	3	7	13	3	p	p	3	p	7	3	p	59
59	3	7	43	3	13	p	3	p	7	3	p	137	3	31	p	3	269	13	3	113
61	7	3	p	p	3	p	131	3	41	23	3	13	139	3	7	p	3	p	17	3
63	137	p	3	23	p	3	7	p	3	p	p	3	53	7	3	p	p	3	13	11
67	p	3	p	31	3	p	13	3	173	163	3	7	p	3	19	11	3	211	7	3
69	13	127	3	7	p	3	19	37	3	29	7	3	p	11	3	193	31	3	p	p
71	3	p	7	3	p	p	3	13	79	3	p	11	3	263	p	3	7	19	3	131
73	p	3	29	p	3	71	47	3	7	11	3	31	p	3	13	7	3	p	p	3
77	3	37	13	3	67	11	3	23	179	3	p	p	3	7	p	3	11	p	3	79
79	211	3	p	11	3	7	29	3	67	13	3	223	7	3	11	p	3	199	37	3
81	79	11	3	13	7	3	89	p	3	p	251	3	11	199	3	19	13	3	7	137
83	3	p	107	3	p	269	3	19	p	3	7	193	3	p	31	3	67	7	3	p
87	23	7	3	p	p	3	11	p	3	31	19	3	37	61	3	7	53	3	149	p
89	3	p	19	3	11	13	3	7	p	3	p	41	3	p	7	3	p	23	3	47
91	103	3	11	47	3	p	7	3	p	37	3	23	13	3	29	p	3	p	p	3
93	11	p	3	p	p	3	13	p	3	149	p	3	7	89	3	179	127	3	43	7
97	53	3	17	7	3	151	41	3	19	p	3	271	31	3	p	p	3	7	11	3
99	19	13	3	17	p	3	p	p	3	7	23	3	p	p	3	41	7	3	53	19

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TAB. XLIII.

	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859
01	167	37	3	7	p	3	11	p	3	59	7	3	p	197	3	13	p	3	239	17
03	3	31	7	3	11	p	3	71	137	3	167	p	3	p	41	3	7	p	3	p
07	7	151	3	p	p	3	19	7	3	197	13	3	139	23	3	37	p	3	53	271
09	3	241	107	3	13	p	3	23	p	3	p	p	3	7	223	3	59	13	3	137
11	p	3	p	59	3	7	211	3	p	19	3	13	7	3	p	233	3	p	11	3
13	29	19	3	p	7	3	191	p	3	p	151	3	p	p	3	p	11	3	7	53
17	p	3	7	p	3	223	13	3	89	7	3	47	11	3	229	p	3	p	p	3
19	13	7	3	p	29	3	37	p	3	p	11	3	31	13	3	7	p	3	p	151
21	3	p	p	3	p	p	3	7	11	3	p	p	3	41	7	3	p	23	3	11
23	73	3	p	37	3	p	7	3	271	163	3	23	p	3	13	p	3	11	19	3
27	3	p	11	3	7	181	3	193	p	3	p	7	3	11	p	3	p	59	3	29
29	11	3	p	7	3	137	p	3	41	13	3	11	p	3	p	31	3	7	p	3
31	17	p	3	13	p	3	p	p	3	7	23	3	29	p	3	p	7	3	p	p
33	3	7	131	3	23	p	3	11	7	3	13	p	3	p	37	3	19	p	3	p
37	19	p	3	11	p	3	7	p	3	157	p	3	p	7	3	23	29	3	p	19
39	3	11	p	3	17	7	3	101	43	3	277	19	3	61	p	3	p	83	3	7
41	31	3	61	19	3	17	53	3	37	29	3	7	13	3	43	113	3	179	7	3
43	229	p	3	7	p	3	13	83	3	173	7	3	p	31	3	131	p	3	p	11
47	p	3	p	p	3	59	47	3	7	p	3	p	p	3	p	7	3	19	p	3
49	7	13	3	p	p	3	p	7	3	17	p	3	163	11	3	p	41	3	293	61
51	3	19	173	3	79	p	3	p	13	3	17	11	3	7	p	3	97	p	3	23
53	p	3	13	67	3	7	p	3	53	11	3	17	7	3	p	13	3	29	p	3
57	3	23	109	3	p	11	3	131	p	3	7	31	3	17	97	3	11	7	3	43
59	p	3	7	11	3	p	p	3	p	7	3	p	p	3	11	67	3	191	23	3
61	p	7	3	29	13	3	31	p	3	p	p	3	11	p	3	7	p	3	19	67
63	3	p	p	3	p	103	3	7	113	3	11	13	3	p	7	3	17	139	3	31
67	p	17	3	239	p	3	11	29	3	p	257	3	7	19	3	41	p	3	17	7
69	3	73	17	3	7	19	3	103	p	3	97	7	3	p	p	3	p	199	3	13
71	13	3	11	7	3	23	227	3	p	31	3	53	71	3	127	p	3	7	43	3
73	11	41	3	139	17	3	p	13	3	7	241	3	269	59	3	83	7	3	79	149
77	7	3	71	p	3	83	17	3	13	p	3	19	53	3	7	p	3	31	11	3
79	83	p	3	19	23	3	7	17	3	p	149	3	107	7	3	13	11	3	157	127
81	3	p	271	3	p	7	3	149	17	3	p	103	3	p	11	3	47	p	3	7
83	47	3	89	13	3	41	19	3	29	17	3	7	11	3	73	23	3	109	7	3
87	3	29	7	3	13	251	3	p	11	3	p	17	3	103	p	3	7	13	3	11
89	p	3	31	p	3	p	11	3	7	37	3	13	17	3	53	7	3	11	p	3
91	7	p	3	p	11	3	p	7	3	p	p	3	19	17	3	11	p	3	13	p
93	3	59	11	3	19	29	3	p	23	3	p	p	3	7	17	3	67	p	3	113
97	13	269	3	37	7	3	p	19	3	11	43	3	p	13	3	p	17	3	7	23
99	3	p	p	3	p	31	3	11	73	3	7	p	3	23	193	3	43	7	3	p

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TAB. XLIV.

	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879
01	3	29	p	3	7	p	3	277	11	3	19	7	3	67	71	3	17	p	3	11
03	17	3	13	7	3	23	11	3	61	43	3	p	29	3	p	13	3	7	p	3
07	3	7	11	3	71	19	3	31	7	3	167	p	3	11	p	3	13	229	3	17
09	7	3	p	17	3	p	257	3	47	233	3	11	37	3	7	p	3	139	277	3
11	p	p	3	p	13	3	7	p	3	11	p	3	p	7	3	p	79	3	p	p
13	3	p	73	3	p	7	3	11	p	3	p	13	3	p	61	3	p	239	3	7
17	p	p	3	7	103	3	37	17	3	23	7	3	13	p	3	p	41	3	137	p
19	3	11	7	3	89	241	3	p	17	3	173	p	3	29	19	3	7	p	3	13
21	13	3	151	37	3	31	19	3	7	17	3	p	p	3	p	7	3	p	53	3
23	7	71	3	p	p	3	29	7	3	p	17	3	p	p	3	p	p	3	31	11
27	p	3	23	173	3	7	p	3	13	p	3	151	7	3	p	11	3	37	71	3
29	p	43	3	131	7	3	p	p	3	p	29	3	19	11	3	13	p	3	7	23
31	3	p	53	3	19	p	3	43	31	3	7	11	3	23	17	3	p	7	3	p
33	227	3	7	13	3	p	41	3	71	7	3	p	83	3	p	17	3	59	p	3
37	3	p	83	3	13	11	3	7	p	3	p	79	3	p	7	3	11	13	3	47
39	97	3	p	11	3	p	7	3	37	p	3	13	23	3	11	p	3	p	17	3
41	139	11	3	p	p	3	23	127	3	227	p	3	7	167	3	p	p	3	13	7
43	3	p	p	3	7	37	3	p	p	3	11	7	3	19	p	3	p	p	3	p
47	13	277	3	79	137	3	11	223	3	7	61	3	43	13	3	p	7	3	107	31
49	3	7	p	3	11	23	3	13	7	3	p	p	3	113	157	3	p	47	3	37
51	7	3	11	p	3	41	73	3	p	p	3	p	p	3	7	29	3	p	59	3
53	11	101	3	p	p	3	7	p	3	89	263	3	p	7	3	p	23	3	p	281
57	47	3	p	p	3	101	193	3	p	13	3	7	p	3	19	p	3	127	7	3
59	41	29	3	7	31	3	19	101	3	p	7	3	71	p	3	p	11	3	103	p
61	3	p	7	3	p	p	3	53	p	3	13	43	3	199	11	3	7	19	3	p
63	89	3	p	67	3	107	79	3	7	19	3	101	11	3	149	7	3	13	41	3
67	3	199	281	3	p	13	3	p	11	3	83	67	3	7	47	3	29	p	3	11
69	p	3	p	p	3	7	11	3	p	p	3	61	7	3	23	67	3	11	p	3
71	17	p	3	p	7	3	13	p	3	29	p	3	197	41	3	11	p	3	7	13
73	3	17	11	3	43	p	3	19	109	3	7	179	3	11	p	3	73	7	3	p
77	p	7	3	17	p	3	p	107	3	11	19	3	p	23	3	7	43	3	p	p
79	3	p	19	3	17	p	3	7	13	3	31	p	3	59	7	3	p	61	3	97
81	59	3	13	p	3	11	7	3	283	p	3	p	p	3	p	13	3	41	p	3
83	p	p	3	11	197	3	17	p	3	13	p	3	3	p	3	p	p	3	23	7
87	31	3	p	7	3	p	23	3	17	37	3	p	191	3	89	p	3	7	p	3
89	19	79	3	p	13	3	p	59	3	7	73	3	41	31	3	p	7	3	179	11
91	3	7	p	3	p	131	3	229	7	3	17	13	3	281	p	3	p	11	3	p
93	7	3	p	19	3	13	p	3	31	79	3	17	p	3	7	11	3	p	13	3
97	3	p	p	3	67	7	3	29	113	3	251	11	3	17	59	3	p	p	3	7
99	13	3	211	p	3	p	181	3	67	11	3	7	p	3	17	251	3	19	7	3

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TAB. XLV.

	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899
01	p	3	193	p	3	7	41	3	p	19	3	p	7	3	13	p	3	271	89	3
03	p	19	3	227	7	3	251	107	3	p	p	3	p	p	3	37	p	3	7	11
07	p	3	7	233	3	67	p	3	p	7	3	p	37	3	29	11	3	109	31	3
09	17	7	3	13	211	3	p	43	3	67	p	3	p	11	3	7	13	3	p	p
11	3	17	p	3	p	61	3	7	p	3	13	11	3	31	7	3	p	283	3	47
13	283	3	17	47	3	p	7	3	p	11	3	p	p	3	p	p	3	13	19	3
17	3	p	19	3	7	11	3	79	p	3	p	7	3	p	p	3	11	73	3	p
19	p	3	47	7	3	17	23	3	p	p	3	p	13	3	11	p	3	7	p	3
21	23	11	3	p	29	3	13	p	3	7	p	3	11	179	3	p	7	3	p	13
23	3	7	p	3	p	p	3	17	7	3	11	p	3	13	223	3	19	23	3	p
27	19	13	3	p	p	3	7	83	3	17	127	3	p	7	3	p	p	3	43	19
29	3	p	83	3	11	7	3	p	13	3	17	19	3	p	37	3	47	53	3	7
31	47	3	11	19	3	223	263	3	211	113	3	7	p	3	p	13	3	61	7	3
33	11	31	3	7	191	3	61	89	3	13	7	3	17	157	3	p	p	3	p	139
37	p	3	p	p	3	29	151	3	7	p	3	p	p	3	17	7	3	19	11	3
39	7	53	3	p	13	3	137	7	3	19	269	3	233	41	3	17	11	3	p	p
41	3	19	p	3	59	37	3	p	73	3	p	13	3	7	11	3	17	43	3	53
43	17	3	79	23	3	7	p	3	p	29	3	97	7	3	p	151	3	17	13	3
47	3	181	17	3	241	p	3	p	11	3	7	239	3	47	23	3	157	7	3	11
49	13	3	7	17	3	73	11	3	23	7	3	59	31	3	p	149	3	11	p	3
51	191	7	3	53	11	3	p	13	3	p	p	3	149	199	3	7	37	3	19	293
53	3	13	11	3	197	17	3	7	p	3	19	p	3	11	7	3	p	p	3	23
57	173	199	3	149	53	3	p	17	3	11	p	3	7	19	3	13	p	3	59	7
59	3	23	p	3	7	19	3	11	17	3	29	7	3	193	p	3	p	p	3	p
61	107	3	p	7	3	11	p	3	p	17	3	163	p	3	137	p	3	7	23	3
63	83	131	3	11	p	3	p	37	3	7	13	3	23	p	3	p	7	3	73	p
67	7	3	61	97	3	31	p	3	p	43	3	13	17	3	7	p	3	p	p	3
69	p	p	3	19	p	3	7	29	3	p	p	3	p	7	3	43	p	3	13	11
71	3	37	103	3	p	7	3	p	181	3	p	23	3	p	17	3	p	11	3	7
73	29	3	41	67	3	23	13	3	p	193	3	7	p	3	131	11	3	107	7	3
77	3	p	7	3	103	101	3	13	31	3	281	11	3	139	p	3	7	17	3	p
79	p	3	43	p	3	283	71	3	7	11	3	257	73	3	13	7	3	p	17	3
81	7	109	3	31	23	3	p	7	3	101	229	3	19	p	3	29	p	3	11	17
83	3	163	13	3	19	11	3	47	p	3	p	101	3	7	43	3	11	p	3	p
87	59	11	3	13	7	3	131	19	3	23	p	3	11	p	3	101	13	3	7	29
89	3	29	p	3	107	p	3	p	103	3	7	p	3	71	109	3	p	7	3	p
91	137	3	7	157	3	p	31	3	11	7	3	79	29	3	p	p	3	13	p	3
93	p	7	3	37	p	3	11	p	3	p	41	3	p	p	3	7	257	3	241	31
97	37	3	11	p	3	19	7	3	p	p	3	191	13	3	31	p	3	p	p	3
99	11	89	3	109	p	3	13	p	3	61	139	3	7	p	3	p	19	3	p	7

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INCOMPOSITS.

TAB. XLVI.

	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919
01	p	11	3	73	p	3	7	13	3	p	17	3	11	7	3	37	139	3	p	29
03	3	13	p	3	p	7	3	p	p	3	11	17	3	p	13	3	47	p	3	7
07	p	p	3	7	p	3	11	61	3	p	7	3	223	17	3	13	101	3	p	73
09	3	251	7	3	11	29	3	p	71	3	p	31	3	p	17	3	7	293	3	p
11	p	3	11	13	3	p	19	3	7	p	3	179	197	3	p	7	3	p	p	3
13	7	97	3	p	23	3	31	7	3	229	13	3	53	127	3	p	17	3	p	107
17	p	3	p	37	3	7	p	3	197	p	3	13	7	3	113	23	3	41	11	3
19	p	227	3	181	7	3	p	83	3	23	p	3	19	53	3	71	11	3	7	17
21	3	p	83	3	19	131	3	257	p	3	7	p	3	29	11	3	p	7	3	p
23	p	3	7	41	3	p	13	3	p	7	3	293	11	3	p	19	3	37	p	3
27	3	p	p	3	31	p	3	7	11	3	227	p	3	271	7	3	59	29	3	11
29	197	3	23	59	3	p	7	3	61	79	3	p	p	3	13	p	3	11	229	3
31	p	193	3	103	11	3	p	p	3	p	29	3	7	p	3	11	p	3	131	7
33	3	173	11	3	7	p	3	41	p	3	p	7	3	11	p	3	43	p	3	149
37	179	23	3	13	p	3	233	31	3	7	59	3	p	149	3	239	7	3	p	89
39	3	7	p	3	p	37	3	11	7	3	13	p	3	241	61	3	p	199	3	p
41	7	3	31	61	3	11	p	3	p	211	3	p	23	3	7	p	3	13	p	3
43	127	109	3	11	149	3	7	103	3	199	181	3	p	7	3	31	113	3	29	p
47	53	3	p	167	3	p	p	3	p	p	3	7	13	3	19	43	3	23	7	3
49	17	p	3	7	151	3	13	p	3	103	7	3	p	167	3	83	37	3	53	11
51	3	17	7	3	29	23	3	151	47	3	83	p	3	13	109	3	7	11	3	p
53	p	3	17	p	3	83	269	3	7	19	3	p	p	3	p	7	3	p	31	3
57	3	89	43	3	17	137	3	47	13	3	23	11	3	7	p	3	151	p	3	p
59	p	3	13	p	3	7	p	3	43	11	3	p	7	3	p	13	3	89	97	3
61	113	29	3	109	7	3	17	11	3	13	41	3	263	103	3	19	71	3	7	p
63	3	p	p	3	61	11	3	17	p	3	7	p	3	211	p	3	11	7	3	41
67	p	7	3	23	13	3	71	139	3	17	19	3	11	p	3	7	31	3	p	p
69	3	37	19	3	p	41	3	7	89	3	11	13	3	p	7	3	29	163	3	p
71	p	3	p	p	3	13	7	3	11	p	3	17	107	3	23	p	3	p	13	3
73	p	p	3	p	p	3	11	43	3	29	61	3	7	p	3	p	p	3	p	7
77	13	3	11	7	3	53	p	3	19	p	3	73	97	3	17	p	3	7	79	3
79	11	31	3	p	173	3	p	13	3	7	p	3	37	23	3	17	7	3	139	19
81	3	7	p	3	p	239	3	23	7	3	p	19	3	p	13	3	17	p	3	59
83	7	3	137	19	3	p	29	3	13	37	3	p	p	3	7	p	3	17	11	3
87	3	p	17	3	41	7	3	p	p	3	79	67	3	p	11	3	277	263	3	7
89	p	3	p	13	3	157	23	3	97	p	3	7	11	3	191	67	3	19	7	3
91	23	p	3	7	17	3	89	163	3	19	7	3	p	59	3	p	p	3	43	67
93	3	19	7	3	13	17	3	p	11	3	71	p	3	p	p	3	7	17	3	11
97	7	p	3	p	11	3	p	7	3	p	p	3	p	p	3	11	47	3	13	p
99	3	p	11	3	p	p	3	29	17	3	p	p	3	7	p	3	107	41	3	197

INCOMPOSITS.

Tab. XLVII.

	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939
01	3	31	137	3	p	233	3	7	p	3	p	157	3	13	7	3	p	p	3	p
03	p	3	p	241	3	p	7	3	17	61	3	p	11	3	23	p	3	p	19	3
07	3	p	19	3	7	p	3	p	11	3	17	7	3	p	p	3	p	83	3	11
09	p	3	13	7	3	79	11	3	p	53	3	17	83	3	29	13	3	7	p	3
11	101	p	3	p	11	3	37	83	3	7	281	3	17	23	3	11	7	3	p	p
13	3	7	11	3	p	71	3	23	7	3	47	p	3	11	109	3	13	31	3	p
17	19	251	3	p	13	3	7	p	3	11	191	3	31	7	3	17	179	3	23	19
19	3	p	p	3	p	7	3	11	101	3	167	13	3	p	p	3	17	7	3	7
21	17	3	p	19	3	11	23	3	p	p	3	7	73	3	103	41	3	17	7	3
23	23	17	3	7	29	3	p	p	3	43	7	3	13	p	3	p	251	3	17	p
27	13	3	p	17	3	67	p	3	7	p	3	23	53	3	p	7	3	19	p	3
29	7	181	3	127	17	3	211	7	3	19	41	3	p	p	3	p	p	3	101	11
31	3	13	149	3	p	17	3	47	p	3	31	p	3	7	13	3	109	11	3	29
33	p	3	p	p	3	7	17	3	13	199	3	p	7	3	233	11	3	67	103	3
37	3	199	p	3	23	37	3	p	17	3	7	11	3	p	223	3	p	7	3	p
39	31	3	7	13	3	29	p	3	263	7	3	p	p	3	41	89	3	p	107	3
41	p	7	3	107	97	3	p	11	3	p	13	3	p	31	3	7	29	3	11	p
43	3	p	p	3	13	11	3	7	227	3	19	17	3	269	7	3	11	13	3	37
47	83	11	3	p	193	3	p	163	3	41	p	3	7	17	3	139	37	3	13	7
49	3	43	29	3	7	19	3	137	p	3	11	7	3	277	17	3	71	241	3	p
51	p	3	p	7	3	p	13	3	11	p	3	p	p	3	113	17	3	7	p	3
53	13	p	3	p	59	3	11	p	3	7	p	3	p	13	3	p	7	3	127	47
57	7	3	11	p	3	p	p	3	p	p	3	19	p	3	7	p	3	29	17	3
59	11	157	3	19	p	3	7	23	3	p	p	3	179	7	3	p	73	3	47	17
61	3	23	13	3	p	7	3	p	p	3	29	59	3	89	19	3	229	p	3	7
63	43	3	257	p	3	151	19	3	p	13	3	7	p	3	p	p	3	p	7	3
67	3	37	7	3	p	p	3	p	p	3	13	151	3	73	11	3	7	41	3	p
69	23	3	p	p	3	p	p	3	7	31	3	p	11	3	151	7	3	13	37	3
71	7	61	3	71	89	3	p	7	3	239	11	3	19	p	3	137	47	3	p	p
73	3	p	53	3	19	13	3	113	11	3	163	23	3	7	211	3	283	79	3	11
77	p	p	3	p	7	3	13	19	3	109	p	3	37	p	3	11	113	3	7	13
79	3	p	11	3	p	43	3	p	131	3	7	p	3	11	p	3	23	7	3	p
81	11	3	7	p	3	p	p	3	293	7	3	11	p	3	p	p	3	191	269	3
83	p	7	3	p	23	3	p	31	3	11	p	3	p	p	3	7	p	3	223	p
87	71	3	13	p	3	11	7	3	29	p	3	p	p	3	p	13	3	p	p	3
89	17	p	3	11	p	3	59	p	3	13	p	3	7	47	3	31	19	3	p	7
91	3	11	41	3	7	53	3	p	19	3	127	7	3	61	p	3	13	71	3	193
93	19	3	17	7	3	p	p	3	p	p	3	41	29	3	p	173	3	7	p	3
97	3	7	p	3	17	29	3	71	7	3	p	13	3	59	p	3	43	11	3	p
99	7	3	23	p	3	13	p	3	p	113	3	p	79	3	7	11	3	97	13	3

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TAB. XLVIII.

	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959
01	23	3	p	181	3	11	13	3	7	43	3	p	31	3	p	7	3	p	p	3
03	7	139	3	11	67	3	p	7	3	p	p	3	p	13	3	43	p	3	p	29
07	p	3	p	p	3	7	89	3	113	p	3	p	7	3	13	p	3	p	149	3
09	p	p	3	p	7	3	37	p	3	107	p	3	19	191	3	149	67	3	7	11
11	3	p	13	3	19	29	3	53	p	3	7	p	3	p	73	3	23	7	3	p
13	41	3	7	37	3	p	p	3	59	7	3	227	p	3	p	11	3	p	p	3
17	3	p	71	3	263	47	3	7	53	3	13	11	3	p	7	3	p	p	3	p
19	149	3	p	257	3	31	7	3	p	11	3	73	p	3	p	23	3	13	p	3
21	167	p	3	p	p	3	p	11	3	23	p	3	7	199	3	59	p	3	11	7
23	3	61	59	3	7	11	3	p	p	3	167	7	3	19	37	3	11	p	3	p
27	17	11	3	p	p	3	13	p	3	7	p	3	11	p	3	p	7	3	79	13
29	3	7	p	3	89	p	3	43	7	3	11	251	3	13	p	3	p	29	3	p
31	7	3	17	p	3	p	173	3	11	59	3	p	p	3	7	p	3	p	61	3
33	p	13	3	17	p	3	7	61	3	p	29	3	p	7	3	83	p	3	47	23
37	271	3	11	29	3	17	101	3	p	139	3	7	131	3	19	13	3	p	7	3
39	11	23	3	7	p	3	17	211	3	13	7	3	p	p	3	p	59	3	239	197
41	3	47	7	3	p	p	3	17	p	3	101	89	3	67	p	3	7	19	3	37
43	157	3	73	p	3	p	31	3	7	19	3	p	23	3	p	7	3	67	11	3
47	3	31	79	3	p	p	3	p	p	3	17	13	3	7	11	3	101	p	3	p
49	p	3	307	p	3	7	p	3	p	p	3	17	7	3	31	p	3	23	13	3
51	163	p	3	p	7	3	p	41	3	p	11	3	13	97	3	19	p	3	7	229
53	3	p	p	3	29	23	3	19	11	3	7	p	3	17	53	3	41	7	3	11
57	p	7	3	157	11	3	103	13	3	269	19	3	p	167	3	7	23	3	p	p
59	3	13	11	3	59	p	3	7	29	3	23	43	3	11	7	3	17	31	3	p
61	11	3	p	721	3	p	7	3	13	p	3	11	p	3	p	p	3	17	257	3
63	p	17	3	197	p	3	181	193	3	11	p	3	7	47	3	13	271	3	17	7
67	109	3	107	7	3	11	137	3	19	23	3	59	p	3	p	227	3	7	37	3
69	19	p	3	11	17	3	41	41	3	7	13	3	47	p	3	p	7	3	p	19
71	3	7	31	3	13	17	3	p	7	3	p	19	3	283	p	3	29	13	3	p
73	7	3	p	19	3	p	17	3	p	73	3	13	p	3	7	31	3	p	p	3
77	3	41	23	3	p	7	3	p	17	3	31	p	3	127	307	3	241	11	3	7
79	p	3	29	p	3	271	13	3	79	17	3	7	p	3	p	11	3	19	7	3
81	13	53	3	7	107	3	73	p	3	19	7	3	151	11	3	p	163	3	p	41
83	3	19	7	3	p	p	3	13	239	3	p	11	3	p	p	3	7	p	3	53
87	7	97	3	37	19	3	p	7	3	43	p	3	p	17	3	61	103	3	11	p
89	3	131	13	3	61	11	3	p	p	3	p	p	3	7	17	3	11	p	3	p
91	37	3	p	11	3	7	23	3	31	13	3	p	7	3	11	17	3	p	p	3
93	23	11	3	13	7	3	p	p	3	p	p	3	11	p	3	109	13	3	7	59
97	73	3	7	p	3	p	281	3	11	7	3	23	233	3	29	p	3	13	17	3
99	p	7	3	p	53	3	11	47	3	p	61	3	157	19	3	7	83	3	41	17

INCOMPOSITS.

TAB. XLIX.

	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979
01	p	17	3	23	p	3	p	11	3	7	p	3	13	p	3	p	7	3	11	47
03	3	7	17	3	149	11	3	p	7	3	p	p	3	p	257	3	11	41	3	13
07	19	11	3	193	17	3	7	13	3	p	p	3	11	7	3	281	p	3	47	19
09	3	3	23	3	229	7	3	97	131	3	11	19	3	31	13	3	p	199	3	7
11	67	3	p	19	3	103	17	3	11	p	3	7	41	3	29	p	3	p	7	3
13	p	223	3	7	67	3	11	17	3	199	7	3	p	23	3	13	p	3	p	179
17	p	3	11	13	3	p	79	3	7	17	3	p	67	3	61	7	3	19	29	3
19	7	277	3	61	p	3	53	7	3	19	13	3	191	307	3	113	31	3	23	p
21	3	19	p	3	13	263	3	311	p	3	p	17	3	7	37	3	41	13	3	181
23	131	3	p	p	3	7	23	3	p	103	3	13	7	3	p	p	3	79	11	3
27	3	97	41	3	211	p	3	197	p	3	7	p	3	p	11	3	233	7	3	p
29	109	3	7	p	3	83	13	3	37	7	3	23	11	3	p	17	3	p	p	3
31	13	7	3	p	p	3	71	p	3	p	11	3	p	13	3	7	17	3	19	p
33	3	251	p	3	73	37	3	7	11	3	19	137	3	131	7	3	89	17	3	11
37	137	p	3	p	11	3	41	p	3	31	23	3	7	19	3	11	163	3	227	7
39	3	127	11	3	7	19	3	p	179	3	p	7	3	11	139	3	251	43	3	37
41	11	3	157	7	3	29	241	3	113	13	3	11	p	3	p	103	3	7	p	3
43	p	79	3	13	p	3	p	89	3	7	53	3	47	311	3	23	7	3	p	p
47	7	3	109	23	3	11	127	3	p	29	3	19	31	3	7	p	3	13	p	3
49	139	p	3	11	43	3	7	p	3	67	107	3	79	7	3	p	p	3	p	41
51	3	11	29	3	p	7	3	31	p	3	37	p	3	67	19	3	p	239	3	7
53	p	3	101	p	3	p	19	3	23	p	3	7	13	3	p	p	3	67	7	3
57	3	p	7	3	p	p	3	p	p	3	71	p	3	13	41	3	7	11	3	23
59	p	3	p	167	3	223	163	3	7	p	3	p	p	3	p	7	3	29	p	3
61	7	13	3	173	p	3	p	7	3	47	31	3	19	11	3	p	61	3	p	p
63	3	23	p	3	19	61	3	p	13	3	29	11	3	7	p	3	127	59	3	163
67	17	p	3	29	7	3	p	11	3	13	113	3	23	p	3	43	101	3	7	p
69	3	17	p	3	p	11	3	p	157	3	7	p	3	p	29	3	11	7	3	313
71	23	3	7	11	3	269	p	3	73	7	3	p	211	3	11	p	3	p	p	3
73	191	7	3	17	13	3	277	29	3	p	p	3	11	p	3	7	p	3	97	p
77	29	3	43	p	3	13	7	3	11	37	3	p	89	3	107	p	3	p	13	3
79	p	p	3	31	p	3	11	p	3	p	193	3	7	p	3	p	19	3	p	7
81	3	p	p	3	7	p	3	17	19	3	p	7	3	p	43	3	23	277	3	13
83	13	3	11	7	3	59	109	3	17	293	3	157	p	3	71	p	3	7	p	3
87	3	7	73	3	p	p	3	p	7	3	17	p	3	p	3	3	p	p	3	p
89	7	3	p	113	3	p	31	3	13	p	3	17	271	3	7	23	3	p	11	3
91	307	43	3	41	47	3	7	151	3	23	79	3	17	7	3	13	11	3	53	29
93	3	29	p	3	p	7	3	43	p	3	151	83	3	17	11	3	211	19	3	7
97	p	19	3	7	p	3	p	p	3	p	7	3	149	p	3	17	151	3	223	43
99	3	p	7	3	13	29	3	p	11	3	89	37	3	173	p	3	7	13	3	11

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TAB. L.

	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999
01	3	p	283	3	19	13	3	89	p	3	7	113	3	199	p	3	103	7	3	p
03	23	3	7	197	3	137	151	3	29	7	3	p	13	3	107	19	3	179	11	3
07	3	17	p	3	p	p	3	7	p	3	181	23	3	13	7	3	p	p	3	p
09	p	3	17	37	3	23	7	3	p	p	3	p	11	3	p	151	3	p	p	3
11	p	13	3	17	p	3	31	p	3	p	11	3	7	47	3	191	p	3	151	7
13	3	41	p	3	7	29	3	p	11	3	p	7	3	19	89	3	23	p	3	11
17	p	59	3	p	11	3	17	p	3	7	p	3	47	p	3	11	7	3	p	41
19	3	7	11	3	p	p	3	17	7	3	83	p	3	11	37	3	13	p	3	163
21	7	3	p	p	3	83	p	3	17	31	3	11	313	3	7	23	3	p	173	3
23	83	p	3	p	13	3	7	269	3	11	p	3	p	7	3	p	p	3	p	p
27	61	3	p	p	3	11	p	3	37	p	3	7	67	3	19	p	3	31	7	3
29	167	p	3	7	p	3	19	p	3	p	7	3	13	71	3	p	67	3	p	p
31	3	11	7	3	257	37	3	p	23	3	167	p	3	17	p	3	7	19	3	13
33	13	3	23	107	3	p	53	3	7	19	3	p	p	3	17	7	3	p	p	3
37	3	13	193	3	173	211	3	p	p	3	97	p	3	7	13	3	17	11	3	37
39	17	3	31	29	3	7	p	3	13	p	3	p	7	3	p	11	3	17	p	3
41	p	17	3	43	7	3	p	293	3	163	p	3	p	11	3	13	37	3	7	139
43	3	p	17	3	p	p	3	19	97	3	7	11	3	41	77	3	p	7	3	17
47	p	7	3	p	17	3	23	11	3	p	13	3	61	p	3	7	251	3	11	89
49	3	61	19	3	13	11	3	7	p	3	37	p	3	p	7	3	11	13	3	127
51	71	3	p	11	3	139	7	3	41	53	3	13	p	3	11	p	3	23	31	3
53	31	11	3	59	p	3	47	17	3	p	p	3	7	73	3	113	227	3	13	7
57	p	3	p	7	3	67	13	3	11	17	3	229	p	3	271	29	3	7	61	3
59	13	103	3	41	p	3	11	61	3	7	17	3	p	13	3	p	7	3	p	19
61	3	7	97	3	11	p	3	13	7	3	23	17	3	67	79	3	p	p	3	p
63	7	3	11	19	3	p	p	3	109	p	3	53	17	3	7	p	3	67	37	3
67	3	89	13	3	p	7	3	283	p	3	157	131	3	p	17	3	p	p	3	7
69	281	3	p	p	3	241	p	3	p	13	3	7	53	3	p	17	3	19	7	3
71	101	127	3	7	59	3	79	43	3	19	7	3	37	p	3	p	11	3	p	p
73	3	19	7	3	p	p	3	p	p	3	13	p	3	43	11	3	7	17	3	257
77	7	31	3	p	19	3	101	7	3	29	11	3	p	p	3	p	263	3	p	17
79	3	p	23	3	p	13	3	p	11	3	p	41	3	7	31	3	p	113	3	11
81	p	3	29	131	3	7	11	3	61	p	3	p	7	3	53	p	3	11	p	3
83	43	47	3	37	7	3	13	173	3	31	p	3	101	23	3	11	83	3	7	13
87	11	3	7	p	3	311	29	3	p	7	3	11	43	3	p	53	3	p	59	3
89	47	7	3	p	149	3	p	223	3	11	p	3	p	19	3	7	p	3	23	p
91	3	149	227	3	p	19	3	7	13	3	197	p	3	p	7	3	131	73	3	p
93	233	3	13	61	3	11	7	3	p	p	3	281	31	3	37	13	3	p	191	3
97	3	11	p	3	7	p	3	31	p	3	41	7	3	p	p	3	13	23	3	19
99	263	3	p	7	3	43	229	3	p	p	3	19	109	3	29	137	3	7	283	3

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INDEFEISIBLE, in our Law, signifies what cannot be defeated or made void: As a Good and Indefeisible Estate.

INDEMNITIES. When a Church is Appropriate 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 Pension, 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, without Partition. *Kitchin*, fol. 241. in these Words; 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 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 thereby to be *Inducted* into his Living: And if he be refused *Induction*, 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 *Inductor*, or Person to be Inducted, be kept out of the Church or House by Lay-Men, the Writ *de Vi Laicâ* 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 *Induction* is, for the *Inductor* 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 Induct you into the Real, Actual, and Corporal Possession of the Rectory or Vicarage of* A. *with all its Fruits, Profits, Members, and Appurtenances.* This done, he opens the Door, and puts the Clerk in Possession of the Church, and shuts the Door upon him; who, after he hath tolled a Bell (if there be any) comes out, and desires the *Inductor* to indorse a Certificate of his *Induction* on the Arch-Deacon's Warrant, and that all present will signify 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 *Induction*; only that he must have Witness that he was truly possess'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 Assent and Consent; and he must then also read the Bishop's *English Certificate*, in which is the Declaration of his Conformity; and of all this he must have two or three good Witnesses; who must Sign that they heard him do it, and be ready to attest it *vivâ voce*, if required: And within three Months after *Induction* 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*, so called, because they are next the Sun, the Centre of the Planetary System. An Account of their Motion and *Phænomena* 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 contrary 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 *Mercury*, be considered 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 Superior and Inferior Planets is not from any real *Difference* in their Motions, but arises solely from the different Position 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 *slower*, and sometimes *swifter*; now to be *stationary*, and now *retrograde*; 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.

2. The *Sun*, *Venus* and *Mercury*, singly considered, 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 since 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 the Year are thus accurately equal to one another; yet the Periodic Times of *Venus*, if reckon'd

 from

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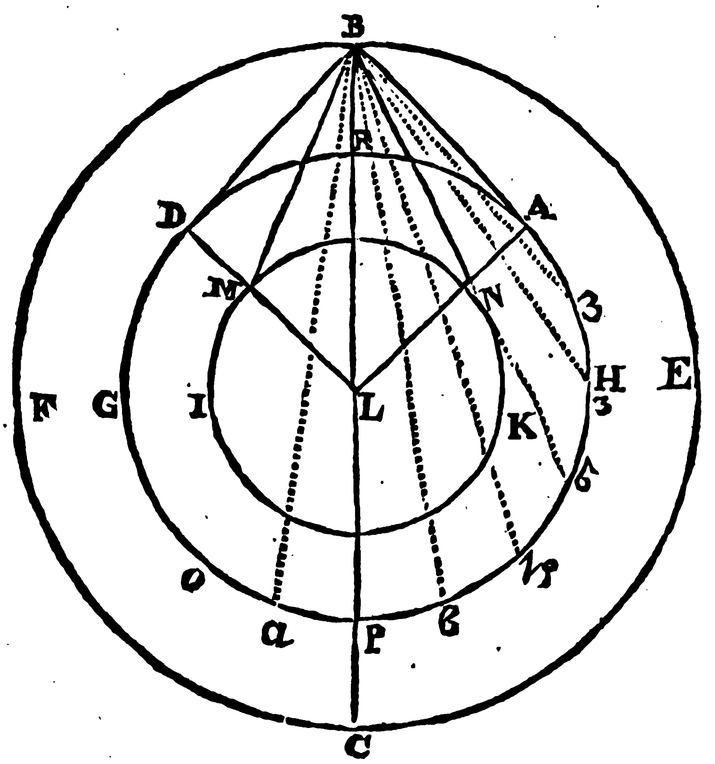
from any one present Position to the Sun, to a like subsequent one, if compared with the Periodic Times of *Mercury* in a like Position, will appear to be of a much longer Length.

For this Inequality of the Periodic Times, according 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 Periodic Times of *Venus*, considered 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 Spectator at the Earth, he would find in them the same Inequality: For the Motion of *Mercury* will be sooner, and oftner *more swift*, 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 *Phænomena*: 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. Now the Quantity of these Angles, in a Proportion assign'd, may be had from the Semidiameters of the Orbits being found by Observation, and by Trigonometrical 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 been observed of *Mercury*, by the use of long and good Telescopes.

These *Phænomena* 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, since 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 considered *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 seen: But when she comes into the Position *D*, then

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 since 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 Half-Moon. When she comes into the Position 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* designs, 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 *Phænomena* 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 Consideration 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 *Distance* 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 since 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 seeing 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 make her Splendour increase. But between *A* 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, 'till she will set *Heliacally*, and so become invisible. Thus also 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 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 *H A*; she 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 *Phænomenon* hath a double Original or Cause; for it depends on the Excentricity of the Orbits both of *Venus* and of the Earth. For if the Distance *L A* (in the former *Fig.*) of *Venus* from the Sun; or if *L B*, the Distance of the Earth from the Sun, be unequal; it cannot be, but that the Angle *L B A*, in the Triangle *L B A*, which is called the greatest Elongation, must also 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*; 'tis then plain, that while the Planet moves Easterly from *P* to *Q*, to an Eye placed in *B*, it must appear *Direct*, 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 β*, *β γ*, *δ ε*, *ε ζ*, 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 seem 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 *A R*, it will meet with the former Lines *B ζ*, *B ε*, *B δ*, *B γ*, 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 before.

And should you suppose the Earth, as it is, moving in the Orbit *B F C E*; 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 *slower* 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 stood still: As will be easily understood by a little Consideration 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 *Phænomena* 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 therefore

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fore will be ſubject to the greateſt Anomalies of Latitude.

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.

INFINITELY *Infinite Fractions*. In *Phil. Collect.* N. 3. Dr. *Rihood* proves that *Infinitely Infinite Fractions*, or all the Powers of Fractions, whoſe 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 notwithſtanding 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.

Let $\begin{cases} A = \text{to the Abſolute Numb. in any Equation.} \\ n = \text{to the Exponent of the higheſt Power.} \\ x = \text{to Root or Quantity ſought.} \\ N = \text{any known Number taken at pleaſure.} \\ n = \text{an unknown Number.} \\ 1, p, q, r, s, \&c. = \text{to the reſpective Coefficients of the given Equation.} \end{cases}$

Then will $N + n = x$; and $\mp 1 \times x^n \mp p \times x^{n-1} \mp q x^{n-2} \mp r \times x^{n-3} \mp, \&c. = A$, repreſent any Equation whatſoever.

And becauſe $N + n$ is ſuppoſed equal to x, ſuch a General Equation may be thus expreſſed:

$$\mp 1 \times \overline{N+n}|^{n} \mp p \times \overline{N+n}|^{n-1} \mp q \times \overline{N+n}|^{n-2} \mp r \times \overline{N+n}|^{n-3} \mp, \&c. = A.$$

But to bring this into a *Series*, it is neceſſary firſt to prove, That every Power raiſed from a Binomial, (without regarding the Co-efficients) conſiſts, or is compoſed of two Ranks or *Series* of Powers; one increaſing from n^{n-n}, or 1, to n^n, and the other decreaſing from N^n to N^{n-1} or 1; and each Member in one is multiplied into its correſponding Member in the other reſpectively; as may appear thus:

$$\overline{N+n}^2 = \begin{Bmatrix} NN \\ 2\,Nn \\ nn \end{Bmatrix} = \begin{Bmatrix} N^n \times n^{n-n} \text{ or } 1. \\ N^{n-1} \times n^{n-1} \text{ twice} \\ N^{n-n} \times n^n \end{Bmatrix}$$

Again,

$$\overline{N+n}^3 = \begin{Bmatrix} NNN \\ 3NNn \\ 3Nnn \\ nnn \end{Bmatrix} = \begin{Bmatrix} N^n \times n^{n-n} \\ N^{n-2} \times n^{n-2} \\ N^{n-2} \times n^{n-} \\ N^{n-n} \times n^n \end{Bmatrix} \text{thrice}$$

And ſo it will always be *ad Infinitum*. *Q. E. D.* Hence theſe two *Corollaries*.

COROLLARY I.

That the Co-efficient of the ſecond Term in any Power raiſed from a *Binomial*, is always $= n$ the Exponent of the higheſt Power.

COROLLARY II.

That the Root or Side of n^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;

$$\pm 1 \times \overline{N^n \pm {}_n N^{n-1} n} \pm p \times \overline{N^{n-1} \pm {}_{n-1} N^{n-2} N} \pm q \times N^{n-2} \pm {}_{n-2} N^{n-2} n \pm r \times \overline{N^{n-3} \pm {}_{n-3} N^{n-4} n} \pm, \&c. = A.$$

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 with contrary Signs, as being to be tranſpos'd to the other ſide of the Equation: Therefore firſt,

$$n = \frac{A \pm 1 \times N^n \mp p \times N^{n-1} \pm q \times N^{n-2} \pm r \times N^{n-3}, \&c.}{1 \times {}_n N^{n-1} \pm p \times {}_{n-1} N^{n-2} \pm q \times {}_{n-2} N^{n-3} \pm r \times {}_{n-3} N^{n-4}, \&c.}$$

Which

Which Theorem exhibits all possible particular ones, for extracting of Roots, according to the first sort 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 sort* universally: 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.

Now from either of these *two Generals*, to deduce any *particular Theorem*, for finding the *Root* of any *given Equation*; we need only consider, that $N^{n-n} = 1$, or $\frac{N^n}{N^n} = 1$, that Unity will neither multiply nor divide; as also that ${}_{n-n}N^{n} = 0$, or ${}_{n}N^{n} - {}_{n}N^{n} = 0$, and any Quantity, multiply'd into 0, is $= 0$; and when either Case happens (which always will, except where the last Term is wanting) the *Theorem* is determined.

Therefore,

Suppose any Equation, as	Then we shall find $n =$ *By the first General Theorem*,	$x =$ *By the second General Theor.*
$x^2 = A$	$\frac{A - N^2}{2N}$	$\frac{A + N^2}{2N}$
$x^3 = A.$	$\frac{A - N^3}{3N^2}$	$\frac{A + 2N^3}{3N^2}$
$x4 = A.$	$\frac{A - N^4}{4N^3}$	$\frac{A + 3N^4}{4N^3}$
$x^2 \pm px = A$	$\frac{A - N^2 \mp pN}{2N \pm p}$	$\frac{A + N^2}{2N \pm p}$
$-x^2 \pm px = A$	$\frac{A + N^2 - pN}{-2N + p}$	$\frac{A - N^2}{-2N + p}$
$x^4 \pm px^3 = A$	$\frac{A - N^4 \mp pN^3}{4N^3 \pm 3pN^2}$	$\frac{A + 3N^4 \pm 2pN^3}{4N^3 \pm 3pN^2}$
$x^3 \pm px^2 \pm qx = A$, &c.	$\frac{A - N^3 \mp pN^2 \mp qN}{3N^2 \pm 2pN \pm q}$	$\frac{A + 2N^3 \pm pN^2}{3N^2 \pm 2pN \pm q}$

And after the same manner for any *Equation* whatsoever.

Thus having the particular *Theorem*, the *Application* in either Case is as follows:

Let *N* be any *Number* taken at Pleasure, as before.

T be = *Theorem*, in which *N* must always be of its last Value found.

Then the Process will be of the

First General Theorem.	*Second General Theorem.*
N the 1st. $\pm T =$ *N* the 2d. Then	$T =$ *N* the 2d. Then
N the 2d. $\pm T =$ *N* the 3d. Then	$T =$ *N* the 3d. Then
N the 3d. $\pm T =$ *N* the 4th. Then	$T =$ *N* the 4th. Then
N the 4th. $\pm T =$ *N* the 5th, &c.	$T =$ *N* the 5th, &c.

Some of which Values of *N* will terminate in the true Root sought, if it have one: But if it be a Surd; then the Value of *N* will proceed into an *Infinite Series*, but may be prosecuted nearer the Truth than any assignable: Which *Series*, each *Operation*, will proceed in *Number of Places*, in a *Geometrical Progression*; whose first Term is 1, and *Ratio* = 2, *Viz.* First 1, then 2, then 4, then 8, then 16, then 32, &c. Places.

It is likewise observable, That the *first* General Theorem *converges*, by finding out a *Number* to be added to, or subtracted from the *last* Value of *N*, (as it shall be affected with + or −) until *N* be = *x* sought. So the *last converges* by *N* itself,

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self, whose Value, at each Operation, shall grow nearer and nearer, until it be = to x sought.

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 *Adfection*: 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;

$$\text{Viz. } xxx + 25xx + 836x = 53297$$
$$\text{Or } xxx + pxx + qx = A.$$

Then it would be $xxx + \dot{2}5xx + 8\dot{3}6x = 53\dot{2}97$
For the *absolute Numb.* is a Cube, *Co-efficients* q a Square, p a Lateral; and are *pointed 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* $xxx + 2xx + 8x = 53$
Second 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 $n = \dfrac{A - A^2}{2N} = T$, and take $N = 1$;

Therefore $1 + T(= ,5) = 1,5 = N$ the 2d.
∴ $1,5 - T(= -,083) = 1,417 = N$ the 3d.
∴ $1,417 - T(= -,002783) = 1,414217 = N$ the 4th.
∴ $1,414217 - T(= -,000003437622) = 1,41421356237\dot{8} = N$ the 5th $= x$.

2. Suppose $xx = 2 = A$. Seek x by the second General Theorem.

Then $x = \dfrac{A + N^2}{2N} = T$, and take $N = 1$, as before.

Therefore $T = 1,5 = N$ the 2d.
∴ $T = 1,416 = N$ the 3d.
∴ $T = 1,414215 = N$ the 4th.
∴ $T = 1,4142135623 73 = N$ the 5th. $= x$.

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 $xxxx = 2839,8241 = A$. Seek x by Theorem 1.

Then $n = \dfrac{A - N^4}{3N^3} = T$, and take $N = 10$.

Therefore $10 - T(= -3) = 7 = N$ the 2d.
∴ $7 + T(= +,4) = 7,4 = N$ the 3d.
∴ $7 - T(= -,1) = 7,3 = x$, the true Biquadratick Root sought.

4. Suppose $xxxx = 2839,8241 = A$, as before. Seek x by the second Theorem.

Then $x = \dfrac{A + 3N^4}{4N^3} = T$, 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* sought.

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 $xx + \dot{5}8\dot{7}x = 9\dot{8}7\dot{4}5\dot{9}$ or $xx + px = A$. Seek x by *Theor.* 1. (*i. e.*) $n = \dfrac{A - N^2 - pN}{2N + p} = T$.

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.
∴ $78 - T(= -3,4) = 746 = N$ the 3d.
∴ $746 - T(= -3,34) = 742,66 = N$ the 4th.
∴ $742,66 - T(= -,012689) = 742,647311 = x$ sought.

6. Suppose $xx - 20x = 53482$, or $xx - px = A$. Seek x by the second General Theorem.

Then $x = \dfrac{A + N^2}{2N - p} = T$, 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. $= x$ sought.

From these two last it is plain; *First*, That there is no absolute Necessity for Punctation. *Secondly*, That Punctation does nevertheless *shorten* the Work, where it can be done.

But

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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 *affected* 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.

INFINITESIMALS, (as 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 *Phænomenon.*

1. That in a well darken'd Room, a Hole, whose Diameter was $\frac{1}{42}$ 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 had 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, *viz.* 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, $1, \sqrt{\frac{1}{3}}, \sqrt{\frac{1}{5}}$; and their Intervals in the same Proportion with them; *i. e.* the Fringes and their Intervals together to be in the continued Progression of $1, \sqrt{\frac{1}{3}}, \sqrt{\frac{1}{5}}, \sqrt{\frac{1}{7}}$, or thereabouts.

5. The Sun shining into a darkened Room thro' a Hole $\frac{1}{4}$ of 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 $\frac{3}{4}$ of an Inch square for the Light to pass through. Behind the Hole, on the Pastboard, he fastned 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.

6. He placed another by the former; so that 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 *least 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 mentioned 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 Knife 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 *Streams* 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; 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 to that made by the Edges

Edges of the Knives, where they met and join'd without crossing. 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 border'd 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, *acts alike* 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 Actions* dispos'd the *Red* Light into larger, and the *Violet* into smaller, and the Lights of intermediate Colours into Fringes of intermediate Bignesses, *without changing the Colour* of any sort of Light. When therefore the Hair, in the first 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, composed the *White Beam* of the Sun's Light; but, whenever separated, compose Lights of the several Colours which they are originally dispos'd to exhibit. And this mightily confirms his Doctrine and Theory of Colours, as indeed all kinds of Experiments and Considerations do. See *Colours*.

These wonderful Properties of the *Inflection of the Rays of Light* are caused by a Body acting at a distance on the Rays; and yet this Action of *Inflection* 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 *inflected*, and separated into those *three Fringes* of Colours mention'd by Sir *Is. Newton* in his excellent *Opticks*, *Lib.* 3. and before observed by *Grimaldus* 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 *Fimbriæ*, 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 signify the Freeholders, or Commonalty of the Kingdom, which were called *Ingenui*, *Liberi*, and *Legales Homines*: But the Word was not restrained only to *Plebeians*; since 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 *Grosse*, is a Term in Law for what belongs to the *Person* of any Lord, and not to the Manor, Lands, &c. as a *Villain in Grosse*, an *Advowson in Grosse*, &c.

INHOC, the same antiently with what is now in the North called an *Intock*; and in *Oxfordshire*, 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 fenced 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 *Doomsday* and other old Books, and signified 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*, *Demesnes*, in opposition to *Utland* or *Outland*, which was in Tenancy. These *Inlands* the Feudists call *Terras Curtis*, *ac intra Curtem*, *Court Lands*, or such as were appropriated to the Court or House of the Lord. So

INLANTAL, *Inland* or Demesne, was opposed 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 *Kitchin*, 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, that the Mind can be employ'd about in Thinking.

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 κοιναὶ ἔννοιαι, 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, seems 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 Gracious

cious Creator should have furnished the Nascent Mind with them: And, secondly, 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 stampt and impress'd originally on our Minds.

To the former 'tis easy to answer; That, if the same 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 supposing them *Innate*: And if this Power can and doth exert it self early and easily, and enables us to assent to the Truth of such *useful Notions and Principles*, as soon as ever the Terms expressing 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 Refute 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 *innate* 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 *innate* 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 short such as these.

That should they argue that there are certain Principles both *speculative* and *practical*, 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 consent 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, *Whatsoever is, is: 'Tis impossible any thing should be and not be at the same time*, &c. Though these have a settled Reputation as *Maxims*, and deservedly; yet are they so far from having an universal Assent 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 *abstracted 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, '*tis there to no purpose*: Wherefore, he that hath a right Notion of the Wisdom 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.

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 whose 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 Assent as soon 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 Experience.

INORDINATE *Proportion*, is where the Order of the Terms are disturbed.

INSCRIBED *Bodies*: On *Gunter's Sector*, 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 signify the *Dodecahedron*, *Sphere*, *Icosihedron*, *Cube*, *Octahedron*, and *Tetrahedron*.

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 in it.*

2. *The Side of any of the Five Regular Bodies given, to find the Radius of the Circumscribing 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 *Aristotle* and *Pliny*; because of their having certain *Incisuræ*, Cuttings or Indentings, in and about their Bodies. The *Greeks* called them Ἔντομα. The Judicious Mr. *Ray* in his *Methodus Insectorum* thus distinguishes the several Kinds of *Insects*.

Insects are (1.) either Ἀμεταμόρφωτα, or such as do *not* change their Form; Or, (2.) Μεταμορφούμενα, such as do really change their Form.

Those that do not change their Form are either (1.) Ἄποδα without Feet, or (2.) *Pedata* with Feet; and of these there are some Kinds that cast their Skins.

Insects without Feet are either *Terrestrial*, or *Land Insects*, or *Aquatick*.

Terrestrial Insects are either such as are produced on the *Land*, or in the *Earth*; and not in the *Water*; as the *Lumbrici Terrestres*; which are either of the *larger sort*, and are called *Dew-Worms*; or of a *smaller size*: 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 *Tæniæ*. (3.) *Cucurbitini*, which some will have to be only the Fragments of the *Tæniæ*: (See *Nich. Andri M. D. De Variis Vermium Speciebus.*) (4.) The *Ascarides*, which are chiefly found in the *Rectum*.

Those Worms that are found in the Intestines of Beasts are of two sorts, the *Oblongi* and *Pellucidi*, of the thickness of a Horse-Hair; and therefore called *Vermiculi Setiformes*: And the *Breves* and *Crassiores*, which often are found in Horses, and are called the *Botts*.

To this *Genus* of *Terrestrial Insects* many Natural Historians refer *Snails*, whether with or without Shells.

Water Insects without Feet, not changing Form, are either of the

Greater sort, 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 sorts; As the *Medicinal Hirudines*, or *Leaches*; the *common Black-Horse-Leaches*, and the *Ash-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 sort* 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 six Feet; (2.) *Octapoda*, with eight Feet; (3.) with fourteen Feet; (4.) *Polypoda*, with many Feet.

Those that have but six Feet are either,

1. *Terrestrial*; and these of a *Larger kind*; As (1.) The Yellowish *Insect* found in rotten decaying Oaks; (2.) The Black one on the Ground, called by *Mouffet*, *Vermivorous*; (3.) The Black one living under Ground, with a Forceps at the Tail; (4.) A White sort, with square black Spots on its Back; (5.) The *Farinarium*, bred in Meal, of a whitish Colour.

Smaller sort: Some of which are found about the Bodies of *Animals*; As (1.) the *Cimex*, or *Wall-Louse*, of a stinking Smell; (2.) *Ricinus*, 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; as (1.) One that in Bigness 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 Insect*, found often in the Flowers of the *Chelidonium*; (4.) A Subterraneous sort, a little whitish; (5.) One that skips like a Grashopper, but is much less.

2. *Aquatick*. As (1.) the *Pediculus Marinus Grandis*, 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, Grass, &c.

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 adhere to the Skin.

3. The *Syrones* or Mites.

Insects not changing Form, and with fourteen Feet, and therefore by Mr. *Ray* called Τεσσαρεσκαιδεκάποδα, are the *Aselli*: Of which there are three sorts: As,

1. The *Sea-Asellus*; 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.

3. *Asellus Asininus*, with a forked Tail, not rolling itself up. To this Species may be added the *Asellus Marinus Figuræ brevioris*, rolling itself up; (2.) *Asellus Aquarum dulcium*, with long Legs, and two Bristles 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 the Rocks by the Sea-sides; the other of a Silver Colour, found in Houses.

There

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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 πολύποδα) 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 rising 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 *Cornish 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.

Insects which do really undergo a Change of their Form are called Μεταμορφούμενα; of which *Swammerdam* hath given the best Account: Tho' he shews that this Word is improperly used, since 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 Insects 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 subsisted 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 sort are,

1. The *Libellæ*, or *Perlæ*, which are produced from an *Insect* of six 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 Fissure, which begins between the Eyes, and is continued to the Roots of the Wings, and is there join'd to the Lateral Fissures.

2. The *Cimices Silvestres*, whose Characteristick Marks (according to *Willoughby*) are (1.) A long *Proboscis*, not spiral, but strait; (2.) Their upper 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 *Locustæ*; which *Willoughby* refers to the *Insecta* Αμεταμόρφωτα.

4. The *Grylli Campestres*.

5. The *Grylli Domestici*, or *Crickets*.

6. The *Gryllo Talpa*, *Mole Cricket*.

7. The *Cicada*, or *Grasshopper*.

8. The *Blatta*, according to *Swammerdam*.

9. The *Tipulæ Aquaticæ*, which run very swiftly on the Surface of the Water, and have a Sting in their Mouths like the *Cimices* or *Ticks*.

10. The *Scorpius Aquaticus*, with a Sting also in its Mouth.

11. The *Muscæ Aquaticæ*; called by *Androvandus*, *Apes Amphibiæ*.

12. The *Hemerobius*, or *Ephemera*, or *Diaria*, of *Swammerdam*.

13. The *Forficula*, or *Auricularia*. *Vid. Mouffet*, p. 175.

The *Second Species* of Transmutation includes such *Insects* as undergo a double Metamorphosis, or Change of Shape.

1. Into a *Chrysalis*, or something analogous to it.

2. Into a Flying *Insect*.

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. Κολεόπτερα, or *Vaginipennia*, as the *Scarabæi*, *Beetles*.

2. Ἀνέλυτρα, whose Wings are open and expanded: And the Wings of these are either *Farinaceous*, as the *Papiliones*, &c. or *Membranous*, as the *Apes*, *Muscæ*, &c. and these are either Δίπτερα, with two Wings, or Τετράπτερα, with four Wings.

The *Scarabæi* may be divided (1.) In respect of their Horns, into the *Nasicornis*, *Bucerota* and *Cervus Volans*, or *Taurus*. (2.) In respect of their *Antennæ*, 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* ἡμικολεόπτερος: The

Proscarabæus, or *Oyl-Beetle*; so called from its emitting from its Joints a kind of Oyl, on its being pressed or squeezed.

The *Anelytra*, with farinaceous or mealy Wings, are called *Papiliones*, *Butter-flies*; and these are either *Diurnal*, or *Nocturnal*, or the *Phalæna*.

The Specifick Distinction of the *Diurnal* is, that they always settle with their Wings erect; are produced from an angulous *Aurelia*, and have their *Antennæ Studded* (*Clavatæ*.) Of these there are about 50 kinds observed in *England*.

The *Nocturnal* Butterflies, or the *Phalænæ*, are vastly numerous; and cannot very clearly be methodized. But for Memory and Distinction's sake they may be divided into,

1. The *Geometrigenæ*, 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 *Erucæ*, with 14 Feet. Of this Kind, which is very numerous, there hath been distinguished the *Phalæna Fasciata*; whose Wings are in *Patches* or *Area's* of different Colours. *Phalæna Lineata*, whose Wings are marked with transverse Lines. *Phalæna Punctata*, 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 middle size between both. One of the larger Kinds may be distinguish'd also by their inner Wings running out beyond the upper, when they sit or rest:

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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 *Phalenæ Prædatrices*, or *Accipitrinæ*.

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 *Festucæ*, lying parallel one to another; of which there are two kinds; a Greater, where the *Festucæ* are two Inches long; and a Lesser, which is very common, and are called *Straw-Worms*: Or else the *Festucæ* lie transversely, and are shorter; having sometimes pieces of Shells and Stones intermix'd with them. Others, whose Cases are *strait* also, have no *Festucæ*; but always either Sand or Gravel. And of these, some have the *Thecæ round*, and are called *Cod-Baits*: Others are *flat* and *compressed*.

2. *Crooked* or *Horned*; which run tapering. Of these Mr. *Ray* reckons four kinds; a greater and lesser Black sort, 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 simple Change from a *Vermiculus* to a flying *Insect*; but yet with a sensible *αστρία*, *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 with-"out; and under that *first Skin* or Covering hath "its Members increased by degrees; not flipping "it, or putting it off, as other *Vermiculi* do when "they change into *Nymphæ*, but assuming the "Figure of a *Nympha* in it; For a time 'tis quite "motionless, till the superfluous Moisture is eva-"porated, 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 Flie."

Of this Kind are our *Flesh-Flies*; and all the *Nymphæ Vermiformes*; the *Vespæ Ichneumones*, &c.

As to the *Generation* of *Insects*, Dr. *George Gordon*, in *Philos. Transact.* N°. 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 Ovo*, only because we cannot discern 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-flies 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 *Insects* 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 *Insects* 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 believed also that *Insects* had no *Hearts*; whereas our Microscopes do now discover, that when *Insects* 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 Parts. He observes also that 'tis wrong to call *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 full 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 *J. Swammerdam. Ultraject.* 1669. 4to.

Joh. Goedartius de Insectis cum Appendice. By Dr. *Lister.* 1682. 4to.

Malpighius de Bombyce.

Experienze intorno alla Generatione de gl' Insetti. By *Fr. Redi.* 1668. 4to.

Mouseti 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 Anatomica de Cochleis & Limacibus. Lond.* 1694. 8vo.

INSINUATION *of a Will*, in the Civil Law, signifies the first Production of it, or the leaving it *Penes Registrum*, in order to his Probate.

INSTALLMENT, is a Settlement or sure Placing of any Person in his proper Place: See 20 *Car.* 2. *c.* 2. 'Tis sometimes confounded in the Law with Abatement: The Word is chiefly used for the Induction of a Dean, Prebendary, or other Ecclesiastical Dignitary, into the Possession of his *Stall*, or Proper Seat, in the Cathedral Church

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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 Ecclesiæ* was used for the Books, Vestments, and Utensils belonging to a Church. And *Instaurata 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 Vicarage.

The Clerk kneels down before the Bishop while he pronounces the Words of *Institution*, (*Instituo te Rectorem Ecclesiæ 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 he 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 *Can.* 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, &c. and therefore he should desire some present to write their Names on the Back of his Instruments; and make *Memorandums* 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 enter upon the Glebe, and take the Tithes; but he cannot *Lett* or *Grant* them; nor *Sue* 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 *Insult* thus the *Counterscarp* 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, So much remains *Insuper* to such an Accountant: That is, So much remains due on such an Account.

INTAGLIO'S, are Precious Stones engraved with Heads of Great Men, or Inscriptions, &c. such as are often set 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 Hawk and Buzzard*. In *Herefordshire* '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 inflicted 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.* 12.

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.

SHILLINGS,

Shillings, Pence, and Farthings, reduc'd to the Decimal Parts of a Pound.

s.	d.	Decimal Parts of a Pound.	s.	d.	Decimal Parts of a Pound.	s.	d.	Decimal Parts of a Pound.	s.	d.	Decimal Parts of a Pound.
—	—	—	—	—	—	-1	-2¼	.059375	-1	-9½	.089583
—	—¼	.001042	—	-7¼	.030208	-1	-2½	.060417	-1	-9¾	.090625
—	—½	.002083	—	-7½	.03125	-1	-2¾	.061458	-1	10	.091667
—	—¾	.003125	—	-7¾	.032292	-1	-3	.0625	-1	10¼	.092708
—	-1	.004167	—	-8	.033333	-1	-3¼	.063542	-1	10½	.09375
—	-1¼	.005208	—	-8¼	.034375	-1	-3½	.064583	-1	10¾	.094792
—	-1½	.00625	—	-8½	.035417	-1	-3¾	.065625	-1	11	.095833
—	-1¾	.007292	—	-8¾	.036458	-1	-4	.066667	-1	11¼	.096875
—	-2	.008333	—	-9	.0375	-1	-4¼	.067708	-1	11½	.097917
—	-2¼	.009375	—	-9¼	.038542	-1	-4½	.06875	-1	11¾	.098958
—	-2½	.010417	—	-9½	.039583	-1	-4¾	.069792	-2	—	.1
—	-2¾	.011458	—	-9¾	.040625	-1	-5	.070833	-3	—	.15
—	-3	.0125	—	10	.041667	-1	-5¼	.071875	-4	—	.2
—	-3¼	.013542	—	10¼	.042708	-1	-5½	.072917	-5	—	.25
—	-3½	.014583	—	10½	.04375	-1	-5¾	.073958	-6	—	.3
—	-3¾	.015625	—	10¾	.044792	-1	-6	.075	-7	—	.35
—	-4	.016667	—	11	.045833	-1	-6¼	.076042	-8	—	.4
—	-4¼	.017708	—	11¼	.046875	-1	-6½	.077083	-9	—	.45
—	-4½	.01875	—	11½	.047917	-1	-6¾	.078125	10	—	.5
—	-4¾	.019792	—	11¾	.048958	-1	-7	.079167	11	—	.55
—	-5	.020833	-1	—	.05	-1	-7¼	.080208	12	—	.6
—	-5¼	.021875	-1	—¼	.051042	-1	-7½	.08125	13	—	.65
—	-5½	.022917	-1	—½	.052083	-1	-7¾	.082292	14	—	.7
—	-5¾	.023958	-1	—¾	.053125	-1	-8	.083333	15	—	.75
—	-6	.025	-1	-1	.054167	-1	-8¼	.084375	16	—	.8
—	-6¼	.026042	-1	-1¼	.055208	-1	-8½	.085417	17	—	.85
—	-6½	.027003	-1	-1½	.05625	-1	-8¾	.086458	18	—	.9
—	-6¾	.028125	-1	-1¾	.057292	-1	-9	.0875	19	—	.95
—	-7	.029167	-1	-2	.058333	-1	-9¼	.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.* ½.

Note, If you cannot find in the Table the exact Decimal sought 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 Business 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 6 *l.*

		l.	*s.*	*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.*
.05 the Hundredth part of 5 Pounds.

7.89375 which is the Decimal answering to 7 *l.* 17 *s.* 10 ½ *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 .01 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 Cent.*

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. ?

```
 .00002739726028
             150
 ---------------
   4109589042000
             365
 ---------------
 15000000000330000
               6
 ---------------
9.000000001980000
```

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 2 *per Cent.* 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	.00002739726 &c. as above.
2 ———	.00005479452
3 ———	.00008219178
4 ———	.00010958904
5 ———	.00013698630
6 ———	.00016438356
7 ———	.00019178082
8 ———	.00021917808
9 ———	.00024657534
10 ———	.00027397260
	&c.

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, &c. gives the Interest of any Sum of Money, at the same Rate.

Take an Example at 3 l. per Cent.

Interest of 1 *l.* for one Day, is	.00008219178
2 ———	.00016438356
3 ———	.00024657534
4 ———	.00032876712
5 ———	.00041095890
6 ———	.00049315068
7 ———	.00057534246
8 ———	.00065753424
9 ———	.00073972602

And then 'tis easy to find, that the Interest of 1 *l.* being, as before, .000082, &c. That of

10 will be	.000822*
100 ———	.008219
1000 ———	.082192*.
10000 ———	.821918*
100000 ———	8.219178
1000000 ———	82.191781

Because moving the Point of Separation still one Place nearer to the Left Hand, multiplies any Decimal by 10, 100, 1000, &c. as is shewn under *Decimals.*

And thus the following Tables of *Daily Interest* were made.

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 fewer 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

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INTEREST for One Day, at 3, 4, 5, and 6 Pound *per Cent. per Annum.*

At 3 l. per Cent. per An.		*At 4 l. per Cent per An.*		*At 5 l. per Cent. per An*		*At 6 l. per Cent. per An.*	
Principal.	Intereſt.	Principal.	Intereſt.	Principal.	Intereſt.	Principal.	Intereſt.
10000000	821.9178	10000000	1095.8904	10000000	1369.8630	10000000	1643.8356
9000000	739.7260	9000000	986.3014	9000000	1232.8767	9000000	1479.4521
8000000	657.5342	8000000	876.7123	8000000	1095.8904	8000000	1315.0685
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	246.5753	3000000	328.7671	3000000	410.9589	3000000	493.1507
2000000	164.3836	2000000	219.1781	2000000	273.9726	2000000	328.7671
1000000	82.1918	1000000	109.5890	1000000	136.9863	1000000	164.3836
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
600000	49.3151	600000	65.7534	600000	82.1918	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	24.6575	300000	32.8767	300000	41.0959	300000	49.3151
200000	16.4384	200000	21.9178	200000	27.3973	200000	32.8767
100000	8.2192	100000	10.9589	100000	13.6986	100000	16.4384
90000	7.3973	90000	9.8630	90000	12.3288	90000	14.7945
80000	6.5753	80000	8.7671	80000	10.9589	80000	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	50000	5.4795	50000	6.8493	50000	8.2192
40000	3.2877	40000	4.3836	40000	5.4795	40000	6.5753
30000	2.4658	30000	3.2877	30000	4.1096	30000	4.9315
20000	1.6438	20000	2.1918	20000	2.7397	20000	3.2877
10000	.8219	10000	1.0959	10000	1.3699	10000	1.6438
9000	.7397	9000	.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	.4110	5000	.5479	5000	.6849	5000	.8219
4000	.3288	4000	.4384	4000	.5479	4000	.6575
3000	.2466	3000	.3288	3000	.4110	3000	.4932
2000	.1644	2000	.2192	2000	.2740	2000	.3288
1000	.0822	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	.0767	700	.0959	700	.1151
600	.0493	600	.0658	600	.0822	600	.0986
500	.0411	500	.0548	500	.0685	500	.0822
400	.0329	400	.0438	400	.0548	400	.0658
300	.0247	300	.0329	300	.0411	300	.0493
200	.0164	200	.0219	200	.0274	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	.0058	70	.0077	70	.0096	70	.0115
60	.0049	60	.0066	60	.0082	60	.0099
50	.0041	50	.0055	50	.0068	50	.0082
40	.0033	40	.0044	40	.0055	40	.0066
30	.0025	30	.0033	30	.0041	30	.0049
20	.0016	20	.0022	20	.0027	20	.0033
10	.0008	10	.0011	10	.0014	10	.0016
9	.0007	9	.0010	9	.0012	9	.0015
8	.0007	8	.0009	8	.0011	8	.0013
7	.0006	7	.0008	7	.0010	7	.0012
6	.0005	6	.0007	6	.0008	6	.0010
5	.0004	5	.0005	5	.0007	5	.0008
4	.0003	4	.0004	4	.0005	4	.0007
3	.0002	3	.0003	3	.0004	3	.0005
2	.0002	2	.0002	2	.0003	2	.0003
1	.0001	1	.0001	1	.0001	1	.0002

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INTEREST for One Day, at 7, 8, 9, and 10 Pound *per Cent. per Annum.*

At 7 l. per Cent. per An.		*At 8 l. per Cent per An.*		*At 9 l. per Cent. per An.*		*At 10 l. per Cent. per An.*	
Principal.	Intereft.	Principal.	Intereft.	Principal.	Intereft.	Principal.	Intereft.
10000000	1917.8082	10000000	2191.7808	10000000	2465.7534	10000000	2739.7260
9000000	1726.0274	9000000	1972.6027	9000000	2219.1781	9000000	2465.7534
8000000	1534.2466	8000000	1753.4247	8000000	1972.6027	8000000	2191.7808
7000000	1342.4658	7000000	1534.2466	7000000	1726.0274	7000000	1917.8082
6000000	1150.6849	6000000	1315.0685	6000000	1479.4521	6000000	1643.8356
5000000	958.9041	5000000	1095.8904	5000000	1232.8767	5000000	1369.8630
4000000	767.1233	4000000	876.7123	4000000	986.3014	4000000	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
800000	153.4247	800000	175.3425	800000	197.2603	800000	219.1781
700000	134.2466	700000	153.4247	700000	172.6027	700000	191.7808
600000	115.0685	600000	131.5068	600000	147.9452	600000	164.3836
500000	95.8904	500000	109.5890	500000	123.2877	500000	136.9863
400000	76.7123	400000	87.6712	400000	98.6301	400000	109.5890
300000	57.5342	300000	65.7534	300000	73.9726	300000	82.1918
200000	38.3562	200000	43.8356	200000	49.3151	200000	54.7945
100000	19.1781	100000	21.9178	100000	24.6575	100000	27.3973
90000	17.2603	90000	19.7260	90000	22.1918	90000	24.6575
80000	15.3425	80000	17.5342	80000	19.7260	80000	21.9178
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
40000	7.6712	40000	8.7671	40000	9.8630	40000	10.9589
30000	5.7534	30000	6.5753	30000	7.3973	30000	8.2192
20000	3.8356	20000	4.3836	20000	4.9315	20000	5.4795
10000	1.9178	10000	2.1918	10000	2.4658	10000	2.7397
9000	1.7260	9000	1.9726	9000	2.2192	9000	2.4658
8000	1.5342	8000	1.7534	8000	1.9726	8000	2.1918
7000	1.3425	7000	1.5342	7000	1.7260	7000	1.9178
6000	1.1507	6000	1.3151	6000	1.4795	6000	1.6438
5000	.9589	5000	1.0959	5000	1.2329	5000	1.3699
4000	.7671	4000	.8767	4000	.9863	4000	1.0959
3000	.5753	3000	.6575	3000	.7397	3000	.8219
2000	.3836	2000	.4384	2000	.4932	2000	.5479
1000	.1918	1000	.2192	1000	.2466	1000	.2740
900	.1726	900	.1973	900	.2219	900	.2466
800	.1534	800	.1753	800	.1973	800	.2192
700	.1342	700	.1534	700	.1726	700	.1918
600	.1151	600	.1315	600	.1479	600	.1644
500	.0959	500	.1096	500	.1233	500	.1370
400	.0767	400	.0877	400	.0986	400	.1096
300	.0575	300	.0658	300	.0740	300	.0822
200	.0384	200	.0438	200	.0493	200	.0548
100	.0192	100	.0219	100	.0247	100	.0274
90	.0173	90	.0197	90	.0222	90	.0247
80	.0153	80	.0175	80	.0197	80	.0219
70	.0134	70	.0153	70	.0173	70	.0192
60	.0115	60	.0132	60	.0148	60	.0164
50	.0096	50	.0110	50	.0123	50	.0137
40	.0077	40	.0088	40	.0099	40	.0110
30	.0058	30	.0066	30	.0074	30	.0082
20	.0038	20	.0044	20	.0049	20	.0055
10	.0019	10	.0022	10	.0025	10	.0027
9	.0017	9	.0020	9	.0022	9	.0025
8	.0015	8	.0018	8	.0020	8	.0022
7	.0013	7	.0015	7	.0017	7	.0019
6	.0012	6	.0013	6	.0015	6	.0016
5	.0010	5	.0011	5	.0012	5	.0014
4	.0008	4	.0009	4	.0010	4	.0011
3	.0006	3	.0007	3	.0007	3	.0008
2	.0004	2	.0004	2	.0005	2	.0005
1	.0002	1	.0002	1	.0002	1	.0003

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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 265 l. *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 19*l.* 1*s.* 7¼*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 89	June 92	July 91	Aug. 92	Sept. 92	Oct. 92	Nov. 92	Dec. 91	Jan. 92	Feb. 92	Mar. 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
	June 151	July 150	Aug. 153	Sept. 153	Oct. 153	Nov. 153	Dec. 153	Jan. 153	Feb. 153	Mar. 151	Apr. 151	May 151
	July 181	Aug. 181	Sep. 184	Oct. 183	Nov. 184	Dec. 183	Jan. 184	Feb. 184	Mar. 181	Apr. 182	May 181	June 182
To	Aug. 212	Sep. 212	Oct. 214	Nov. 214	Dec. 214	Jan. 214	Feb. 215	Mar. 212	Apr. 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. 275	Feb. 276	Mar. 273	Apr. 274	May 273	June 273	July 273	Aug. 273	Sept. 274
	Nov. 304	Dec. 303	Jan. 306	Feb. 306	Mar. 304	Apr. 304	May 304	June 304	July 303	Aug. 304	Sept. 304	Oct. 304
	Dec. 334	Jan. 334	Feb. 337	Mar. 334	Apr. 335	May 334	June 335	July 334	Aug. 334	Sept. 335	Oct. 334	Nov. 335
	Jan. 365	Feb. 365	Mar. 365	Apr. 365	May 365	June 365	July 365	Aug. 365	Sept. 365	Oct. 365	Nov. 365	Dec. 365

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 *November*, 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 Rate* 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 at

	l.
1 *per Cent.*	.009900990099
2 — —	.019607843137
3 — —	.029126213592
4 — —	.038461538462
5 — —	.047619047619
6 — —	.056603773585
7 — —	.065420560748
8 — —	.074074074074
9 — —	.082568807339
10 — —	.090909090909

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? - - .05660;

.05660, &c. being the Discount of 1 *l.* for one Year, at the Rate of 6 *per Cent.* as above; that multiplied by 100 *l.* will produce 5.5660377, &c. Which Decimal being reduced, gives us 5 *l.* 13 *s.* 2 $\frac{1}{4}$ *d.* and no more: And therefore that is to be look'd upon as the true Discount of 100 *l.* at 6 *l. per Cent.* for one Year.

And yet nothing is more common, than to allow 6 *l.* for the Discount of 100 *l.* for a Year, at 6 *l. per Cent.* But he that doth so, certainly wrongs himself: For he ought to receive so much Money as, at 6 *l. per Cent.* Interest, will amount to 100 *l.* in one Year, which less than 94 *l.* 6 *s.* 9 $\frac{1}{2}$ *d.* will not do.

The several Discounts of 1 *l.* 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 Cent.*	.000027126000
2 ———	.000053720118
3 ———	.000079797845
4 ———	.000105374078
5 ———	.000130463144
6 ———	.000155078832
7 ———	.000179234413
8 ———	.000202942669
9 ———	.000226215911
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

1 *l.* - is —	.000079797845
2 — —	.000159595691
3 — —	.000239393536
4 — —	.000319191382
5 — —	.000398989227
6 — —	.000478787073
7 — —	.000558584918
8 — —	.000638382764
9 — —	.000718180609
10 — —	.000797978455
100 — —	.007979784546
1000 — —	.079797845458
	&c.

And after this manner the following Tables of Discount are framed.

DISCOUNT for One Day, at 3, 4, 5, and 6 Pound *per Cent. per Annum.*

At 3 l. per Cent. per An.		*At 4 l. per Cent. per An.*		*At 5 l. per Cent. per An.*		*At 6 l. per Cent. per An.*	
Principal.	Discount.	Principal.	Discount.	Principal.	Discount.	Principal.	Discount.
10000000	797.9785	10000000	1053.7408	10000000	1304.6314	10000000	1550.7883
9000000	718.1806	9000000	948.3667	9000000	1174.1683	9000000	1395.7095
8000000	638.3828	8000000	842.9926	8000000	1043.7052	8000000	1240.6307
7000000	558.5849	7000000	737.6185	7000000	913.2420	7000000	1085.5518
6000000	478.7871	6000000	632.2445	6000000	782.7789	6000000	930.4730
5000000	398.9892	5000000	526.8704	5000000	652.3157	5000000	775.3942
4000000	319.1914	4000000	421.4963	4000000	521.8526	4000000	620.3153
3000000	239.3935	3000000	316.1222	3000000	391.3894	3000000	465.2365
2000000	159.5957	2000000	210.7482	2000000	260.9263	2000000	310.1577
1000000	79.7978	1000000	105.3741	1000000	130.4631	1000000	155.0788
900000	71.8181	900000	94.8367	900000	117.4168	900000	139.5709
800000	63.8383	800000	84.2993	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	500000	65.2316	500000	77.5394
400000	31.9191	400000	42.1496	400000	52.1853	400000	62.0315
300000	23.9394	300000	31.6122	300000	39.1389	300000	46.5236
200000	15.9596	200000	21.0748	200000	26.0926	200000	31.0158
100000	7.9798	100000	10.5374	100000	13.0463	100000	15.5079
90000	7.1818	90000	9.4837	90000	11.7417	90000	13.9571
80000	6.3838	80000	8.4299	80000	10.4371	80000	12.4063
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	50000	6.5232	50000	7.7539
40000	3.1919	40000	4.2150	40000	5.2185	40000	6.2032
30000	2.3939	30000	3.1612	30000	3.9139	30000	4.6524
20000	1.5960	20000	2.1075	20000	2.6093	20000	3.1016
10000	.7980	10000	1.0537	10000	1.3046	10000	1.5508
9000	.7182	9000	.9484	9000	1.1742	9000	1.3957
8000	.6384	8000	.8430	8000	1.0437	8000	1.2406
7000	.5586	7000	.7376	7000	.9132	7000	1.0856
6000	.4788	6000	.6322	6000	.7828	6000	.9305
5000	.3990	5000	.5269	5000	.6523	5000	.7754
4000	.3192	4000	.4215	4000	.5219	4000	.6203
3000	.2394	3000	.3161	3000	.3914	3000	.4652
2000	.1596	2000	.2107	2000	.2609	2000	.3102
1000	.0798	1000	.1054	1000	.1305	1000	.1551
900	.0718	900	.0948	900	.1174	900	.1396
800	.0638	800	.0843	800	.1044	800	.1241
700	.0559	700	.0738	700	.0913	700	.1086
600	.0479	600	.0632	600	.0783	600	.0930
500	.0399	500	.0527	500	.0652	500	.0775
400	.0319	400	.0421	400	.0522	400	.0620
300	.0239	300	.0316	300	.0391	300	.0465
200	.0160	200	.0211	200	.0261	200	.0310
100	.0080	100	.0105	100	.0130	100	.0155
90	.0072	90	.0095	90	.0117	90	.0140
80	.0064	80	.0084	80	.0104	80	.0124
70	.0056	70	.0074	70	.0091	70	.0109
60	.0048	60	.0063	60	.0078	60	.0093
50	.0040	50	.0053	50	.0065	50	.0078
40	.0032	40	.0042	40	.0052	40	.0062
30	.0024	30	.0032	30	.0039	30	.0047
20	.0016	20	.0021	20	.0026	20	.0031
10	.0008	10	.0011	10	.0013	10	.0016
9	.0007	9	.0009	9	.0012	9	.0014
8	.0006	8	.0008	8	.0010	8	.0012
7	.0006	7	.0007	7	.0009	7	.0011
6	.0005	6	.0006	6	.0008	6	.0009
5	.0004	5	.0005	5	.0007	5	.0008
4	.0003	4	.0004	4	.0005	4	.0006
3	.0002	3	.0003	3	.0004	3	.0005
2	.0002	2	.0002	2	.0003	2	.0003
1	.0001	1	.0001	1	.0001	1	.0002

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DISCOUNT for One Day, at 7, 8, 9, and 10 *per Cent. per Annum.*

At 7 l. per Cent. per An.		*At 8 l. per Cent per An.*		*At 9 l. per Cent. per An*		*At 10 l. per Cent. per An.*	
Principal	Discount.	Principal.	Discount.	Principal.	Discount.	Principal.	Discount.
10000000	1792.3441	10000000	2029.4267	10000000	2262.1591	10000000	2490.6600
9000000	1613.1097	9000000	1826.4840	9000000	2035.9432	9000000	2241.5940
8000000	1433.8753	8000000	1623.5414	8000000	1809.7273	8000000	1992.5280
7000000	1254.6409	7000000	1420.5987	7000000	1583.5114	7000000	1743.4620
6000000	1075.4065	6000000	1217.6560	6000000	1357.2955	6000000	1494.3960
5000000	896.1721	5000000	1014.7133	5000000	1131.0796	5000000	1245.3300
4000000	716.9377	4000000	811.7707	4000000	904.8636	4000000	996.2640
3000000	537.7032	3000000	608.8280	3000000	678.6477	3000000	747.1980
2000000	358.4688	2000000	405.8853	2000000	452.4318	2000000	498.1320
1000000	179.2344	1000000	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	142.0599	700000	158.3511	700000	174.3462
600000	107.5406	600000	121.7656	600000	135.7295	600000	149.4396
500000	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	60.8828	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	90000	20.3594	90000	22.4159
80000	14.3388	80000	16.2354	80000	18.0973	80000	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	50000	10.1471	50000	11.3108	50000	12.4533
40000	7.1694	40000	8.1177	40000	9.0486	40000	9.9626
30000	5.3770	30000	6.0883	30000	6.7865	30000	7.4720
20000	3.5847	20000	4.0589	20000	4.5243	20000	4.9813
10000	1.7923	10000	2.0294	10000	2.2622	10000	2.4907
9000	1.6131	9000	1.8265	9000	2.0359	9000	2.2416
8000	1.4339	8000	1.6235	8000	1.8097	8000	1.9925
7000	1.2546	7000	1.4206	7000	1.5835	7000	1.7435
6000	1.0754	6000	1.2177	6000	1.3573	6000	1.4944
5000	.8962	5000	1.0147	5000	1.1311	5000	1.2453
4000	.7169	4000	.8118	4000	.9049	4000	.9963
3000	.5377	3000	.6088	3000	.6786	3000	.7472
2000	.3585	2000	.4059	2000	.4524	2000	.4981
1000	.1792	1000	.2029	1000	.2262	1000	.2491
900	.1613	900	.1826	900	.2036	900	.2242
800	.1434	800	.1624	800	.1810	800	.1993
700	.1255	700	.1421	700	.1584	700	.1743
600	.1075	600	.1218	600	.1357	600	.1494
500	.0896	500	.1015	500	.1131	500	.1245
400	.0717	400	.0812	400	.0905	400	.0996
300	.0538	300	.0609	300	.0679	300	.0747
200	.0358	200	.0406	200	.0452	200	.0498
100	.0179	100	.0203	100	.0226	100	.0249
90	.0161	90	.0183	90	.0204	90	.0224
80	.0143	80	.0162	80	.0181	80	.0199
70	.0125	70	.0142	70	.0158	70	.0174
60	.0108	60	.0122	60	.0136	60	.0149
50	.0090	50	.0101	50	.0113	50	.0125
40	.0072	40	.0081	40	.0090	40	.0100
30	.0054	30	.0061	30	.0068	30	.0075
20	.0036	20	.0041	20	.0045	20	.0050
10	.0018	10	.0020	10	.0023	10	.0025
9	.0016	9	.0018	9	.0020	9	.0022
8	.0014	8	.0016	8	.0018	8	.0020
7	.0013	7	.0014	7	.0016	7	.0017
6	.0011	6	.0012	6	.0014	6	.0015
5	.0009	5	.0010	5	.0011	5	.0012
4	.0007	4	.0008	4	.0009	4	.0010
3	.0005	3	.0006	3	.0007	3	.0007
2	.0004	2	.0004	2	.0005	2	.0005
1	.0002	1	.0002	1	.0002	1	.0002

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* 6 l. 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 6 *l. 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.	*Dis.* 18.0001

Answer 18 *l.*

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 6 *l. per Cent. &c.*

So 1.	Multiply'd by 103, the Amount (at 3 *l. per Cent.*) will be	1.03	At the End of the	1st Year,
1.03		1.0609		2d Year,
1.0609		1.092727		3d Year,
1.092727		1.127509		4th Year,
1.125509		1.159274		5th Year,
1.159274		1.194052		6th Year,
1.194052		1.229874		7th Year.

And thus Table the First, following, of the Amount of 1 *l.* 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 *continued Division* of the Principal by 1.03, 1.04, 1.05, 1.06, *&c.* according to the Rate of Interest, is 3, 4, 5 or 6 *l. per Cent.*

Thus 1.	Divided by 103; the present Value (at 3 *l. per Cent.*) will be	.970874	Payable at the End of the	1st Year,
.970874		.942596		2d Year,
.942596		.915142		3d Year,
.915142		.888487		4th Year,
.888487		.862609		5th Year,
.862609		.837484		6th Year,
.837484		.813092		7th Year.

And thus the Second of the following Tables may be form'd.

The Amount of any *Annuity* or other yearly Payment, in any Number of Years, at 3 *l. per Cent. per Ann.* Compound Interest, will be found thus:

Multiply the first yearly Payment by 1.03 (when as in this Case, the Rate of Interest is 3 *l. per Cent.* otherwise by 1.06, *&c.* whatever that be) and to the Product add the *second 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	1 *l.*	the Amount in 1 Year.
Multiplied by	1.03	
	1.03	
Second Yearly Paym.	1.	
	2.03	Amount in 2 Years.
Multiplied by	1.03	
	2.0909	
Third Yearly Paym.	1.	
	3.0909	Amount in 3 Years.
Multiplied by	1.03	
	3.183627	
Fourth Yearly Paym.	1.	
	4.183627	Amount in 4 Years, *&c.*

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 added together, will be the present Value for two Years: The first, second, and third, so added, will give the Value for three Years, *&c.*

Exam-

Example of 1 l. per Ann. *at* 3 l. per Cent.

I find the present Value of 1 *l.* payable at the End of several Years, to be, as here under expreſs'd.

At the End of	1	Year is	.970874
	2		.942596
	3		.915142
	4		.888487
	5		.862609
	6		.837484
	7		.813092, &c.

Then the present Value of 1 *l. per Ann.* at 3 *l. per Cent.*

For	1	Year is	.870874	being the	1ſt Number above,	added together.
	2		1.913470		1, 2,	
	3		2.828612		1, 2, and 3,	
	4		3.717099		1, 2, 3, and 4,	
	5		4.579708		1, 2, 3, 4, and 5,	
	6		5.417192		1, 2, 3, 4, 5, and 6,	
	7		6.230284		1, 2, 3, 4, 5, 6, and 7,	

And thus the Fourth Table following is Form'd and Compoſed.

TABLE

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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.

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.*
1	1.030000	1.040000	1.050000	1.060000	1.070000	1.080000	1.090000	1.100000
2	1.060900	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
5	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	1.967151	2.158925	2.367364	2.593742
11	1.384234	1.539454	1.710339	1.898299	2.104852	2.331639	2.580426	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	1.979932	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	2.292018	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	1.806111	2.191123	2.653298	3.207135	3.869684	4.660957	5.604411	6.727500
21	1.860295	2.278768	2.785963	3.399564	4.140562	5.033834	6.108808	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	10.834706
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	7.686087	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	3.167027	4.616366	6.704751	9.703507	13.994820	20.115298	28.815982	41.144779
40	3.262038	4.801021	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	3.895044	6.074823	9.434258	14.590487	22.472623	34.474085	52.676742	80.179534
47	4.011895	6.317816	9.905971	15.465917	24.045707	37.232012	57.417649	88.197488
48	4.132252	6.570528	10.401270	16.393872	25.728907	40.210573	62.585237	97.017236
49	4.256219	6.833349	10.921333	17.377504	27.529930	43.427419	68.217908	106.718960

TABLE

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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.

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	4.383906	7.106983	11.467400	18.420154	29.457025	46.901612	74.357520	117.300806
51	4.515423	7.390951	12.040770	19.525363	31.519017	50.653741	81.049697	129.129942
52	4.650886	7.686589	12.642808	20.696885	33.725348	54.706041	88.344170	142.042936
53	4.790412	7.994052	13.274949	21.938698	36.086122	59.082524	96.295145	156.247229
54	4.934125	8.313814	13.938696	23.255020	38.612151	63.809126	104.961708	171.871952
55	5.082149	8.646367	14.635631	24.650322	41.315001	68.913856	114.408262	189.059147
56	5.234613	8.992222	15.367412	26.129341	44.207052	74.426964	124.705005	207.965062
57	5.391651	9.351910	16.135783	27.697101	47.301545	80.381182	135.928456	228.761568
58	5.553401	9.725987	16.942572	29.358927	50.612653	86.811611	148.162017	251.637725
59	5.720003	10.115026	17.789701	31.120463	54.155539	93.756540	161.496598	276.801498
60	5.891603	10.519627	18.679186	32.987691	57.946427	101.257064	176.031292	304.481648
61	6.068351	10.940413	19.613145	34.966952	62.002677	109.357629	191.874108	334.929812
62	6.250402	11.378029	20.593802	37.064969	66.342864	118.106239	209.142778	368.422794
63	6.437914	11.833150	21.623493	39.288868	70.986865	127.554738	227.965628	405.265073
64	6.631051	12.306476	22.704667	41.646200	75.955945	137.759117	248.482535	445.791580
65	6.829982	12.798735	23.839901	44.144972	81.272861	148.779846	270.845963	490.370728
66	7.034882	13.310685	25.031896	46.793670	86.961962	160.682234	295.222099	539.407812
67	7.245929	13.843112	26.283490	49.601290	93.049299	173.536813	321.792088	593.348593
68	7.463307	14.396836	27.597665	52.577368	99.562750	187.419758	350.753376	652.683453
69	7.687206	14.972710	28.977548	55.732010	106.532142	202.413338	382.321180	717.951798
70	7.917822	15.571618	30.426426	59.075930	113.989392	218.606406	416.730086	789.746978
71	8.155357	16.194483	31.947747	62.620486	121.968650	236.094918	454.235794	868.721675
72	8.400017	16.842262	33.545134	66.377715	130.506455	254.982511	495.117016	955.593843
73	8.652018	17.515953	35.222391	70.360378	139.641907	275.381112	539.677547	1051.153227
74	8.911578	18.216591	36.983510	74.582001	149.416840	297.411601	588.248526	1156.268550
75	9.178926	18.945255	38.832686	79.056921	159.876019	321.204529	641.190894	1271.895405
76	9.454293	19.703065	40.774320	83.800336	171.067341	346.900892	698.898074	1399.084945
77	9.737922	20.491187	42.813036	88.828356	183.042054	374.652963	761.798901	1538.993440
78	10.030060	21.310835	44.953688	94.158058	195.854998	404.625200	830.360802	1692.892784
79	10.330962	22.163269	47.201372	98.807541	209.564848	436.995216	905.093274	1862.182062
80	10.640891	23.049799	49.561441	105.795993	224.234388	471.954834	986.551660	2048.400269
81	10.960117	23.971791	52.039513	112.143753	239.930795	509.711220	1075.341319	2253.240295
82	11.288921	24.930663	54.641489	118.872378	256.725950	550.488118	1172.122037	2478.564325
83	11.627588	25.927889	57.373563	126.004721	274.696767	594.527167	1277.613021	2726.420757
84	11.976416	26.965005	60.242241	133.565004	293.925540	642.089341	1392.598193	2999.062833
85	12.335709	28.043605	63.254353	141.578904	314.500328	693.456488	1517.932030	3298.969117
86	12.705780	29.165349	66.417071	150.073639	336.515351	748.933007	1654.545913	3628.866028
87	13.086953	30.331963	69.737925	159.078057	360.071426	808.847648	1803.455045	3991.752631
88	13.479562	31.545242	73.224821	168.622741	385.276426	873.555459	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	441.102980	1018.915088	2335.526583	5313.022752
91	14.729481	35.484107	84.766883	200.832382	471.980188	1100.428295	2545.723976	5844.325027
92	15.171366	36.903471	89.005227	212.882325	505.018802	1188.462558	2774.839134	6428.757530
93	15.626507	38.379610	93.455489	225.655264	540.370118	1283.539563	3024.574656	7071.633283
94	16.095302	39.914794	98.128263	239.194580	578.196026	1386.222728	3296.786375	7778.796611
95	16.578161	41.511386	103.034676	253.546255	618.669748	1497.120546	3593.497148	8556.676272
96	17.075506	43.171841	108.186410	268.759030	661.976630	1616.890190	3916.911892	9412.343899
97	17.587771	44.898715	113.595731	284.884572	708.314994	1746.241405	4269.433962	10353.578289
98	18.115404	46.694664	119.275517	301.977646	757.897044	1885.940718	4653.683018	11388.936118
99	18.658866	48.562450	125.239293	320.096305	810.949837	2036.815975	5072.514490	12527.829730
100	19.218632	50.504948	131.501258	339.302084	867.716325	2109.761253	5529.040791	13780.612703

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.

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.*
1	.970874	.961539	.952381	.943396	.934579	.925926	.917431	.909091
2	.942596	.924556	.907029	.889997	.873439	.857339	.841680	.826446
3	.915142	.888996	.863838	.839619	.816298	.793832	.772184	.751315
4	.888487	.854804	.822702	.792094	.762895	.735030	.708425	.683013
5	.862609	.821927	.783526	.747258	.712986	.680583	.649931	.620921
6	.837484	.790315	.746216	.704960	.666342	.630170	.596267	.564474
7	.813092	.759918	.710682	.665057	.622750	.583491	.547034	.513158
8	.789409	.730690	.676839	.627412	.582009	.540269	.501866	.466507
9	.766417	.702587	.644609	.591898	.543934	.500249	.460428	.424098
10	.744094	.675564	.613913	.558395	.508349	.463194	.422411	.385543
11	.722421	.649581	.584679	.526787	.475093	.428883	.387533	.350494
12	.701380	.624597	.556837	.496969	.444012	.397114	.355535	.318631
13	.680951	.600574	.530321	.468839	.414965	.367698	.326179	.289664
14	.661118	.577475	.505068	.442301	.387817	.340461	.299246	.263331
15	.641862	.555265	.481017	.417265	.362446	.315242	.274538	.239392
16	.623167	.533908	.458112	.393646	.338735	.291891	.251870	.217629
17	.605017	.513373	.436297	.371314	.316574	.270269	.231073	.197845
18	.587395	.493628	.415521	.350344	.295864	.250249	.211994	.179859
19	.570286	.474643	.395734	.330513	.276508	.231712	.194490	.163508
20	.553676	.456387	.376890	.311805	.258419	.214548	.178431	.148644
21	.537549	.438834	.358942	.294155	.241513	.198657	.163698	.135131
22	.521892	.421955	.341850	.277505	.225713	.183941	.150182	.122846
23	.506692	.405726	.325571	.261797	.210947	.170315	.137781	.111678
24	.491934	.390121	.310068	.246979	.197147	.157699	.126405	.101526
25	.477606	.315717	.295303	.232999	.184249	.146018	.115968	.092296
26	.463695	.360689	.281241	.219810	.172196	.135202	.106392	.083905
27	.450189	.346816	.267848	.207368	.160930	.125187	.097607	.076278
28	.437077	.333477	.255094	.195630	.150402	.115914	.089548	.069343
29	.424346	.320651	.242946	.184557	.140563	.107328	.082155	.063039
30	.411987	.308319	.231377	.174110	.131367	.099377	.075371	.057309
31	.399987	.296460	.220359	.164255	.122773	.092016	.069148	.052099
32	.388337	.285052	.209866	.154957	.114741	.085200	.063438	.047362
33	.377026	.274094	.199873	.146186	.107235	.078889	.058200	.043057
34	.366045	.263552	.190355	.137012	.100219	.073045	.054395	.039143
35	.355383	.253416	.181290	.130105	.093663	.067635	.048986	.035584
36	.345032	.243669	.172657	.122741	.087535	.062625	.044941	.032349
37	.334983	.234297	.164436	.115793	.081809	.057986	.041231	.029408
38	.325226	.225295	.156605	.109238	.076457	.053690	.037826	.026735
39	.315754	.216621	.149148	.103056	.071455	.049713	.034703	.024304
40	.306557	.208289	.142046	.097222	.066780	.046031	.031838	.022095
41	.297658	.200278	.135282	.091719	.062412	.042621	.029209	.020086
42	.288959	.192575	.128840	.086527	.058329	.039464	.026797	.018260
43	.280543	.185168	.122704	.081630	.054513	.036541	.024584	.016600
44	.272372	.178046	.116861	.077009	.050946	.033834	.022555	.015091
45	.264439	.171198	.111297	.072650	.047614	.031328	.020692	.013719
46	.256737	.164614	.105997	.068538	.044499	.029007	.018984	.012472
47	.249259	.158283	.100949	.064658	.041587	.026859	.017416	.011338
48	.241999	.152195	.096142	.060998	.038867	.024869	.015978	.010307
49	.234950	.146341	.091564	.057546	.036324	.023027	.014659	.009370
50	.228107	.140713	.087204	.054288	.033948	.021321	.013449	.008519

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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 10 *l. per Cent. per Ann.* Compound Interest.

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.*
51	.221463	.135301	.083051	.051215	.031727	.019742	.012338	.007744
52	.215013	.130097	.079096	.048316	.029651	.018280	.011319	.007040
53	.208750	.125093	.075330	.045582	.027711	.016925	.010385	.006400
54	.202670	.120282	.071743	.043001	.025899	.015672	.009527	.005818
55	.196767	.115656	.068326	.040567	.024204	.014511	.008741	.005289
56	.191036	.111207	.065073	.038271	.022621	.013436	.008019	.004808
57	.185472	.106930	.061974	.036105	.021141	.012441	.007357	.004371
58	.180070	.102817	.059023	.034061	.019758	.011519	.006749	.003974
59	.174825	.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	.159990	.087889	.048558	.026980	.015073	.008467	.004781	.002714
63	.155330	.084508	.046246	.025453	.014087	.007840	.004387	.002468
64	.150806	.081258	.044044	.024012	.013166	.007259	.004024	.002243
65	.146413	.078133	.041946	.022653	.012304	.006721	.003692	.002039
66	.142149	.075128	.039949	.021370	.011497	.006223	.003387	.001854
67	.138009	.072238	.038047	.020161	.010747	.005762	.003108	.001685
68	.133989	.069460	.036235	.019020	.010044	.005336	.002851	.001532
69	.130086	.065788	.034509	.017943	.009387	.004940	.002616	.001393
70	.126297	.064219	.032866	.016927	.008773	.004574	.002400	.001266
71	.122619	.061749	.031301	.015969	.008199	.004236	.002202	.001151
72	.119047	.059374	.029811	.015065	.007662	.003922	.002020	.001046
73	.115580	.057091	.028391	.014213	.007161	.003631	.001853	.000951
74	.112214	.054395	.027039	.013408	.006693	.003362	.001700	.000865
75	.108945	.052784	.025752	.012649	.006255	.003113	.001560	.000786
76	.105772	.050754	.024525	.011933	.005846	.002883	.001431	.000715
77	.102691	.048801	.023357	.011258	.005463	.002669	.001313	.000649
78	.099700	.046924	.022245	.010620	.005106	.002471	.001204	.000591
79	.096796	.045120	.021186	.010019	.004772	.002288	.001105	.000537
80	.093997	.043384	.020177	.009452	.004460	.002119	.001014	.000488
81	.091240	.041716	.019216	.008917	.004168	.001962	.000930	.000444
82	.088582	.040111	.018301	.008412	.003895	.001817	.000853	.000403
83	.086002	.038569	.017430	.007936	.003640	.001682	.000783	.000367
84	.083497	.037085	.916600	.007487	.003402	.001557	.000718	.000333
85	.081065	.035659	.015809	.007063	.003180	.001442	.000659	.000303
86	.078704	.034287	.015056	.006663	.002972	.001335	.000604	.000276
87	.076412	.032969	.014339	.006286	.002777	.001236	.000554	.000251
88	.074186	.031701	.013657	.005930	.002596	.001145	.000509	.000228
89	.072026	.030481	.013006	.005595	.002426	.001060	.000467	.000207
90	.069928	.029309	.012387	.005278	.002267	.000981	.000428	.000188
91	.067891	.028182	.011797	.004979	.002119	.000909	.000393	.000171
92	.065914	.027098	.011235	.004697	.001980	.000841	.000360	.000156
93	.063994	.026056	.010700	.004432	.001851	.000779	.000331	.000141
94	.062130	.025053	.010191	.004181	.001730	.000721	.000303	.000129
95	.060320	.024290	.009705	.003944	.001616	.000668	.000278	.000117
96	.058563	.023163	.009243	.003721	.001511	.000618	.000255	.000106
97	.056858	.022272	.008803	.003510	.001412	.000573	.000234	.000097
98	.055202	.021416	.008384	.003312	.001319	.000530	.000215	.000088
99	.053594	.020592	.007985	.003124	.001233	.000491	.000197	.000080
100	.052033	.019800	.007604	.002947	.001152	.000455	.000181	.000073

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.

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.*
1	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
2	2.030000	2.040000	2.050000	2.060000	2.070000	2.080000	2.090000	2.100000
3	3.090900	3.121600	3.152500	3.183600	3.214900	3.246400	3.278100	3.310000
4	4.183627	4.246464	4.310125	4.374616	4.439943	4.506112	4.573129	4.641000
5	5.309136	5.416323	5.525631	5.637093	5.750739	5.866601	5.984711	6.105100
6	6.468410	6.632975	6.801913	6.975319	7.153291	7.335929	7.523335	7.715610
7	7.662462	7.898294	8.142008	8.393838	8.654021	8.922803	9.200435	9.487171
8	8.892336	9.214226	9.549109	9.897468	10.259803	10.636628	11.028474	11.435888
9	10.159106	10.582795	11.026564	11.491316	11.977989	12.487558	13.021036	13.579477
10	11.463879	12.006107	12.577893	13.180795	13.816448	14.486562	15.192930	15.937425
11	12.807796	13.486351	14.206787	14.971643	15.783599	16.645487	17.560293	18,531167
12	14.192030	15.025805	15.917127	16.869941	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	17.086324	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	21.761588	23.697512	25.840366	28.212880	30.840217	33.750226	36.973704	40.544703
18	23.414435	25.645413	28.132385	30.905653	33.999033	37.450244	41.301338	45.599173
19	25.116868	27.671229	30.539004	33.759992	37.378965	41.446263	46.018458	51.159090
20	26.870374	29.778079	33.065954	36.785591	40.995492	45.761964	51.160119	57.274999
21	28.676486	31.969202	35.719252	39.992727	44.865177	50.422921	56.764530	64.002499
22	30.536780	34.247970	38.505214	43.392290	49.005739	55.456755	62.873338	71.402749
23	32.452884	36.617889	41.430475	46.995828	53.436141	60.893296	69.531938	79.543024
24	34.426470	39.082604	44.501999	50.815577	58.176671	66.764759	76.789813	88.497327
25	36.459264	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
33	55.077841	66.209527	80.063771	97.343165	118.933425	145.950620	179.800315	222.251550
34	57.730177	69.857909	85.066959	104.183755	128.258765	158.626670	196.982343	245.476705
35	60.462082	73.652225	90.320307	111.434780	138.236878	172.316804	215.710754	271.024376
36	63.275944	77.598314	95.839323	119.120867	148.913460	187.102148	236.124722	299.126813
37	66.174223	81.702246	101.628139	127.268119	160.337402	203.070320	258.375947	330.039495
38	69.159449	85.970336	107.709546	135.904206	172.561020	220.315945	282.629782	364.043444
39	72.234233	90.409150	114.095023	145.058458	185.640292	238.941221	309.066463	401.447789
40	75.401260	95.025516	120.799774	154.761966	199.635112	259.056519	337.882444	442.592568
41	78.663298	99.826536	127.839763	165.047684	214.609570	280.781040	369.291864	487.851824
42	82.023197	104.819598	135.231751	175.950545	230.632240	304.243523	403.528132	537.637007
43	85.483892	110.012382	142.993339	187.507577	247.776496	329.583005	440.845664	592.400707
44	89.048409	115.412877	151.143006	199.758032	266.120851	356.949645	481.421775	652.640778
45	92.719861	121.029392	159.700156	212.743514	285.749311	386.505617	525.858735	718.904856
46	96.501457	126.870568	168.685164	226.508125	306.751763	418.426066	574.186021	791.795342
47	100.396501	132.945390	178.119422	241.098612	329.224386	452.900152	626.862763	871.974876
48	104.408396	139.263206	188.025393	256.564529	353.270093	490.132164	684.280411	960.172363
49	108.540648	145.833734	198.426663	272.958401	378.998999	530.342737	746.865648	1057.189600
50	112.796867	152.667084	209.347996	290.335905	406.528929	573.770156	815.083557	1163.908560

TABLE

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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.	7 per Cent.	8 per Cent.	9 per Cent.	10 per Cent.
51	117.180773	159.773767	220.815395	308.756059	435.985955	620.671768	889.441077	1281.299416
52	121.696197	167.164718	232.856165	328.281422	467.504971	671.325510	970.499774	1410.429357
53	126.347083	174.851306	245.498974	348.978308	501.230219	726.031550	1058.834943	1552.472393
54	131.137495	182.845359	258.773922	370.917006	537.316442	785.114074	1155.130088	1708.719522
55	136.071620	191.159173	272.712618	394.172027	575.928593	848.923200	1260.091796	1880.591474
56	141.153768	199.805540	287.348249	418.822348	617.253594	917.837056	1374.500058	2069.650622
57	146.388381	208.797762	302.715662	444.951689	661.450646	992.264021	1499.205063	2277.615684
58	151.780033	218.149672	318.851445	472.648790	708.752191	1072.645143	1635.133519	2506.377252
59	157.333434	227.875659	335.794017	502.007718	759.364844	1159.456754	1783.295535	2758.014978
60	163.053437	237.990685	353.583718	533.128181	813.520383	1253.213294	1944.792134	3034.816476
61	168.945040	248.510313	372.262904	566.115872	871.466810	1354.470358	2120.823426	3339.298123
62	175.013391	259.450725	391.876049	601.082824	933.469487	1463.827986	2312.697534	3674.227935
63	181.263793	270.828754	412.469851	638.147793	999.812351	1581.934225	2521.840312	4042.650729
64	187.701707	282.661904	434.093344	677.436661	1070.799215	1709.488963	2749.805940	4447.915802
65	194.332758	294.968380	456.789011	719.082861	1146.755161	1847.248080	2998.288475	4893.707382
66	201.162741	307.767116	480.637912	763.227832	1228.028022	1996.027927	3269.134438	5384.078120
67	208.197623	321.077800	505.669807	810.021502	1314.989983	2156.710161	3564.356537	5923.485932
68	215.443552	334.920912	531.953298	859.622792	1408.039282	2330.246974	3886.148625	6516.834526
69	222.906858	349.317749	559.550963	912.200160	1507.602032	2517.666731	4236.902002	7169.517978
70	230.594064	364.290459	588.528511	967.932170	1614.134173	2720.080070	4619.223182	7887.469776
71	238.511886	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	5490.189062	9545.938429
73	255.067260	412.898823	684.447817	1156.006301	1980.598671	3429.763905	5985.306078	10501.532272
74	263.719277	430.414775	719.670208	1226.366679	2120.240578	3705.145017	6524.983625	11552.685499
75	272.630856	448.631366	756.653718	1300.948680	2269.657418	4002.556619	7113.232151	12708.954049
76	281.809781	467.576621	795.486404	1380.005601	2429.533438	4323.761148	7754.423045	13980.849454
77	291.264075	487.279686	836.260724	1463.805937	2600.600778	4670.662040	8453.321119	15379.934399
78	301.001997	507.770873	879.073761	1552.634293	2783.642833	5045.315003	9215.120019	16918.927839
79	311.032057	529.081708	924.027449	1646.792350	2979.497831	5449.940204	10045.480821	18611.820623
80	321.363019	551.244977	971.228821	1746.599891	3189.062679	5886.935420	10950.574095	20474.002586
81	332.003909	574.294776	1020.790262	1852.395885	3413.297067	6358.890253	11937.125764	22522.402954
82	342.964027	598.266567	1072.829775	1964.539638	3653.227862	6868.601474	13012.467082	24775.643250
83	354.252947	623.197229	1127.471264	2083.412016	3909.953812	7419.089592	14184.589120	27254.207575
84	365.880536	649.125119	1184.844827	2209.416737	4184.650579	8013.616759	15462.202141	29980.628332
85	377.856952	676.090123	1245.087069	2342.981741	4478.576119	8655.706100	16854.800533	32979.691165
86	390.192660	704.133728	1308.341422	2484.560646	4793.076448	9349.[illegible]62587	18372.732363	36278.660282
87	402.898440	733.299078	1374.758493	2634.634285	5129.591799	10098.095594	20027.278276	39907.526310
88	415.985393	763.631041	1444.496418	2793.712342	5489.663225	10906.943242	21830.733321	43899.278941
89	429.464955	795.176282	1517.721239	2962.335082	5874.939651	11780.498701	23796.499320	48290.006835
90	443.348904	827.983334	1594.607301	3141.075187	6287.185426	12723.938597	25939.184258	53120.227519
91	457.649371	862.102667	1675.337666	3330.539698	6728.288406	13742.853685	28274.710842	58433.250271
92	472.378852	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	3969.909669	8245.657514	17315.284101	36619.848607	77777.966110
95	519.272026	1012.784648	2040.693528	4209.104250	8823.853540	18701.506829	39916.634981	85556.762721
96	535.850187	1054.296034	2143.728205	4462.650504	9442.523288	20198.627376	43510.132130	94113.438993
97	552.925692	1097.467876	2251.914615	4731.409535	10104.499918	21815.517566	47427.044021	103525.782892
98	570.513463	1142.366591	2365.510346	5016.294107	10812.814912	23561.758971	51696.477983	113879.361182
99	588.628867	1189.061254	2484.785863	5318.271753	11570.711950	25447.699689	56350.161002	125268.297300
100	607.287733	1237.623705	2610.025156	5638.368058	12381.661793	27484.515664	61422.675492	137796.127030

TABLE

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.

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.*
1	.970874	.961539	.952381	.943396	.934579	.925926	.917431	.909091
2	1.913370	1.886095	1.859410	1.833393	1.808018	1.783265	1.759111	1.735537
3	2.828612	2.775091	2.723248	2.673012	2.624316	2.577097	2.531295	2.486852
4	3.717099	3.629896	3.545950	3.465106	3.387211	3.312127	3.239720	3.169865
5	4.579707	4.451823	4.329477	4.212364	4.100198	3.992710	3.889651	3.790787
6	5.497192	5.242137	5.075612	4.917325	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	7.019693	6.732745	6.463213	6.209794	5.971299	5.746640	5.534819	5.334926
9	7.786109	7.435332	7.107822	6.801692	6.515233	6.246889	5.995247	5.759024
10	8.530203	8.110896	7.721735	7.360087	7.023582	6.710082	6.417658	6.144567
11	9.252625	8.760477	8.306415	7.886875	7.498675	7.138965	6.805191	6.495061
12	9.954005	9.385074	8.863252	8.383844	7.942687	7.536079	7.160725	6.813692
13	10.634956	9.985648	9.393573	8.852683	8.357652	7.903777	7.486904	7.103356
14	11.296074	10.563124	9.898641	9.294984	8.745459	8.244238	7.786151	7.366688
15	11.937936	11.118388	10.379658	9.712249	9.107915	8.559480	8.060689	7.606080
16	12.561103	11.652297	10.837770	10.105895	9.446649	8.851370	8.312559	7.823709
17	13.166120	12.165670	11.274067	10.477260	9.763224	9.121639	8.543632	8.021553
18	13.753515	12.659298	11.689587	10.827603	10.059088	9.371888	8.755625	8.201412
19	14.323801	13.133941	12.085321	11.158116	10.335595	9.603601	8.950115	8.364920
20	14.877476	13.590328	12.462211	11.469921	10.594016	9.818149	9.128546	8.513564
21	15.415026	14.029162	12.821153	11.764077	10.835525	10.016805	9.292244	8.648694
22	15.938918	14.451117	13.163003	12.041582	11.061242	10.200745	9.442426	8.771540
23	16.443610	14.856843	13.488574	12.303379	11.272189	10.371061	9.580207	8.883218
24	16.935544	15.246965	13.798642	12.550357	11.469335	10.528760	9.706612	8.984744
25	17.413149	15.622082	14.093945	12.783356	11.653585	10.674778	9.822580	9.077040
26	17.876844	15.982771	14.375185	13.003166	11.825780	10.809980	9.928973	9.160945
27	18.327033	16.329587	14.643034	13.210534	11.986710	10.935167	10.026580	9.237223
28	18.764110	16.663065	14.898128	13.406164	12.137113	11.051081	10.116128	9.306566
29	19.188456	16.983716	15.141074	13.590721	12.277676	11.158408	10.198283	9.369606
30	19.600443	17.292035	15.372452	13.764831	12.409043	11.257785	10.273654	9.426914
31	20.000430	17.588495	15.592811	13.929086	12.531816	11.349802	10.342802	9.479013
32	20.388767	17.873553	15.802677	14.084043	12.646557	11.435002	10.406240	9.526376
33	20.765793	18.147647	16.002550	14.230229	12.753792	11.513891	10.464441	9.569432
34	21.131838	18.411199	16.192905	14.368141	12.854011	11.586936	10.517836	9.608575
35	21.487222	18.664615	16.374195	14.498246	12.947674	11.654570	10.566822	9.644159
36	21.832254	18.908284	16.546852	14.620987	13.035209	11.717195	10.611763	9.676508
37	22.167237	19.142580	16.711288	14.736780	13.117018	11.775181	10.652994	9.705917
38	22.492464	19.367866	16.867893	14.846019	13.193475	11.828871	10.690820	9.732651
39	22.808217	19.584486	17.017041	14.949074	13.264930	11.878585	10.725523	9.756956
40	23.114774	19.792775	17.159087	15.046297	13.331710	11.924615	10.757360	9.779051
41	23.412402	19.993053	17.294369	15.138016	13.394122	11.967237	10.786569	9.799137
42	23.701361	20.185628	17.423208	15.224543	13.452451	12.006701	10.813366	9.817397
43	23.981904	20.370797	17.545913	15.306173	13.506963	12.043242	10.837951	9.833998
44	24.254276	20.548843	17.662774	15.383182	13.557910	12.077076	10.860505	9.849089
45	24.518715	20.720041	17.774070	15.455832	13.605523	12.108404	10.881197	9.862808
46	24.775451	20.884655	17.880067	15.524370	13.650022	12.137411	10.900181	9.875280
47	25.024710	21.042938	17.981016	15.589028	13.691609	12.164269	10.917597	9.886618
48	25.266709	21.195133	18.077158	15.650026	13.730476	12.189139	10.933576	9.896925
49	25.501659	21.341474	18.168722	15.707572	13.766800	12.212165	10.948235	9.906295
50	25.729766	21.482186	18.255925	15.761860	13.800748	12.233487	10.961683	9.914814

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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.

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.*
51	25.951230	21.617487	18.338977	15.813076	13.832475	12.253229	10.974021	9.922558
52	26.166242	21.747584	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	27.505833	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	28.306481	22.968551	19.119124	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	28.595043	23.121811	19.201020	16.310493	14.121440	12.422209	11.073475	9.981461
67	28.733052	23.194049	19.239066	16.330654	14.132187	12.427971	11.076582	9.983146
68	28.867041	23.263509	19.275301	16.349673	14.142231	12.433307	11.079433	9.984679
69	28.967127	23.330297	19.309811	16.367616	14.151618	12.438247	11.082049	9.986071
70	29.123424	23.394516	19.342677	16.384544	14.160391	12.442822	11.084448	9.987338
71	29.246043	23.456266	19.373978	16.400513	14.168590	12.447057	11.086650	9.988489
72	29.365090	23.515640	19.403789	16.415578	14.176252	12.450979	11.988670	9.989535
73	29.480670	23.572731	19.432180	16.429791	14.183413	12.454610	11.090523	9.990487
74	29.592884	23.627626	19.459219	16.443199	14.190106	12.457973	11.092223	9.991351
75	29.701829	23.680410	19.484970	16.455848	14.196361	12.461086	11.093782	9.992138
76	29.807601	23.731163	19.509495	16.467781	14.202207	12.463969	11.095213	9.992852
77	29.910293	23.779965	19.532853	16.479039	14.207670	12.466638	11.096526	9.993502
78	30.009993	23.826889	19.555098	16.489659	14.212776	12.469109	11.097730	9.994093
79	30.106789	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	30.292006	23.957109	19.615677	16.518048	14.226175	12.475478	11.100778	9.995562
82	30.380589	23.997220	19.633978	16.526460	14.230070	12.477295	11.101632	9.995965
83	30.466591	24.035789	19.651408	16.534396	14.233710	12.478977	11.102414	9.996332
84	30.550088	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	9.997244
87	30.786270	24.175788	19.713212	16.561896	14.246041	12.484548	11.104950	9.997495
88	30.860457	24.207489	19.729869	16.567827	14.248637	12.485692	11.105459	9.997723
89	30.932482	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	9.998118
91	31.070301	24.295461	19.764059	16.583679	14.255448	12.488642	11.106746	9.998289
92	31.136215	24.322558	19.775294	16.588376	14.257428	12.489484	11.107107	9.998444
93	31.200209	24.348614	19.785994	16.592808	14.259279	12.490263	11.107437	9.998586
94	31.262338	24.373667	19.796185	16.596988	14.261008	12.490984	11.107741	9.968714
95	31.322659	24.397757	19.805891	16.600932	14.262625	12.491652	11.108019	9.998831
96	31.381222	24.420900	19.815134	16.604653	14.264135	12.492271	11.108274	9.998937
97	31.438080	24.443193	19.823937	16.608163	14.265547	12.492843	11.108509	9.999034
98	31.493281	24.464608	19.832321	16.611475	14.266866	12.493373	11.108723	9.999122
99	31.546875	24.485200	19.840306	16.614599	14.268099	12.493864	11.108921	9.999202
100	31.598908	24.505000	19.847910	16.617546	14.269252	12.494319	11.109101	9.999274
P.S.	33.333333	25.000000	20.000000	16.666667	14.285714	12.500000	11.111111	10.000000

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 present 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 present 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 Interest*?

In *Table* I. even with 15 Years, and under 5 *l. per Cent.* I find the Amount of 1 *l.* to be	2.078928
Which multiply'd by the Principal - -	125
The Product will be - - -	259.866, &c.

Answ. 259 *l.* 17 *s.* 4 *d.*

Quest. 2. *What is the present Value of* 259 l. 17 s. 4 d. *to be paid at the End of* 15 *Years, discounting at the Rate of* 5 l. per Cent. per. Ann. *Compound Interest*?

In *Table* II. even with 15 Years, and under 5 *l. per Cent.* I find the present Value of 1 *l.* to be	.481017
Which multiply'd by the Principal	259.8667
The Product will be - - -	125.000, &c.

Answ. 125 *l.*

Quest. 3. *What will* 15 l. per Ann. *amount unto in* 21 *Years, at* 8 l. per Cent. per Ann. *Compound Interest*?

In *Table* III. even with 21 Years, and under 8 *l. per Cent.* I find the Amount of 1 *l. per Ann.* to be	50.422921
Which multiply'd by - - - - - - -	15
The Product will be - - -	756.343815

Answ. 756 *l.* 6 *s.* 10 ½ *d.*

Quest. 4. *What is the present Value of* 15 l. per Ann. *for* 21 *Years to come, at* 8 l. per Cent. per Ann. *Compound Interest*?

In *Table* IV. even with 21 Years, and under 8 *l. per Cent.* I find the present Value of 1 *l. per Ann.* to be	10.016805
Which multiply'd by - - - - - - -	15
The Product will be - - -	150.252075

Answ. 150 *l.* 5 *s.* 0 ½ *d.*

Quest. 5. *What will* 150 *l.* 5 *s.* 0 ½ *d. amount unto in* 21 *Years, at* 8 l. per Cent. per Ann. *Compound Interest*?

In *Table* I. even with 21 Years, and under 8 *l. per Cent.* I find the Amount of 1 *l.* to be	5.033834
Which multiply'd by - - - -	150.252
The Product will be - - -	756.343, &c.

Answ. 756 *l.* 6 *s.* 10 ½ *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 having 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* 6 l. per Cent. per Ann. *Compound Interest*?

I find in *Tab.* IV. the present Value of 1 *l. per Ann.* for 40 Years to come, at 6 *l. per Cent. per Ann.* to be	15.046297
I find in the same *Table* the Value of 1 *l. per Ann.* for 12 Years to come, at the same Rate, to be	8.383844
The Difference is - - - -	6.662453
Which multiply'd by - - - -	60
The Product will be - -	399.747180

Answ. 399 *l.* 14 *s.* 11 ¼ *d.*

Quest. 7. A *has the Possession of an Estate of* 100 l. 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* 5 l. per Cent. per Ann. *Compound Interest*?

I find in the last Line of *Table* IV. under 5 *l. per Cent.* the Fee Simple of 1 *l. per Ann.* to be worth 20 *l.* which multiply'd by 100, the Product is	2000.
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 Product is	1037.9658
The Difference is - - -	962.0342

Answ. 1037 *l.* 19 *s.* 3 ¾ *d.* the Possess. 15 Ys. to come.
962 *l.* 0 *s.* 8 ¼ *d.* 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* 150 l. *as a Fine, and* 300 l. per Ann. *or* 1700 l. *Fine, without any Rent.* B *bids* 650 l. *Fine, and* 200 l. per Ann. *And* C 200 l. *Fine, and* 405 l. per Ann.

The Question is, which is the best Offer, and what the Difference, computing at the Rate of 5 l. per Cent. per Ann. *Compound Interest?*

	l.	s.	d.
The Amount of 1 *l.* in 7 Years at 5 *l. per Cent.* (in *Table* I.) multiply'd by 150 *l.* is	211	01	03½
The Amount of 1 *l. per Ann.* in 7 Years, at 5 *l. per Cent.* (in *Table* III.) multiply'd by 300 *l.* is	2442	12	00½
Therefore *A*'s first Offer, at the End of 7 Years, will amount unto	2653	13	04
The Amount of 1 *l.* in 7 Years, at 5 *l. per Cent.* multiply'd by 1700 *l.* is what *A*'s 2d Offer will amount to in the same time	2392	01	05
The Amount of 1 *l.* in 7 Years, at 5 *l. per Cent.* multiply'd by 650 *l.* is	914	12	03½
The Amount of 1 *l. per Ann* in 7 Years, at 5 *l. per Cent.* multiply'd by 200 *l.* is	1628	08	00½
Therefore *B*'s Offer, at the End of 7 Years, will amount unto	2543	00	04
The Amount of 1 *l.* in 7 Years, at 5 *l. per Cent.* multiply'd by 200 *l.* is	281	08	05
The Amount of 1 *l. per Ann.* in 7 Years, at 5 *l. per Cent.* multiply'd by 405 *l.* is	3297	10	03
Therefore *C*'s Offer, at the End of 7 Years, will amount unto	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	03
A's 2d	1700	00	00
B's	1807	05	06
C's	2543	09	08

Therefore the present Value of what *C* offers is more than *A*'s 1st.	657	11	05
A's 2d.	843	09	08
B's	736	04	02

Which answers the Question.

Or thus;

	l.	s.	d.
A's 1st Offer is 300 *l. per Ann.* the present Value of which, for 7 Years, at 5 *l. per Cent.* is	1735	03	06
And a Fine of — —	150	00	00
	1885	18	03
A's 2d Offer is a Fine of	1700	00	00
B's Offer is 200 *l. per Ann*, the present Value of which, for 7 Years, at 5 *l. per Cent.* is	1157	05	06
And a Fine of — —	650	00	00
	1807	05	06
C's Offer is 405 *l. per Cent.* the present Value of which, for 7 Years, at 5 *l. per Cent.* is	2343	09	00
And a Fine of — —	200	00	00
	2543	09	08

	l.	s.	d.
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* 1550 l. *for an Annuity of* 100 l. per Ann. *for 99 Years.* B *puts* 1550 l. *out at Interest. It is requir'd to know, which will amount to the greatest Sum, at the End of the said 99 Years, at the Rate of* 6 l. per Cent. per Ann. *Compound Interest?*

	l.	s.	d.
The Amount of 1 *l. per Ann.* in 99 Years, at 6 *l. per Cent.* (in *Tab.* III.) multiply'd by 100 *l.* is	531827	03	06
The Amount of 1 *l.* in 99 Years, at 6 *l. per Cent.* (in *Tab.* I.) multiply'd by 1550 *l.* is	496149	05	5½
Therefore *A*'s 100 *l. per Ann.* will amount to more than *B*'s 1550 *l.* in that Term.	35677	18	0½

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 present Value of the Difference is likewise thus found:

Find 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 100 *l. per Ann.* for 99 Years, at 6 *l. per Cent.*			
And from which subtract	1550	00	00
There will remain — —	111	09	02

Which is the present Value of the Difference.

Or thus:

The Interest of *B*'s 1550 *l.* at 6 *l. per Cent.* is 93 *l. per Ann.* Therefore *A* receives 7 *l. per Ann.* more than *B*.

	l.	s.	d.
The present Value of 7 *l. per Ann.* for 99 Years to come, at 6 *l. per Cent.* is	116	06	6

The

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	l.	*s.*	*d.*
The present Value of 1550*l.* to be paid at the End of 99 Years, is	4	16	10
Therefore the present Value of the Difference, is	111	09	03

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 *Reason*.

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 *Is. Newton* shews how to collect, 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 several 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 six 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 dispsosed as those of the Stomach: For the Length of a Fibre is the Thickness of the Coat. This Coat being much larger than the other, lies in Wrinkles or Plaits, which are call'd *Valvulæ Conniventes*. It hath also a great Number of little Glands, which in the small Guts lie in Clusters every where, but where they are knit to the *Mesentery*, These Glands seem to separate a 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 straight, 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 *Peristaltick* Motion of the *Intestines*. The third and external Coat is common, and comes from the *Peritonæum*.

The *Intestines*, tho' properly but one continued Pipe, yet are divided into six Parts; three thin and small, and three thick and great. The thin and small are the *Duodenum*, the *Jejunum*, and *Ileum*. Thick and great *Guts* are the *Cæcum*, *Colon*, and *Rectum*: 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 *Elasticity*.) 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, &c. 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, *Who has lost? I have found, In the King's Holy Ground.*)

And King *Edw.* I. we find, granted to the *Barons of the Ports*, *Inventiones suas per Mare & Terras*, &c.

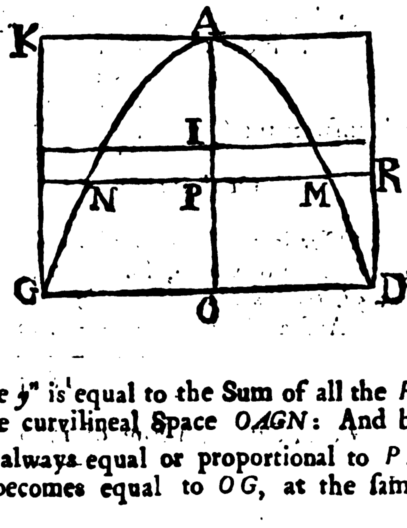
INVERSE *Method of Fluxions*, is the Method of finding the *Flowing Quantity* from the *Fluxion* given; and is the same with what the foreign Mathematicians call the *Calculus Integralis*: On which Subject there is a Treatise publish'd in *French* by Mr. *Carré*, *A.D.* 1700, Printed at *Paris*.

Some call it *Summatory Arithmetick*; and the Reason and Foundation of it Mr. *Hayes* shews in his Book of *Fluxions*.

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 'tis 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. *annex'd*) $PM = y$; the Abscissa $AP = x$; $PR = OD = b$; the Axis $OA = c$: That all the PR, or b's are : to all the PM, or y's : : as $m \mp 1$: is to m.

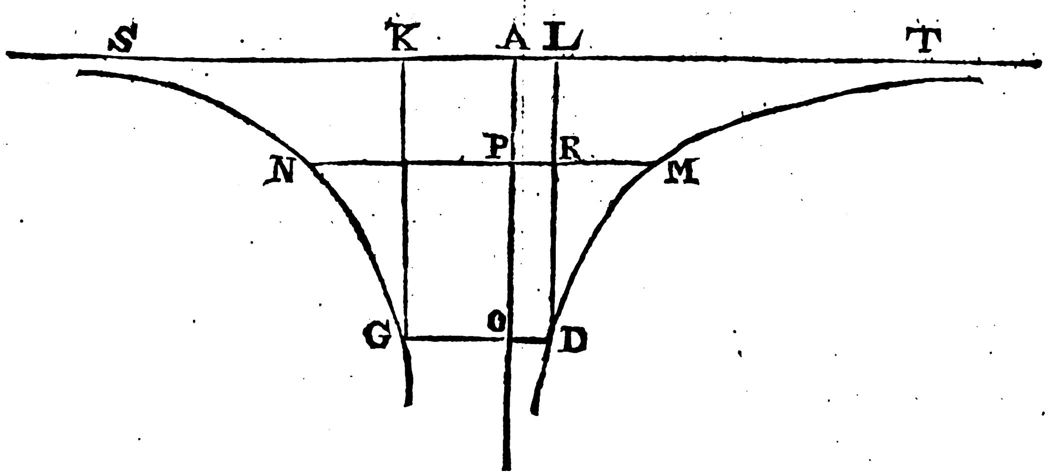
And if it be required to find what Proportion all the b's, advanced to any Power n, has to all the y's advanced to the same Power n, it may be thus investigated.

Suppose the new Curve NG to be described, so that PN be always equal or proportional to $\overline{PM}|^n$ or y^n, then it is manifest that the Sum of



all the y^n is equal to the Sum of all the PN, or to the curvilineal Space $OAGN$: And because y^n is always equal or proportional to PN, and PN becomes equal to OG, at the same time that

that y^n becomes equal to $b^n = \overline{OD}|^n$; 'tis likewise manifest, that the Sum of all the b^n is equal or proportional to the Sum of all the OG, or the Parallelogram $AOGK$. Whence it appears, that to investigate the Proportion of all the y^n to all the b^n is the same thing as to investigate the Proportion of the Curvilineal Space $AOGN$ to the Parallelogram $AOGK$. Which may be done



thus: In Paraboloids and Hyperboloids, the General Equation expressing the Nature of such Curves is $y^m = x$, and consequently $y^n = x^{\frac{n}{m}}$. Now suppose $y^n = z$, then $z = x^{\frac{n}{m}}$, and $z^m = x^n$, which is an Equation, expressing the Nature of a Paraboliform, or Hyperboliform Curve.

Let the said 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^n; therefore when z or PN becomes OG or d, then y^n becomes b^n; and consequently d is $= b^n$; therefore $m \pm n : m :: S : b^n : S : y^n$.

Hence we may easily deduce the 64th Prop. Arith. Infinit. *first discovered by the Learned Dr.* Wallis.

CONSECTARY I.

1. For we found before $z = x^{\frac{n}{m}}$, and it is also $m : m + n :: 1 : 1 + \frac{n}{m} :: y^n : b^n$. *in the direct Series*, and $1 : 1 - \frac{n}{m}$ :: all the y^n : all the b^n. *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 1 is to the Power of the intercepted Diameter or Index of the *Series* (because $z = y^n = x^{\frac{n}{m}}$; and consequently, $x^{\frac{n}{m}}$ represents y^n in the Dimension requir'd) *increas'd by Unity*; so are all the y^n to all the b^n.

CONSECTARY II.

2. Hitherto we have found the Proportion of all the y^n, or (multiplying both by the Fluxion $\dot{x}$) $y^n \dot{x}$ to all the $b^n \dot{x}$, their absolute Value may be found thus: It was by the preceding *Corollary*, $m : m \mp n$ :: all the $z\dot{x}$: all the $d\dot{x}$; that is, so is the Space $AOGN$, to the Rectangle $AOGK = dc$: Therefore $\frac{mdc}{m \mp n}$ = all the $z\dot{x} = S : y^n \dot{x}$, (because $z = y^n$.) But $b^n = d$; Therefore $S : y^n \dot{x} = \frac{mdc}{m \mp n} = \frac{mcb^n}{m \mp n} = \frac{1cb^n}{1 \mp \frac{n}{m}}$.

CONSECTARY III.

3. And if we suppose the Index $\mp \frac{n}{m} = \mp \mu$, then the Value of all the $y^n \dot{x}$ is $= \frac{1cb^n}{1 \mp \mu}$; and again, If in the Place of b^n we substitute $c^{\mp \mu}$ (because $y^n = x^{\mp \frac{n}{m}}$, that is, when y becomes $= b$, and

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and $x = c, c^{\mp \frac{\mu}{m}} = b^{m} = c^{\mp \mu}$) we shall have all the $y^{m} \dot{x} = \frac{c^{1 \mp \mu}}{1 \mp \mu}$.

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 $y^{m} \dot{x}$ are $=$ all the $x^{\mp \mu} \dot{x}$, it is evident, that (rejecting the invariable Quantities, if there be any) all the $x^{\mp \mu} \dot{x}$ $= \frac{c^{1 \mp \mu}}{1 \mp \mu} =$ (by putting the greatest $x = c$) $\frac{x^{1 - \mu}}{1 \mp \mu}$. Whence we have the Demonstration of the fundamental Rule in *Summatory Arithmetick, to find the flowing Quantity of a given Fluxion.*

CONSECTARY V.

5°. For instance, if the Right Line $AO = c$ be divided into an infinite Number of $\dot{x}$, the Sum of all the Rectangles contain'd under any Power of the Abscissa x, and all the $\dot{x}$ respectively, that is, the Sum of all the $x^{\mp \mu} \dot{x}$, or the *Flowing Quantity*, whereof $x^{\mp \mu} \dot{x}$ is the Fluxion, is equal to $\frac{c^{1 \mp \mu}}{1 \mp \mu} = \frac{x^{\mp \mu + 1}}{\mp \mu + 1} =$ 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 insist 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 $a a \dot{x}$, or $a a x^{0} \dot{x}$; to the Index of the flowing Quantity add 1, and then we have $a a x^{0+1} \dot{x}$; divide this by the fluxionary Letter $\dot{x}$, and by the new Index $0 + 1$, or 1, the Quotient $a a x$ is the flowing Quantity of the given Fluxion.

Example II.

Let it be required to find the flowing Quantity of $a y \dot{x} + a x \dot{y}$; the flowing Quantity of the first Member $a y \dot{x}$ is $= a x y$; and that of the second Member $a x \dot{y}$ is $= a x y$: Whence it is plain, that the flowing Quantity of $a y \dot{x} + a x \dot{y}$ is $= a x y$.

Example III.

Let it be required to find the flowing Quantity of $3 x x \dot{x}$; increase the Index of the flowing Quantity x by 1, and then we have $3 x^{3} \dot{x}$, which divide by the new Index 3, and by the fluxionary Letter $\dot{x}$, then the Quotient $= \frac{3 x^{3} \dot{x}}{3 \times \dot{x}} = x^{3}$ is the flowing Quantity of the given Fluxion.

And Universally;

If it be requir'd to find the flowing Quantity of $m x^{m-1} \dot{x}$, increase the *Index* of the flowing Quantity x by 1, and then we have $m x^{m} \dot{x}$, which divide by the new *Index* m, and by the fluxionary Letter $\dot{x}$, 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 $\frac{a \dot{x}}{x x}$; the Fluxion (*Hayes, Art.* 16.) express'd by the other way of Notation, is $a x^{-2} \dot{x}$, and the flowing Quantity thereof is $- a x^{-1} = \frac{-a}{x}$. Thus the Flowing Quantity of $\frac{a x \dot{x}}{x^{\frac{3}{2}}} = \frac{a \dot{x}}{x^{\frac{1}{2}}} = a x^{-\frac{1}{2}} \dot{x}$ is $= 2 a x^{\frac{1}{2}}$.

Example V.

Let it be required to find the flowing Quantity of $\frac{-3 \dot{x}}{x^{4}} = -3 x^{-4} \dot{x}$. To the *Index* of the Power of the flowing Quantity add 1, and divide by the new Exponent, and by $\dot{x}$, the Quotient is $= x^{-3} = \frac{1}{x^{3}} =$ the flowing Quantity required.

Example VI.

Let it be required to find the flowing Quantity of $\frac{x^{2} \dot{x}}{\sqrt{r x}}$; this Fluxion may be express'd

thus,

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thus, $r^{-\frac{1}{2}} \times x^{\frac{3}{2}}\dot{x}$, and then the flowing Quantity thereof is $\frac{2}{5} r^{-\frac{1}{2}} x^{\frac{5}{2}} = \frac{2\sqrt{x^5}}{5\sqrt{r}}$.

Example VII.

The flowing Quantity of $\dot{x}\sqrt{2r\dot{x}}$, or $\dot{x} \times \overline{2r}^{\frac{1}{2}}$ is $\frac{2}{3} \times \overline{2r}|^{\frac{1}{2}} x^{\frac{3}{2}} = \frac{2}{3}\sqrt{2rxxx}$, and the flowing Quantity of $\dot{x}\sqrt{2rx - xx}$ is found by reducing $\overline{2rx - xx}|^{\frac{1}{2}}$ to an infinite Series, and multiplying the same by $\dot{x}$, and then finding the flowing Quantity of every Term.

Example VIII.

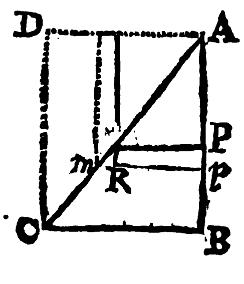
To find the Fluent of $a\dot{x}\sqrt{ax - aa}$. In such Cases where the Fluxion is affected with a *Vinculum*, we must consider whether the fluxional Quantity, standing before the Radical Sign, be the Fluxion of the simple or compound Quantity under the ——— *Vinculum*, for in such Cases the Fluent may be found by the General Rule.

Thus in this Example I observe, that $a\dot{x}$ is the Fluxion of $\overline{ax - aa}$, and therefore the Fluent of $a\dot{x}\sqrt{\overline{ax - aa}|}$ or $a\dot{x} \times \overline{ax - aa}|^{\frac{1}{2}}$ is $\frac{2}{3} \times \overline{ax - aa}|^{\frac{3}{2}} = \frac{2ax - 2aa}{3}\sqrt{ax - aa}$.

In like manner the Fluent of $\frac{r\dot{x} - x\dot{x}}{\overline{2rx - xx}^{\frac{1}{2}}}$, or $\overline{r\dot{x} - x\dot{x}} \times \overline{2rx - xx}|^{-\frac{1}{2}}$ or $\overline{2r\dot{x} - 2x\dot{x}} \times \frac{1}{2}$ $\overline{2rx - xx}|^{\frac{1}{2}}$ will be found (if to the Exponent $-\frac{1}{2}$ we add 1, and divide by the new Exponent $\frac{1}{2}$, and by the fluxionary Quantity $\overline{2r\dot{x} - 2x\dot{x}}$) to be $\sqrt{2rx - xx}$.

These Rules may be demonstrated by Induction 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 $AB = a$, $BC = b$, $AP = x$, $Pp = \dot{x}$, $PM = y$; then the Equation of the Triangle is



$y = \frac{bx}{a}$, and the infinitely little Parallelogram $Mp =$ to the Fluxion of the Triangle, is $= y\dot{x}$ $=$ (by Substitution) $\frac{bx\dot{x}}{a}$: And the flowing Quantity is $\frac{bxx}{2a} = \left(\text{putting } y = \frac{bx}{a}\right) \frac{xy}{2}$. it remains to be proved that the Sum of all the $y\dot{x}$ is $= \frac{xy}{2}$.

Compleat the Parallelogram $ABCD$, then it is evident that the Triangle ABC is equal to the Sum of all the $y\dot{x}$, and the Triangle ADC is equal to the Sum of all the $x\dot{y}$. 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 $y\dot{x} = \frac{xy}{2} =$ Triangle ABC.

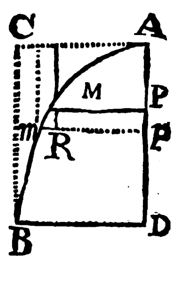
2. Let AMB be a Parabola, $AP = x$, $PM = y$, the Parameter $= 1$, then the Equation of the Curve is $x^{\frac{1}{m}} = y$, and the Fluxion of the Parabolick Space, *viz.* $Mp = y\dot{x} = x^{\frac{1}{m}}\dot{x}$. Now it is evident, that the Sum of all those Parallelograms is equal to the Parabolick Space $AMBD$. And the flowing Quantity of $x^{\frac{1}{m}}\dot{x}$ is $\frac{m}{m+1} x^{\frac{1}{m}+1} = \left(\text{putting } y \text{ for } x^{\frac{1}{m}}\right) \frac{m}{m+1}$ xy, which we must prove to be equal to the Sum of all the $y\dot{x}$.

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 $1 = \frac{mx\dot{y}}{y\dot{x}}$,

And $\frac{1}{m} = \frac{x\dot{y}}{y\dot{x}}$,

Adding 1 to each Side of the Equation } $\frac{1}{m} + 1 = \frac{x\dot{y}}{y\dot{x}} + 1$;



That is $\frac{m+1}{m} = \frac{x\dot{y} + y\dot{x}}{y\dot{x}}$;

Whence

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Whence

$$m : m+1 :: \quad y\dot{x} : \quad x\dot{y} + \quad y\dot{x};$$

And consequently,

$$m : m+1 :: S:y\dot{x} : S:x\dot{y} + S:y\dot{x};$$

But

$$S:x\dot{y} + S:y\dot{x} = xy.$$

Therefore

$$m : m+1 :: S:y\dot{x} : xy;$$

And consequently

$$\frac{m}{m+1} \times xy = S:y\dot{x}. \quad \text{Q. E. D.}$$

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 him 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 *Unciæ* or Numbers prefix'd to the several Terms are,

$$1 \times \frac{m-0}{1} \cdot 1 \times \frac{m-0}{1} \times \frac{m-1}{2} \cdot 1 \times \frac{m-0}{1} \cdot \times \frac{m-1}{2} \times \frac{m-2}{3} \times, \text{ \&c. respectively.}$$

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

$$\overline{P+PQ}|^{\frac{m}{n}} = \overset{A}{P^{\frac{m}{n}}} + \overset{B}{\frac{m}{n} AQ} + \overset{C}{\frac{m-n}{2n} BQ} + \overset{D}{\frac{m-2n}{3n} CQ}, \text{ \&c.}$$

For Instance, if it be required to extract the square 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, $\overline{rr - xx}|^{\frac{1}{2}} = r - \frac{xx}{2r} - \frac{x^4}{8r^3} - \frac{x^6}{16r^5} - \frac{5x^8}{128r^7} -$, &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, $P = a$, $Q = \frac{x}{a}$, and $\frac{m}{n} =$ (n in this Case being $= 1$) m; therefore $\overline{a+x}|^m$ is $= a^m + ma^{m-1}x + m \times \frac{m-1}{2} \times a^{m-2}x^2 + m \times \frac{m-1}{2} \times \frac{m-2}{3} a^{m-3}x^3 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} a^{m-4}x^4$, &c.

By the same Method any *Trinomial*, *Quadrinomial*, &c. or *Infinito-nomial* may be raised to any given Power, *v. g.* To raise the *Infinito-nomial* $a + bz + cz^2 + dz^3 +$, &c. to the Power, whose Exponent is m: In the preceding *Binomial* Theorem,

Instead of x put $\overline{bz + cz^2 + dz^3, \text{\&c.}}|^1$, and instead of x^2 substitute $\overline{bz + cz^2 + dz^3, \text{\&c.}}|^2$ Then it is manifest that $\overline{a + bz + cz^2 + dz^3, \text{\&c.}}|^m$ is $= a^m + ma^{m-1} \times \overline{bz + cz^2 + dz^3, \text{\&c.}}|^1 + m \times \frac{m-1}{2} a^{m-2} \times \overline{bz + cz^2 + dz^3, \text{\&c.}}|^2 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times a^{m-3} \times \overline{bz + cz^2 + dz^3, \text{\&c.}}|^3 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} \times a^{m-4} \times \overline{bz + cz^2 + dz^3, \text{\&c.}}|^4 +$, &c.

Example I.

Let it be required to find the flowing Quantity of this Fluxion $\dot{x}\sqrt{rr - xx}$. Reduce $\sqrt{rr - xx}$ to an (*Hayes*'s *Art.* 93.) Infinite Series, and then $\overline{rr - xx}|^{\frac{1}{2}}$ is $= r - \frac{xx}{2r} - \frac{x^4}{8r^3} - \frac{x^6}{16r^5} - \frac{5x^8}{128r^7} -$, &c. And consequently, $\dot{x}\sqrt{rr - xx}$ is $= r\dot{x} - \frac{x^2\dot{x}}{2r} - \frac{x^4\dot{x}}{8r^3} - \frac{x^6\dot{x}}{16r^5} - \frac{5x^8\dot{x}}{128r^7} -$, &c. And finding the flowing Quantity of every Term of this Series, then the Sum of all the $\dot{x}\sqrt{rr - xx}$ is $= rx - \frac{x^3}{6r} - \frac{x^5}{40r^3} - \frac{x^7}{112r^5} - \frac{5x^9}{1152r^7} -$, &c. Q. E. I.

Example II.

It is required to find the flowing Quantity of $\frac{rr\dot{x}}{r+x}$. It is evident from the (*Hayes*'s *Art.* 16.) Notation of Powers, that $\frac{rr}{r+x}$ is $= rr \times \overline{r+x}|^{-1}$. But $\overline{r+x}|^{-1}$ is $=$ (*Hayes*'s *Art.* 93.) $r^{-1} - \frac{x}{rr} + \frac{xx}{r^3} - \frac{x^3}{r^4} +$, &c. And conse-

conſequently $\frac{rr}{r+\dot{x}}$ or $rr \times \overline{r+x}|^{-1}$ is $= r$ $-x + \frac{xx}{r} - \frac{x^3}{r^2} +$, &c. and $\frac{rr\dot{x}}{r+x}$ is $=$ $r\dot{x} - x\dot{x} + \frac{x^2\dot{x}}{r} - \frac{x^3\dot{x}}{r^2} +$, &c. and the flowing Quantity of $\frac{rr\dot{x}}{r+x}$ is $= rx - \frac{xx}{2} + \frac{x^3}{3r}$ $- \frac{x^4}{4r^2} +$, &c. *Q. E. I.*

SCHOLIUM.

And if we divide the Series (*Examp.* 1.) by $\overline{rr-xx}|^{\frac{1}{2}}$ reduced to an infinite Series, and multiply the Diviſor by the Quotient, we ſhall have $rx - \frac{x^3}{6r} - \frac{x^5}{40r^3} - \frac{x^7}{112r^5} - \frac{5x^9}{1152r^7} -$ &c. $= x + \frac{2x^3}{6r^2} + \frac{32x^5}{123r^4}$, &c. $\overline{rr-xx}|^{\frac{1}{2}}$

And in general, If the given Fluxion conſiſts 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 conſiſts of a finite Number of Terms or not.

The Fluent of a Fluxion involving ſurd 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 affected 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 ſhall begin with ſome eaſy Examples.

Example I.

Let it be required to find the Fluent of $a\dot{x}$ $\sqrt{ax-aa}$, the Fluxion reduced to its ſimpleſt Terms is $a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$. Now ſuppoſe the Fluent of this Fluxion to be $A \times \overline{xa-aa}|^{\frac{3}{2}}$, then it is evident, that the Fluxion of this Fluent muſt be equal to the given Fluxion, *i. e.* $\frac{3}{2} A \times a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$ is $= a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$. Therefore (dividing by $\overline{ax-aa}|^{\frac{1}{2}}$) $\frac{3}{2} A \times a\dot{x} = a\dot{x}$, and $A = \frac{2}{3}$. Having thus found the true Value of the indeterminate Coefficient A (*viz.* $\frac{2}{3}$) in the aſſum'd Equation, ſubſtitute the ſame in place of A, and then we have $\frac{2}{3} \times \overline{ax-aa}|^{\frac{3}{2}}$ or $\frac{2ax-2aa}{3}$ $\sqrt{ax-aa}$ equal to the Fluent of the given Fluxion.

Example II.

To find the Fluent of $\frac{r\dot{x}-x\dot{x}}{\sqrt{2rx-xx}}$, this Fluxion is expreſſed thus, $\overline{r\dot{x}-x\dot{x}} \times \overline{2rx-xx}|^{-\frac{1}{2}}$. Suppoſe the Fluent thereof to be $A \times \overline{2rx-xx}|^{\frac{1}{2}}$. Then the Fluxion of this Quantity is $\frac{1}{2} A \times$ $\overline{2r\dot{x}-2x\dot{x}} \times \overline{2rx-xx}|^{-\frac{1}{2}} = \overline{r\dot{x}-x\dot{x}} \times$ $\overline{2rx-xx}|^{\frac{1}{2}}$; Therefore $\frac{1}{2} A \times 2r\dot{x} - 2x\dot{x}$ $= r\dot{x} - x\dot{x}$, and $A = 1$; and conſequently, the Fluent of the given Fluxion is equal to $\overline{2rx-xx}|^{\frac{1}{2}}$

Example III.

To find the Fluent of $dx^r\dot{x} \times \overline{e+fx^n}|^m$. Aſſume 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 $\overline{Adx^{r-n+1} + Bdx^{r-2n+1} + Cdx^{r-3n+1}, \text{ \&c.}} \times \overline{e+fx^n}|^{m+1} = S : dx^r\dot{x} \times \overline{e+fx^n}|^m$

Then,

$\overline{\overline{r-n+1} \times Adx^{r-n}\dot{x} + \overline{r-2n+1} \times Bdx^{r-2n}\dot{x} + \overline{r-3n+1} \times Cdx^{r-3n}\dot{x}, \text{ \&c.}} \times \overline{e+fx^n}|^{m+1} + \overline{m+1} \times \overline{e+fx^n}|^m \times nfx^{n-1}\dot{x} \times \overline{Adx^{r-n+1} + Bdx^{r-2n+1} + Cdx^{r-3n+1}, \text{ \&c.}} = dx^r\dot{x} \times \overline{e+fx^n}|^m$.

Whence

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Whence, supposing $\frac{1}{p} = m + 1$, and putting $\dot{x} = 1$.

$$\overline{\overline{r-n+1} \times Adx^{r-n} + \overline{r-2n+1} \times Bdx^{r-2n} + \overline{r-3n+1} \times Cdx^{r-3n}, \&c.}$$

$$\times\, \overline{e+fx^n}|^{\frac{1}{p}} + \frac{1}{p} \times n \times Adf \times x^r + \frac{1}{p} \times n \times Bdfx^{r-n} + \frac{1}{p} \times n \times Cdfx^{r-2n}, \&c.$$

$$\times\, \overline{e+fx^n}|^{\frac{1-p}{p}} = dx^r \times \overline{e+fx^n}|^{\frac{1-p}{p}}.$$

And multiplying each Side of the Equation by $p \times \overline{e+fx^n}|^{\frac{p-1}{p}}$ we have $p \times \overline{r-n+1} \times Adx^{r-n} + p \times \overline{r-2n+1} \times Bdx^{r-2n} + p \times \overline{r-3n+1} \times Cdx^{r-3n}$, &c. $\times\, \overline{e+fx^n}| + n \times Adf \times x^r + n \times Bdfx^{r-n} + n \times Cdfx^{r-2n}$, &c. $= dx^r \times \overline{e+fx^n}|^{\frac{1-p}{p}} \times p \times \overline{e+fx^n}|^{\frac{p-1}{p}}$.

Which being order'd, we have

$$\left.\begin{matrix} p \times \overline{r-n+1} \times Adf \\ n \times Adf \\ \end{matrix}\right\} x^r \left.\begin{matrix} +p \times \overline{r-n+1} \times Ade \\ +p \times \overline{r-2n+1} \times Bdf \\ + \qquad n \times Bdf \end{matrix}\right\} x^{r-n} \left.\begin{matrix} +p \times \overline{r-2n+1} \times Bde \\ +p \times \overline{r-3n+1} \times Cdf \\ + \qquad n \times Cdf \end{matrix}\right\} x^{r-2n}, \&c.$$

$$= dx^r \times \overline{e+fx^n}|^{\frac{1-p}{p}} \times p \times \overline{e+fx^n}|^{\frac{p-1}{p}} = p \times dx^r.$$

From which Equation the unknown Coefficient A, B, C, &c. may be determined in this manner;

$$p \times \overline{r-n+1} \times Adf + n \times Adf = pd$$

And dividing by pd,

$$\overline{r-n+1} \times Af + \frac{1}{p} \times n \times Af = 1,$$

Substituting $m+1$ for $\frac{1}{p}$,

$$\overline{r-n+1} \times Af + \overline{m+1} \times n \times Af = 1.$$

Whence $A = \frac{1}{\overline{r-n+1} \times f + \overline{mn+n} \times f} = \frac{1}{\overline{mn+r+1} \times f}$

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.

$$\overline{r-2n+1} \times Bf + \overline{mn+n} \times Bf = \overline{n-r-1} \times Ae.$$

Whence $B = \frac{\overline{n-r-1} \times Ae}{\overline{r-2n+1} \times f + \overline{mn+n} \times f} = \frac{\overline{n-r-1} \times Ae}{\overline{mn+r-n+1} \times f}$.

In like manner,

$$C = \frac{\overline{2n-r-1} \times Be}{\overline{mn+r-2n\ 1} \times f},$$

Whence it is evident that $Adx^{r-n+1} + Bdx^{r-2n+1} + Cdx^{r-3n+1}$, &c.

$\times\, \overline{e+fx^n}|^{m+1}$ is $= \frac{d}{\overline{mn+r+1} \times f} \times x^{r-n+1} + \frac{d}{\overline{mn+r+1} \times f} \times \frac{\overline{n-r-1} \times e}{\overline{mn+r-n+1} \times f}$

$+$

$$\times x^{r-2n+1} + \frac{d}{\overline{mn+r+1} \times f} \times x^{r-n+1} \times \frac{\overline{n-r-1} \times de}{\overline{mn+r-n+1} \times f} \times \frac{\overline{2n-r-1} \times de}{\overline{mn+r-2n+1} \times f} \times x^{r-3n+1}, \text{ \&c. } \times \overline{e+fx^n}|^{m+1} = S : dr\dot{x} \times \overline{e+fx^n}|^m,\ Q.\ E.\ I.$$

In which it may be observed, That the Exponents of the Terms of the Indeterminate Series before the Radical Sign may be taken different from those above, provided that the Exponent of the first Term be not less than $r - n + 1$, 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 n, the Fluent will consist of a finite Number of Terms, when $\frac{r+1+mn}{-n}$ is equal to a positive whole Number: And that when the Exponents decrease regularly by n, the Fluent will consist of a finite Number of Terms, when $\frac{r+1}{n}$ is equal to a positive whole Number.

This General *Theorem* may easily be applied to find the Fluent of any given Fluxion included in the General one $dx^r \dot{x} \times \overline{e+fx^n}|^m$. *V. G.* To find the Fluent of $a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$. I put the same equal to the General Fluxion, *viz.*

$$dx^r \dot{x} \times \overline{e+fx^n}|^m = a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}.$$

Then $d = a$, $f = 0$, $f = a$, $n = 1$, $m = \frac{1}{2}$, $e = -aa$; and if we substitute the said particular Values of d, r, f, n, m, e in the General Fluent, we shall have

$$\frac{d}{\overline{mn+r+1} \times f} \times x^{r-n+1} + \frac{d}{\overline{mn+r+1} \times f} \times \frac{\overline{n-r-1} \times de}{\overline{mn+r-n+1} \times f} \times x^{r-2n+1} + \frac{d}{\overline{mn+r+1} \times f} \times \frac{\overline{n-r-1} \times de}{\overline{mn+r-n+1} \times f} \times \frac{\overline{2n-r-1} \times de}{\overline{mn+r-2n+1} \times f} \times x^{r-3+1} +, \text{ \&c. } \times \overline{e+fx^n}|^{m+1} = \frac{a}{\overline{\frac{1}{2}+1} \times a} \times x^{0-1+1} \times \overline{ax-aa}|^{\frac{1}{2}+1} = \tfrac{2}{3} \times \overline{ax-aa}|^{\frac{3}{2}} = S : a\dot{x}\sqrt{ax-aa}.$$

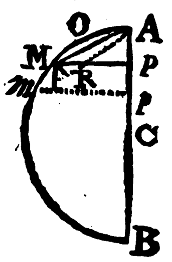
Q. E. I.

I have hitherto 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 Treatise, writ by that excellent Analyst 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 flowing 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 $\dot{x}\sqrt{2rx-xx}$. On the Center C, with



the Radius $CB = r$, describe the Semi-circle AMB, and suppose $AP = x$; then is $PB = 2r - x$, and $MP = \sqrt{2rx-xx}$, and $Pp = \dot{x}$; therefore the Fluxion of the *Area*, *viz.* the Parallelogram Mp is $= \dot{x}\sqrt{2rx-xx}$, and consequently the Sum of all the $\dot{x}\sqrt{2rx-xx}$, 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 $\frac{rx\dot{x}}{2\sqrt{2rx-xx}}$. 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 $AM = \sqrt{2rx}$, and Rm the Fluxion thereof is $\frac{r\dot{x}}{\sqrt{2rx}}$. Now because the Triangles APM, MRm, are (the Angles AMP and MmR standing on equal Arches of the Circle) similar, it is $PM\ (\sqrt{2rx-xx}) : AP\ (x) :: Rm\ \left(\frac{r\dot{x}}{\sqrt{2rx}}\right) : MR = \frac{rx\dot{x}}{\sqrt{2rx} \times \sqrt{2rx-xx}}$; and consequently the infinitely little Sector $MAR = \frac{1}{2} AR \times MR$ is $= \frac{rx\dot{x}}{2\sqrt{2rx-xx}} =$ to the given Fluxion: Whence it is evident that the

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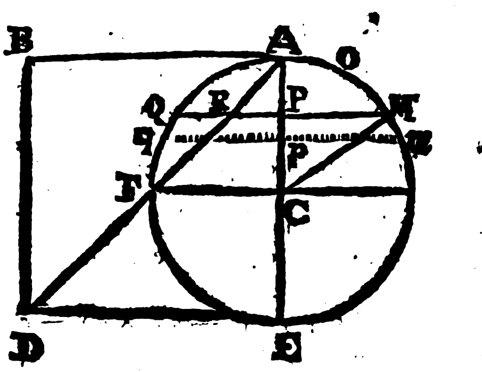
Segment $AOMA$ is the flowing Quantity of the given Fluxion.

Example III.

Let it be required to find the flowing Quantity of this Fluxion $x\dot{x} \times 2\sqrt{2rx - xx}$. On



the Center C, with the Radius $CA = r$, describe the Circle $AFEM$; and suppose $= x$, $Pp = \dot{x}$, $PE = 2r - x$, the Circumference $AFEM = c$; then, I say, that the Sum of all the $x\dot{x} \times 2\sqrt{2rx - xx}$ 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 thro' AD, and perpendicular 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^{o}.) $= x\dot{x} \times 2\sqrt{2rx - xx}$; and consequently the Sum of all the $x\dot{x} \times 2\sqrt{2rx - xx}$ is (when AP becomes equal to AE, or $x = 2r$) equal to the Semi-quadrantal *Ungula* $ADE = \frac{rrc}{2}$. *Q. E. I.*

And thus innumerable Instances might be assign'd, to assist us in finding the flowing Quantity of any Fluxion, without having immediate Recourse to an Infinite Series.

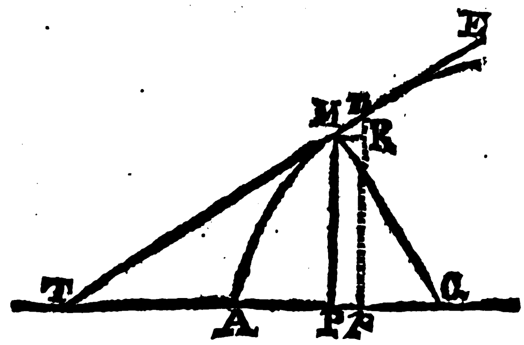
INVERSE *Method of Tangents*, is the Method of finding an Equation to express the Nature of a Curve in an Equation, express'd in the *nearest Terms.* This depends on the Problem of finding the *fluent* or *flowing Quantity*, by having the Fluxion given (of which see the *Inverse Method of Fluxions* above 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 sorts 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.

1. What I mean by the nearest Terms will be best explain'd by an *Example.*

Suppose $PT = t$, $AP = x$, $PM = y$, $MT = s$; and let the Equation expressing the Nature of



the Curve be $y^3 + ayy = x^3 + bxx$; Then the Sub-tangent TP will be $t =$ (*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 $3y^3 = 3x^3 + 3bxx - 3ayy$; and consequently $t = \frac{3x^3 + 3bxx - ayy}{3xx + 2bx}$, such 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.) AMm be described, and draw MT to touch the Curve in M; then suppose the *Abscissa* $AP = x$; the Ordinate $PM = y$, $Pp = \dot{x}$, $Rm = \dot{y}$; then because the Triangles mRM, MPT are similar; therefore $mR\ (\dot{y}) : RM\ (\dot{x}) :: PM\ (y) : PT = \frac{y\dot{x}}{\dot{y}}$. 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 $= \frac{2y^3}{3rr}$. The Sub-tangent PT is $= \frac{y\dot{x}}{\dot{y}} =$ (*ex Hyp.*) $\frac{2y^3}{3rr}$; therefore $3rry\dot{x} = 2y^3\dot{y}$, and $3rr\dot{x} = 2y^2\dot{y}$: And substituting x for $\dot{x}$, and

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and y for $\dot{y}$: $3rrx = 2y^3$, and (dividing $3rrx$ by 1 the Exponent of x, and dividing $2y^3$ by 3 the Exponent of y) $3rrx = \frac{2}{3}y^3$, and $9rrx = 2y^3$, which divided by 2, we have $\frac{9}{2}rrx = y^3$, the Equation expressing the Nature of the Curve *AMm*.

Example II.

Let it be required to find the Property of the Curve *AMm*, the Sub-tangent PT being $= \frac{2yy}{r}$.

The Sub tangent PT is $= \frac{y\dot{x}}{\dot{y}} =$ (by Supposition) $\frac{2yy}{r}$; and therefore $ry\dot{x} = 2yy\dot{y}$, and $r\dot{x} = 2y\dot{y}$, and (substituting x for $\dot{x}$, and y for $\dot{y}$) $rx = 2yy$, and consequently (dividing rx by the Exponent of x, and $2yy$ by 2 the Exponent of y) $rx = yy$, which shews that the Curve *AMm* 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 $= \frac{3y^3 + 2byy}{3xx + 2ax}$.

The Sub-tangent PT is $= \frac{y\dot{x}}{\dot{y}} = \frac{3y^3 + 2byy}{3xx + 2ax}$.

Therefore $3xx\dot{x} + 2ax\dot{x} = 3y^2\dot{y} + 2by\dot{y}$ and (putting x for $\dot{x}$, and y for $\dot{y}$) $3x^3 + 2ax^2 = 3y^3 + 2by^2$, and (dividing every Term by the Exponent of the Flowing Quantity therein) $x^3 + axx = y^3 + byy$; which Equation expresses the Nature of the Curve *AMm*.

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 (*Hayes*, Art. 61.) sixth 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 necessary to observe from the forecited Place:

1°. The Sub-tangent t is always of one Dimension, and is express'd by a Fraction.

2°. When the Value of the Sub-tangent is expressed in the nearest Terms, then the Numerator of the Fraction consists only of those Terms wherein the Ordinate y, (or the Tangent s) 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; nor the Ordinate y, Tangent s, or Curve z, in the Denominator.

4°. But if the Equation of the Curve contain mix'd Terms, then both x, z, 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 side, and every t changed into x, and every s into 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 Method of Tangents.

1°. Change every t into x, and every s into z (denoting the Curve) and transpose all the Terms to one side of the Equation, and diligently observe whether all the Terms are Simple, or some Simple and others Mixt.

2°. If all the Terms be Simple, divide every Term by the Exponent of the Intermediate or Flowing Quantity in the same; so have you the Equation expressing the Nature of the Curve.

3°. And if there be any mixt Terms, then observe (*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.

4°. Retain only one of those mixt Terms which occur more than once in the Equation, and manage the other simple Terms according to *Hayes*, Sect. 2. and there will arise an Equation expressing the Nature of the Curve.

Example I.

Suppose $t = \frac{y^3 + ayy - bby}{xx + ax + bb}$; then (by *Rule* 1.) changing t into x, and transposing all the Terms to one side of the Equation, we have $x^3 + axx + bbx - y^3 - ayy + bby$; and because all the Terms are simple Terms, therefore (2.) $\frac{1}{3}x^3 + \frac{1}{2}axx + bbx - \frac{1}{3}y^3 - \frac{1}{2}ayy + bby = 0$, which is an Equation expressing the Nature of the Curve, as was required.

Example II.

Let the Value of the Sub-tangent be $t = \frac{3y^3 + 2ayy - 2xyy - xxy}{3xx + 2xy + yy}$, then we have (by 1.) $3x^3 + 2yxx + yyx - 3y^3 - 2ayy + 2xyy + xxy$, and because we have the mixt

mixt Terms $2yxx$ and yxx, alſo yyx, and $2yyx$, 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 $yxx + yyx$ (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 $x^3 + yxx + yyx - y^3 - ayy = 0$.

Example III.

And the Method is the ſame if the Curve z enter into the Value of the Sub-tangent, *v.g.* ſuppoſe

$$t = \frac{6ay^3zz + 4ay^3zs + aay^4 - yxxz^3 - 2yxxzzs}{2yxz^2}$$

change every t into x, and every s into z; and tranſpoſe all the Terms over to the ſame Side of the Equation, and then we have $2yz^3xx + yxxz^3 + 3yxxz^3 - 6ay^3zz - 4ay^3zz - aay^4$.

Wherein the Term $yxxz^3$, containing three flowing Quantities, is found thrice, and the Term ay^3zz, 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 $yz^3x^2 - 2ay^3zz - \frac{1}{4}aay^4 = 0$: Or adding any determinate Quantity bb; $yz^3x^2 - 2ay^3zz - \frac{1}{4}aay^4 + bb = 0$.

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 conſiſting of invariable Quantities are rejected and vaniſh: And this is ſometimes abſolutely neceſſary, *v.g.* Suppoſe $t = \frac{-xy}{2x + y}$: 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 $xx + xy = bb$.

COROLLARY.

Hence, if the Value of the Subnormal (Fig. *Hayes*, Art. 82.) PQ be given, the Property of the Curve may be found. For the Triangles QMP, MTP are ſimilar; therefore $QP : PM :: PM : PT$; and if PQ be $= q$, then $t = \frac{yy}{q}$. 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 mRM, QPM, are ſimilar; therefore $MR\ (\dot{x}) : Rm\ (\dot{y}) :: PM\ (y) : PQ = \frac{y\dot{y}}{\dot{x}}$, 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 $\frac{y\dot{y}}{\dot{x}} = \frac{aax}{2yy}$, and $aax\dot{x} = 2y^3\dot{y}$; and (ſubſtituting x for $\dot{x}$, and y for $\dot{y}$) $aaxx \square 2y^4$; therefore (dividing the Terms by the Exponents of x and y reſpectively) $\frac{1}{2}aaxx = \frac{1}{2}y^4$. Whence $ax = y^2$, which ſhews that the Curve AMm is a *Parabola*.

INVEST. To *Inveſt*, in the Law, ſignifies 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 conſign'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 Indiviſo*, 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 *Hæredes*: And theſe muſt *jointly implead*, and *jointly be impleaded*; which Property is common to them and to *Coparceners*. But *Joint-Tenants* have a *ſole Property* of Survivorſhip, which *Coparceners* 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 laid.

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 *Glouceſterſhire*, 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 Refuſe 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,

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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 *Overshot 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 sorts, 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 dextrously 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.* N° 137.

At *Milthorpe* in *Lancashire* they have several Sorts of *Iron-Stone*, some of it making *Coldshire-Iron*; that is, such as is brittle when it is cold. Another sort makes *Redshire*, which is such as is apt to break if it be hammer'd when 'tis 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 Ore (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 Fusion, 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 *Scoriæ* 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 *Sussex* lies from four Foot deep to forty and upwards. There are several sorts of Mine, some hard, some gentle, some rich, some poor, some fine, 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 setting 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: Nor must 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 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

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Every six 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 less in a *Founday*, at last more.

The Hearth, by the Force of the Fire continually 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 lesser Pieces of 1000 Pound, and under, they call *Pigs*.

Of twenty four Load of Coals, they expect eight Ton of *Sows*. To every Load of Coals, which consists of eleven Quarters, they put a Load of Mine, containing eighteen Bushels.

A *Hearth*, if made of good Stone, will ordinarily 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 six *Foundays*. The Cynder, like Scum, swims upon the melted Metal in the *Hearth*, and is let out once or twice before a *Sow* is cast.

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 ¾ of a hundred Pound Weight; which, as soon 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 *Iron*.

At the *Chafery* they only draw out the two Ends suitable to what was drawn out at the *Finery* 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 six Tun in a Week.

One thing is remarkable here: They say, 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, causing it to spatter about so, that it cannot be wrought into a solid Piece. *Ray's Collect. of English Words*, at the End.

IRREGULARITY, in the Canon-Law, signifies an Impediment, which will hinder a Person's going into Holy Orders, as being a *Bastard, Maimed, Consenting to a Murder*, &c.

IRREPLEVIABLE, in the Common-Law, signifies what may not be *Replevied*, or set 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 *Act. 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 similar 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 uniformly 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 *Cerebellum* 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 sent 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 leisure enough to go thither to fetch them. The first Jubilee is said to have been Instituted by Pope *Boniface* VIII. *A. D.* 1300. to return every Hundred Years. But Pope *Clement* VI. thought such 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 *Civil Jubilee* at his Court in the Fiftieth Year of his own Age, which was in 1362, granting Pardons, Privileges, and other Civil Indulgencies.

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JUDICIUM *Dei*. Our Anceſtors uſed to call thoſe now prohibited Trials of guilty Perſons by *Ordeal*, *Judicium Dei*, the Judgment of God: See *Ordeal* in this Volume.

JUGUM *Terræ*, is half an Arpent or fifty Perches, mention'd in *Domeſday-Book*, and interpreted there to contain half a Plough-land.

JUPITER. The Calculation of the Eclipſes 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* *Prælectiones Aſtronomicæ*, 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 Aphelion 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 Eclip tick, 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 Reſtitution of the *Poſition*, ſuppoſe the Oppoſition of the *Sun* and *Jupiter*, contains 225$\frac{1}{7}$ Periods of this Satellite.

The firſt Obſerver of this Equation, Mr. *Romer*, aſſerts, 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$\frac{1}{7}$ 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 Shadow, 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 *Epochæ* 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 aſſign'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 *Year*, 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 few Rules and Operations are fully ſufficient for the Calculation of theſe Eclipſes; only I ſhall add an Example to make all plain and clear.

The

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	D.	H.	′	″	Numb. 1.	Numb. 2.
The Year 1702.	1	14	50	36	2292	78.9
The Day *November*	23	10	11	00	0185	184.0
November	25	01	01	36	2477	262.9
Equation 1 +	00	00	03	06	2448	.3
Time first Equated	25	01	04	42	29	262.6
Equation (2) +	00	00	03	29		225.4
The Half Stay +	00	01	04	39		37.2
The equal Time of the Emersion	25	02	12	50	11) 3,1″ (.3″	
The Equation of Time +	00	00	08	25	☉ in ♐ 14	
The apparent Time of the Emersion	25	02	21	15	p. m.	

But since this Eclipse happens in the Day-time, *viz.* *Nov.* 25. at 2 Hours, 25 Minutes, and 15 Seconds past Noon; a 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 *Jupiter* 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 observ'd; 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 *Court-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 signify all such as have Commission from the Prince to give Judgment in any Case.

JUS *Honorarium*, or the *Edicts of the Prætors*, was a Part of the written *Roman* Laws, and was what the *Prætors*, and such kind of Magistrates, did propose by the Consent of the People.

JUS *Retractus sive 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 Divine and Humane. *Particular Justice*, is a constant Will and Desire 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.*

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 *Fitzherbert*, *Lambert*, *Crompton*, and in *Smith de Repub. Anglor.* lib. 2. cap. 9. They were called

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Guardians of the Peace till the 36 *Edw.* 3. cap. 12. where they are stiled *Justices*. Those that live in, and are Members of Towns, Corporations, &c. are called *Justices within Liberties*.

JUSTICE SEAT, is the highest Court that is held in a Forest, and before the Lord Chief Justice in Eyre of the Forest, upon Warning given forty Days before; and then the Judgments are always given, and the Fines set for Offences, that were presented at the Courts of *Attachments*, and the Offenders indicted at the *Swain-Motes*: See *Manwood's Forest Law*, c. 24.

JUSTICES *of Traile Baston*, were a kind of 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 Baston*, or Staff, 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 Baculum*, brought to the Staff of Justice.

KAL KAL

KALENDÆ, 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.* 2. cap. 7. and consists 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 *Staffordshire*, among the common People, a very peculiar Kind of perpetual *Kalendar* or Almanack, which 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 *Clogg*, I suppose from its Form and Matter, being usually made of a Piece of Wood, squared into four 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 perfect than others. The following Figure, which I borrow from Dr. *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 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 *Notch*, or Day to which it belongs, with a *Hook* returned back against the Course of the *Line*; which seems 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 5; and with the Addition of as many Points as make up the Number design'd, As if it be 8, there are three Points added to the hooked Line, &c.

When the *Golden 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 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 so on, &c.

And for the *Distances* of the Numbers of the same Denomination, 'tis to be noted that they stand asunder either 30 or 29 Days, interchangeably. 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 29 Days Distance, you will have 3 again set to the 1st of *March*; and at the last of *March*, at 30 Days Distance, 3 again, &c.

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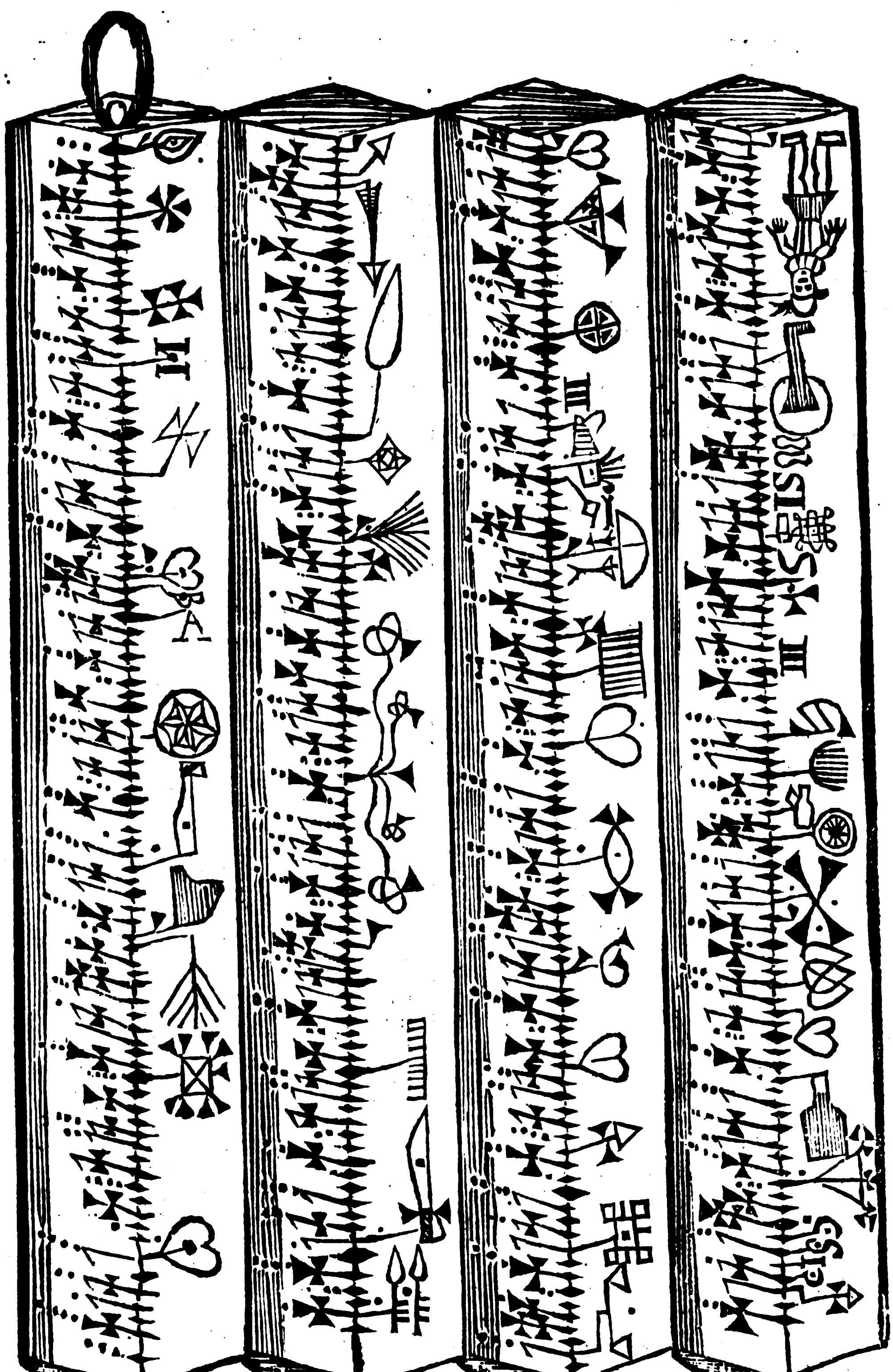
Note, 3 ſtands againſt the 1ſt of *January*, becauſe 3 was the *Golden Number*, when the Fathers of the *Nicene Council* ſettled the Time for the Obſervation of *Eaſter*. See *Plot*, *in Loc. cit.*

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 Day, 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 *Waſſailling*, or *Carouſing-Horn*, that the Danes uſed to make merry withal at that Time.



The Uſe of this Clogg is chiefly to find by the *Prime* or *Golden Number* the *Eccleſiaſtical New Moons*, and the *Moveable Feaſts*; and the *Immoveable 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 *Provincia* or *Regio*, and consisted 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* saith 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 signified *Embattelled* 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 Castles.

KEYSTONE in an Arch, is placed at the Top or Vertex of Elliptical or such-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 situated under the Liver; the left under the Spleen.

In a Fœtus their external Substance is divided 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 *Peritonæum*, 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 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 *Capsula*, and are divided into several Branches, which surround the *Pelvis*. These Branches are again sub-divided into an Infinity of other lesser 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 also in Infinity of Glands, which are all very small.

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 *Papillæ*.

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 sort of *Capsula* to the Blood Vessels.

The 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*, *Glandulæ Renales*, &c. you will find in their proper 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 such 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 Merchandise, usually of about an hundred Pounds, but something more or less, according to the different Customs of different Nations.

KNAVE, is an old *Saxon* Word for a Man-Servant, and is so used in 14 *E.* 3. *Stat.* 1. c. 3. and *Verstegan* thinks it comes from the *Dutch Cnapa*, which signifies the same Thing. *Cnapa* in *Saxon* 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 *Exod.* 1.16. and other Places of the Bible.

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KNEVELS, the ſame with *Kevels.*

KNIGHT, *Miles*, from the *Saxon Cnite*, ſignifies with us a Perſon that beareth Arms, and who for Valour and Martial Conduct is by the Sovereign, or his Authority, ſingled from the ordinary ſort 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 *Romans* called them *Equites*; the *Italian* Word is *Cavallieri*; the *French*, *Chevaliers*; the *Germans*, *Reyters*; the *Spaniards*, *Gavallares*, &c. It appears by the *Stat.* 1 *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 *Britannia*, ſhortly expreſſes in theſe Words: *Noſtris vero Temporibus qui Equeſtrem Dignitatem ſuſcipit, flexis genibus educto Gladio leviter in humero percutitur; Princeps his Verbis Gallice effatur: Sois 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 *Worceſterſhire.* They take Place of *Knights Batchelors*, and come after *Baronets.*

KNIGHTS-FEE, is ſo much Inheritance as is ſufficient 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 poſſeſs'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 ſought 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 a 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 Prieſts; 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 *Uſher of the Garter* is alſo *Uſher 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 *Motto*, and with Rays of Silver iſſuing from thence every way like a Star; whence 'tis uſually called the *Star and Garter.*

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, whereof one of the Houſe is Party.

KNIGHTEN *Gyld*, was anciently a *Guild* in *London*, conſiſting 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. Stow's Annals*, p. 151.

KNOCKING-*Mill*, is the ſame with a Stamping-Mill, which ſee, and alſo the Word *Tin.*

LAB

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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 signifies a *Fathom*.

LACHES, in the Law-sense, seems to signify *Slackness* or *Negligence*, as appears from *Littleton*, *Fol.* 403 and 726, where *Laches* of Entry is nothing else but a Neglect 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 Laws 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 *Lagh-day*, that is, a Lawday, or Day of open Court: Hence also a *Lages-Man* is *Homo 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*, l. 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*, *quasi à Ligando*: and so long as they continue in the 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, *Lagslite*, *Laghslite*, is used in the Laws of *Hen.* I. c. 13. for a Transgression of the Law; and sometimes for the Punishment thereunto belonging.

LAMMAS-DAY, quasi *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* alive 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 paid 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 *Essex*.

LAND GABLE or *Gavel*, was anciently a Tax or Rent issuing out of Land: 'Tis called in *Doomsday Census Prædialis*; and *Spelman* saith, 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 such Services and Duties as were laid on those that held Land. These were three Obligations, which from their Number were called *Trinoda Necessitas*, 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 *Landirecta*, Rights that charged the *very Land*, whether possest 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 present to a Church within six Months after voidable; on which Neglect, Title is given to the Ordinary to *Collate* to the said 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 signifies 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 Preservation 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, 'tis 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 *Sussex*. 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;

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Country, or over three or more Hundreds or Wapentakes; whose *Territory* was called a *Tithing*, or a *Leid* or *Leithen*. Perhaps the *Ridings* in *Yorkshire* 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 assembled 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 Astrolabe. 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 consequently his Meridian Altitude is the Co-Latitude: Subduct therefore that from 90, the Remainder 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 Distance 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 51°. 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 some 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 Tenant, by way of *Emphyteusis*, as an Acknowledgment upon *Investitures*, or for being put into Possession.

LAUDUM, was formerly used for an Arbitration or decisive 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 bruised Ore from the Coffer of a stamping Mill in the Tin-works) run away while the Ore sinks 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 20*s*. Piece marked with xx; one of 10*s*. 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 *Gildas*; of which there some remain in our present Laws. *Vid. Mag. Chart.* c. 1. *and* 14.

(2.) There was the *Merchen Lage*, mentioned in *Cambden's Brit.* and *Polyd. Hist. Angliæ, 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 *Acts 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 Courtesy of* England, 13 *E.* I. 3.

To *Wage Law* (*Vadiare Legem*) is to put in Security: To *make Law* (*facere Legem*) at a Day assigned: 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 assign, 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 Offenders in Camps, &c.

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 Ecclesiastic Judges do proceed in Causes 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 District, 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, since they

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they cannot meet him at Home to have ordinary Justice.

LAW-*day*, is otherwise called the *View of Frank Pledge* or *Court-Leet*; and is used for the County Court, 1 *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 *Michaelmas-day*, 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 *Somersetshire* 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. The Surface is heathy, ferny and furzy; it feeds Sheep all the Year, and young Beasts, Horses and Colts at Spring and Fall. The Soil is red and stony, but no way *Claiey*, *Marley* or *Chalkey*. The Stones are either of the Nature of Fire-stones 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 considerable Bigness. The 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 *beat* it small, then *wash* it clean in a running Stream, and then sift it in Iron *Rudders*, after which they make an *Hearth* or *Furnace* either of Clay or Fire-stone, which they set in the Ground, and upon it build their Fire which is lighted with Charcoal, and continued 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 Account.

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 *stony 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 sinking 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 *Shole* 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 sink *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, tho' not so deep. The *Groove* is 4 Foot long and 2½ Foot broad, till they meet with Stone, and then they carry it as they can. The *Groove* is supported by Timber; 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 sink 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 some.

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 four 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. A Vein being lost, they drive two or three Fathom in the *Breast*, as the Nature of the Earth directs them. 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*. About 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 soft. The Spar is white, transparent and brittle like Glass. The Chalk white, and heavier than any

Stone.

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Stone. The Vein lies between the Coats and is of different 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-stone*, 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 1½ 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 falling 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 Rats 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, signifies a Plummet of that Metal of about a Foot long, and six or seven pound Weight, which is hung at the End of a long String to sound the Depth of the Sea withal: Therefore their Word is, *Heave the Lead*, that is, sound the Depth of the Water, to know whether it be safe 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 Wood.

LEDGERS, are long Pieces of Timber fastened 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 Compass steered upon, and the real Line of the Ship's Way; for all Ships are apt to fall a little to *Leeward* 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, 1. 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-sail being furled, she *Try* under a Main-sail and Mizzen, she will make her Way four Points before the Beam. 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-Scat*, or a Legacy given to the *Church*, or accustomed Mortuary.

LEGION. In the time of the *Romans* first War in *Sicily*, *Polybius*, *lib.* 1. saith, that the *Roman* Legion consisted of 4000 Foot and 300 Horse; afterward *L. Æmylius* and *C. Atilius Coss.* their Legion (in the great Preparations they made against the *Gauls*) consisted of 5200 Foot and 300 Horse.

After this, some Time before the Battel at *Cannæ*, 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 rises. But now with our Seamen it signifies the Mediterranean Sea, and especially the Eastern Part of it; and our Trade thither 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. Transact.* N° 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 since, and Mr. *Butterfield*, Instrument-Maker to the *French* King is now dead.

In *Phil. Transf.* N° 74. *p.* 2217, is an Account of a Book, then publishing, about *the Art of Levelling* by Mr. *Mariotte*; 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 *Snowdon Hill* in *Wales* (where at the Top it sunk 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 $\frac{1}{10}$ of an Inch for every 30 Yards; which may be divided into many Parts evidently. See *Phil. Transact.* N° 229. And Mr. *Derham*, by Observations of this nature made at the Foot and Top of the Monument, allows $\frac{1}{10}$ 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 Ascent 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 *Spirit 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 in the back Part to fasten it to any Height on the

Staff

Staff. The fore-side 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 Assistants 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 see the black Line thereon cut or covered by the cross Hair in the Telescope; and then let 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 Assistant 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 him also 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.

Back[d].	St.	Forw[d].
029	1	132
178	2	201
199	3	295
221	4	256
6.27		8.84
		627
		2.57

Where all the Back Stations make together 6.27. or six 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 right at last.

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 Comets, *p.* 168, he saith he hath by many Observations 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 sometimes to a prodigious Extent. And, perhaps where the Power or Force of Gravitation ceases, some such *contrary Force* may begin: Of which there seem to be many Instances in the Gravitations or Attractions of the Particles of Matter toward one another. (See *Attraction*.) This Force in such Cases Sir *Is. 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 *Phænomena* 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 signified a *Livery* or Delivery of so much Grass or Corn to a Customary Tenant, who cuts down or prepares the said 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 manumised, 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 Oxgang 15 Acres.

LICENTIA *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 thereunto.

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 Verité*, and in his *Metaphysicks*, viz. That Light and Colours do consist 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 Essential Property necessary 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, Flesh 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.) essentially necessary to the Production of this Quality.

The same Author thinks that *Aristotle*'s Definition of Light, φῶς ἐστὶν ἡ ἐνέργεια τοῦ Διαφανοῦς, 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 sensible, 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.

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P. 114. The Doctor asserts, 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 consequently 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.

P. 118. The Length of the Strokes of the Pulses 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, so wisely contrived, as that the Strength of the Pulse, which was destroyed by so vast a Distance, is restored 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 *Is. 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 Eclipses of *Jupiter*'s Satellites happen about 7 or 8 Minutes sooner than they ought to do by the Tables, when the Earth is interposed 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 Satellites is also swifter in his Descent from his *Aphelium* to his *Perihelium*, 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 Transient 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 sort 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 Vicissitudes; 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 $\frac{1}{4}$ 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 consist 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 Hypotheses, 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 solid 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 *Medium* or Substance, much after the manner that Vibrations are propagated in the Air for causing Sound; and that they move faster than the Rays, so 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 easily 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 refracted 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 severing 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.

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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 Reflection and easy Transmission of the Rays, 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 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 reflecting 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 refract it most strongly, if the Ray be in a Fit of Reflection, do reflect it most easily.

After this he gives several other curious Propositions; from whence he shews, that 'tis easy to collect the Intervals of the Fits of easy Reflection and easy Transmission of any sorts 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.

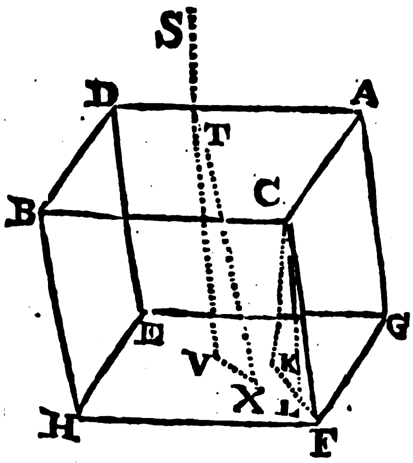
By the Experiments and Observation about the *Inflection* of the Rays of Light (See *Inflection*) he makes it plain, that *Bodies act on Light at a distance*, and by that Action *bend* the Rays of it; and that this Action is strongest at the least distance. He shews also, that Rays which differ in *Refrangibility* 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 'tis probable 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 said coloured 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 inflecting it; and Light on Bodies, by *heating* them, and putting their Parts into a *vibrating Motion*, wherein Heat consists.

All *fix'd Bodies*, when heated beyond a certain degree, do emit *Light* and *shine*; 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 Sea-water shines in a Storm; *Quicksilver* when *shaken in Vacuo*; a Cat's Back, or a Horse's Neck, rubb'd by the Hand in the dark; Wood, Flesh and Fish, when putrified.

The same admirable Author, in the new Queries annexed to the *Latin* 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 strange Body *Island Chrystal* acquaints us with. This was first taken notice of by *Erasmus Bartholinus*, but afterwards more accurately described by *Hugens* in his Book of *Light*, written in *French*. This Chrystal is a pellucid and fissil 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 fortis* 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 A D B C be the Surface of the Refracting Chrystal, C the greatest solid Angle belonging to that Surface: Let G E H F be the opposite Surface, to which the Line C K is perpendicular: This Perpendicular with the Line C F representing the extream Edge of the Chrystal contain an Angle of 19°. 5'. Join K F; in which take K L so, that the Angle K C L may be of 6°. 40'. but the Angle L C F of 12°. 23'. This being done, let the Line S T represent any Incident Ray of Light in the Point T; let T V 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 V X parallel and equal to K L, and so posited that it may lie the same way towards V, as L doth in respect of K. Join T X; and that Line T X shall be the *unusual Refracted Ray*, being carried by the new Refraction from T to X. If then the Incident Ray S T fall also perpendicularly on the Refracting Surface, those two Rays T V, and T X, into which by Refraction it is divided, will become parallel to the two Lines C K and C L: and the other Ray will be transmitted perpendicularly, according to the common Laws of Opticks; and the other (*viz.* T X) diverging by this unusual Refraction from the Perpendicular, will make with it the Angle V T X of about 6 degr. as is found by Experience.

And hence the Plane T V X, and such like similar Planes, which are parallel to the Plane C F K, 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.*



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 S T, which falling on the firſt Surface of the *Iſland Chryſtal*, is divided into the two Rays T V, and T X; and thoſe two Rays come to the latter Surface of the ſaid 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 S T. For the ſame will happen alſo as to the Ray T V, 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 *uſual Ratio*; and thoſe Rays, which in the firſt Surface of the former Chryſtal were refracted with the *unuſual 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 Refraction* 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 Modifications 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 *uſual Ratio*, in paſſing thro' the ſecond be refracted with the *unuſual Ratio*; and thoſe Rays, which in paſſing thro' the firſt Chryſtal were refracted with the *unuſual Ratio*, ſhall in paſſing thro' the ſecond be refracted with the *uſual Ratio*. Wherefore there are not two divers kinds of Rays in their own Nature different; of which one ſort are always and in all Poſitions refracted with the *uſual*, 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 refracted one way with the *uſual*, the other way with the *unuſual 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 Chryſtal, 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 a different Poſition) 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 unuſual Refraction* be accordingly poſited on this or that Side of the Ray.

Wherefore every Ray may be conſidered 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 Place 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 *Diſpoſitions* 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 *Diſpoſitions* 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 Ratio*, 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

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other two Sides are *without* any such *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 false and precarious which have been yet advanced, in order to explain the *Phænomena* of Light by *new Modifications of the Rays*; for they do not depend on any such *Modifications*, but on *congenite* and *immutable* Properties, essentially inherent in the Rays.

And equally erroneous also are those *Hypotheses*, which attempt to explain the *Phænomena* 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 consisted only in a *Pressure* upon the *Medium*, it must be either without any *local Motion*; 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 *Motion* in a fluid Medium, 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 Medium* which lies beyond the Obstacle.

The Force of Gravity tends downwards; and yet the Pressure 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 strait. *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 consist, 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 sounding 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 *strait* again.

The *Rays of Light* are therefore certainly *little Particles*, actually emitted from the *Lucent Body*, and *refracted* by some *Attraction*, by which *Light*, and the *Bodies* on which it falls, do mutually act upon one another; for such Particles or Corpuscles 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 act* 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 *Action* and *Re-action*, 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 to 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 reflected*. Now the Cause of this Reflection cannot be attributed to any Resistance 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 Quicksilver; 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 fall into any of the aforesaid Liquors, they will then not be *reflected*, 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 $\frac{1}{100000}$ 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 *Phænomenon* of the Rays of Light, which he calls *their Fits of easy Transmission and Reflection*, he judges that there is nothing more required, than that the Rays should be very small Corpuscles of Matter, which either by their *Attraction*, *or some other Force*, do excite certain *Vibrations* in the Bodies on which they act;

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act; which Vibrations, being *swifter* 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 therefore produce those *Fits* in the Rays of Light.

And he thinks it very likely, that the *Unusual Refraction*, 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 distort 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 Position 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 corresponding Sides of the Rays of Light are turned towards the Places or Parts of *Unusual Refraction* in the Chrystal, it appears that there is also some Force or Virtue in the Sides of the Rays themselves, 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 one another. Which Virtue in the Magnet, as it is capable of being increased and diminished, and is not 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 such permanent *Force* in two of their Sides, and not have any such thing, at the same time, in their two other; and this without any regard to the *Position* with which they respect the Space or *Medium* thro' which they pass.

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 these Considerations: (1.) That they freely pervade all transparent Bodies, such as Chrystal, Glass, several Pebbles and Gems; and almost all Fluids, but Mercury; and pass where no other Fluid, how thin soever, can enter; and yet no Eye hath ever been able to discover the constituent Particles of the grossest Fluid. (2.) It may be propagated from innumerable different *Luminous Bodies*, without any considerable Opposition to one another, as Dr. *Cheyne* shews 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 Distance 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 Bodies.

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 *Cosmotheoros*, 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 percursa* being the same 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, persisting 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 $16\frac{2}{3}$ 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 seem 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. *Hauksbee*'s Experiments about the Production of Light *in Vacuo* by the Attrition of Bodies, in *Phil. Trans.* N° 304, and in N° 307; and by the Effluvia of one Glass falling on another in Motion, *Phil. Trans.* N° 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 hath 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,

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LIGULA, in our *Latin* Law signifies 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 *Fillet 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 rises a strong 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 / *Apparent* } of a Planet, is a right Line drawn from { *Earth's Centre*, / *Eye 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, intersects 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 signify ten times, or an hundred, or a thousand times themselves, according as the Matter shall require.

The Uses of the *Line of Lines*.

1. *To increase or diminish a Line of any given Length, according to any Ratio required.*

Suppose the Line were $6\frac{1}{2}$ Inches in length; apply it into the Sector by way of parallel Entrance, so that each Foot of the Compasses stand in $6\frac{1}{2}$ 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 $9\frac{1}{4}$ to $6\frac{1}{2}$; or diminished in the Proportion of $2\frac{3}{4}$ to $6\frac{1}{2}$, &c. let the Sector lie, and take with the Compass the parallel Distances between those Points of $9\frac{1}{4}$ and $9\frac{1}{4}$; or of $2\frac{3}{4}$ and $2\frac{3}{4}$, 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 9 to 9 in the *Line of Lines*; and keeping the Sector of that Angle, take the Distance between 1 and 1, and that will be $\frac{1}{9}$ Part of the Line.

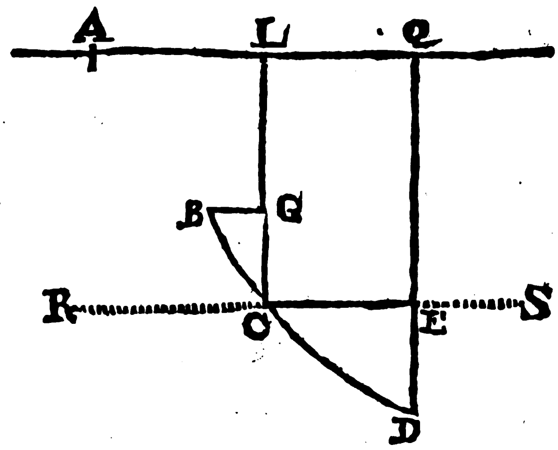
3. *To find what Proportion two or more Lines bear to one another.*

Apply the greater or 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 : 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 B C, C D, two infinitely small Parts of the Curve sought: Then, since the Nature of the Curve is to be such, that the Descent of the Body from B to D,



after its Fall from the Horizontal Line A Q, is to be in the least time possible; we must find in the Line R S (drawn parallel to A Q so, that the Differences between any two Ordinates to the Curve, as of G C, D E, may be equal) a Point in which this must happen.

Now the Velocity of the Body in the Point C is $= \surd : LC$; and its Velocity in the Point D, as $\surd : QD$. Wherefore $\left(\frac{BC}{\surd : LC}\right)$ is $=$ to the Time of the Descent thro' BC, as $\frac{CD}{\surd : QD} =$ to the Time of the Descent thro' CD. by *Prop.* 54. *Newton. Princ.* Wherefore the Point C must be such, as that $\frac{BC}{\surd : LC} + \frac{CD}{\surd : QD}$ 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 $= z$. Wherefore $\frac{\surd : \overline{m^2 + n^2}}{\surd : b} + \frac{\surd : \overline{m^2 + z^2}}{\surd : p} =$ to a

Mini-

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Minimum. And consequently $\frac{\dot{u}u}{b\frac{1}{2}\sqrt{m^2+u^2}}+$ $+\frac{\dot{z}z}{p\frac{1}{2}\sqrt{m^2+z^2}}=0$. But $\dot{u}=-\dot{z}$ (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 $\frac{u}{b\frac{1}{2}\sqrt{m^2+u^2}}=$ to an invariable Quantity. Let then the *Abscissa* AL $=x$; the Ordinate LC $=y$: And therefore BG $=\dot{x}$. GC $=\dot{y}$. BC $=\sqrt{:\dot{x}\dot{x}}$. and let a be any invariable Line. Then will $\frac{\dot{x}}{y\frac{1}{2}\sqrt{:\dot{x}\dot{x}+\dot{y}\dot{y}}}=\frac{1}{\sqrt{:a}}$. Wherefore $\dot{x}\sqrt{a}=y\times\sqrt{\dot{x}\dot{x}+\dot{y}\dot{y}}$. But in every Curve $\dot{x}$ is to $\sqrt{\dot{x}\dot{x}+\dot{y}\dot{y}}$, 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 firing 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 Debt 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.

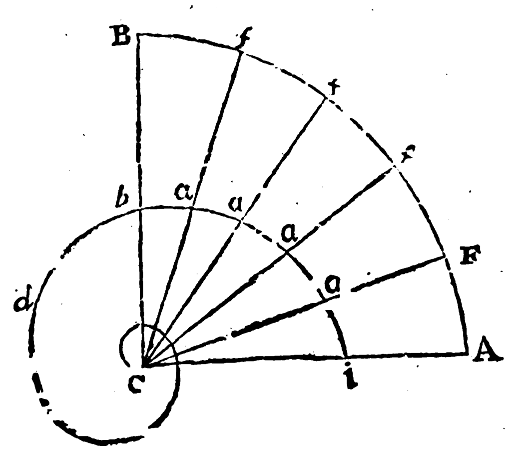
LOCUS *Resolutus*, according to *Pappus*'s Account of it in *Libr. 7mo Mathem. Coll.* is, That it is a proper peculiar Matter, after the common Constitution of the Elements of Geometry, contrived for such Persons as would obtain a ready and easy Method of solving such Problems as shall be proposed to them. (See *Resolution* in Vol. I.) On this Subject *Euclide*, *Apollonius Pegæus*, *Eratosthenes* and *Aristæus Senior*, are the only Writers among the ancient Geometers. *Euclide*'s Tracts are *Datorum Liber Unus*; *Locorum ad Superficiem Duo*; *Porismatum Tres*. *Apollonius*, *de Sectione Rationis* (lately put out at *Oxon* by Mr. *Halley*) *Libri Duo*: *De Sectione Spatii Libri Duo*; *Tactionum Libri Duo*: *Inclinationum Duo*; *Planorum Locorum Duo*: *Conicorum Octo*. Of *Aristæus*, there were *Locorum Solidorum Libri Quinque*. And of *Eratosthenes*, *Duo Libri de Medietatibus*.

There are two Kinds, saith *Pappus*, of this *Resolution*; 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 Sectione Rationis* above-mentioned; 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 small 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.



whose Parts or Portions *C* 1, *Ca*, *Ca*, &c. are Geometrically proportional; then if a Line, as 1, *a*, *a*, *b*, *d*, *C*, be drawn thro' those Points, it will be the *Logarithmick-Spiral*. *Vid. Guido Grand. Theorem. Hugen. Cap.* 1.

LOGARITHMS. The Learned and Ingenious Mr. *Halley*, Savilian Professor of Geometry in *Oxon.* and *F. R. S.* hath in *Phil. Transact.* No 216. and since 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

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A TABLE OF LOGARITHMS

For Numbers increasing orderly from 1 to 10000, with their Differences.

Whereby the Logarithm of any Number under 10000 *may be readily taken.*

Nu.	Log.	Nu.	Log.	Nu.	Log.	Nu.	Log.
1	0.0000000	26	1.4149733	51	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	1.8920946
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	0.7781512	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
9	0.9542425	34	1.5314789	59	1.7708520	84	1.9242793
10	1.0000000	35	1.5440680	60	1.7781512	85	1.9294189
11	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	1.7993405	88	1.9444827
14	1.1461280	39	1.5910646	64	1.8061800	89	1.9493900
15	1.1760912	40	1.6020600	65	1.8129133	90	1.9542425
6	1.2041200	41	1.6127838	66	1.8195439	91	1.9590414
7	1.2304489	42	1.6232493	67	1.8260748	92	1.9637878
18	1.2552725	43	1.6334684	68	1.8325089	93	1.9684829
19	1.2787536	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	73	1.8633229	98	1.9912261
24	1.3802112	49	1.6901961	74	1.8692317	99	1.9956352
25	1.3979400	50	1.6989700	75	1.8750613	100	2.0000000

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Num.	0	1	2	3	4
100	0000000	0004341	0008677	0013009	0017337
101	0043214	0047511	0051805	0056095	0060379
102	0086002	0090257	0094509	0098756	0102999
103	0128372	0132587	0136794	0141003	0145205
104	0170333	0174507	0178677	0182843	0187005
105	0211893	0216027	0220157	0224284	0228406
106	0253059	0257154	0261245	0265333	0269416
107	0293838	0297895	0301948	0305997	0310043
108	0334237	0338257	0342273	0346284	0350293
109	0374265	0378247	0382226	0386202	0390173
110	0413927	0417873	0421816	0425755	0429691
111	0453230	0457140	0461048	0464952	0468852
112	0492180	0496056	0499928	0503767	0507663
113	0530784	0534626	0538464	0542299	0536130
114	0569048	0572856	0576661	0580462	0584260
115	0606978	0610753	0614525	0618293	0622058
116	0644580	0648322	0652061	0655797	0659530
117	0681859	0685569	0689276	0692980	0696681
118	0718820	0722499	0726175	0729847	0733517
119	0755470	0759118	0762762	0766404	3870043
120	0791812	0795430	0799045	0802656	0806265
121	0827854	0831441	0835026	0838608	0842187
122	0863598	0867157	0870712	0874264	0877814
123	0899051	0902580	0906107	0909631	0913151
124	0934217	0937718	0941216	0944711	0948204
125	0969100	0972573	0976043	0979511	0982975
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9761206	9761665	9762124	9762582	9763041	459
9765792	9766251	9766709	9767167	9767625	458
9770373	9770831	9771289	9771747	9772204	458
9774950	9775407	9775864	9776322	9776779	458
9779521	9779978	9780435	9780892	9781348	457
9784088	9784544	9785001	9785457	9785913	457
9788650	9789106	9789562	9790017	9790473	456
9793207	9793662	9794118	9794573	9795028	456
9797759	9798214	9798669	9799124	9799579	455
9802307	9802761	9803216	9803670	9804125	455
9806850	9807304	9807758	9808212	9808666	454
9811388	9811841	9812295	9812748	9813202	454

Num.	0	1	2	3	4
958	9813655	9814108	9814562	9815015	9815468
959	9818186	9818639	9819092	9819544	9819997
960	9822712	9823165	9823617	9824069	9824522
961	9827134	9827686	9828138	9828589	9829041
962	9831751	9832202	9832654	9833105	9833556
963	9836263	9836714	9837165	9837616	9838066
964	9840770	9841221	9841671	9842122	9842572
965	9845273	9845723	9846173	9846623	9847073
966	9849771	9850221	9850670	9851120	9851569
967	9854265	9854714	9855163	9855612	9856061
968	9858754	9859202	9859651	9860099	9860548
969	9863238	9863686	9864134	9864582	9865030
970	9867717	9868165	9868613	9869060	9869508
971	9872192	9872640	9873087	9873534	9873981
972	9876663	9877109	9877556	9878003	9878449
973	9881128	9881575	9882021	9882467	9882913
974	9885590	9886035	9886481	9886927	9887373
975	9890046	9890402	9890937	9891382	9891828
976	9894498	9894943	9895388	9895833	9896278
977	9898946	9899390	9899835	9900279	9900723
978	9903389	9903833	9904277	9904721	9905164
979	9907827	9908270	9908714	9909158	9909601
980	9912261	9912704	9913147	9913590	9914033
981	9916690	9917133	9917575	9918018	9918461
982	9921115	9921557	9921999	9922441	9922884
983	9925535	9925977	9926419	9926860	9927302
984	9929951	9930392	9930834	9931275	9931716
985	9934362	9934803	9935244	9935685	9936126
986	9938769	9939210	9939650	9940090	9940531
987	9943172	9943612	9944051	9944491	9944931
988	9947569	9948009	9948448	9948888	9949327
989	9951963	9952402	9952841	9953280	9953719
990	9956352	9956791	9957229	9957668	9958106
991	9960737	9961175	9961613	9962051	9962189
992	9965117	9965554	9965992	9966430	9966868
993	9969492	9969930	9970367	9970804	9971242
994	9973864	9974301	9974738	9975174	9975611
995	9978231	9978667	9979104	9979540	9979976
996	9982593	9983029	9983465	9983901	5984337
997	9986952	9987387	9987823	9988258	9988694
998	9991305	9991740	9992176	9992611	9993046
999	9995655	9995090	9996524	9996959	9997393

The END *of*

5	6	7	8	9	Diff.
9815921	9816374	9816827	9817280	9817733	453
9820450	9820902	9821355	9821807	9822260	453
9824974	9825426	9825878	9826330	9826782	452
9829493	9829945	9830396	9830848	9831299	452
9834007	9834459	9834910	9835361	9835812	451
9838517	9838968	9839419	9839869	9840320	451
9843022	9843473	9843923	9844373	9844823	450
9847523	9847973	9848422	9848873	9849322	450
9852019	9852468	9852917	9853366	9853816	450
9856510	9856959	9857407	9857856	9858305	449
9860996	9861445	9861893	9862341	9862790	448
9865478	9865926	9866374	9866822	9867270	448
9869955	9870403	9870850	9871298	9871745	447
9874428	9874875	9875322	9875769	9876216	447
9878896	9879343	9879789	9880236	9880682	447
9883360	9883806	9884252	9884698	9885144	446
9887818	9888264	9888710	9889155	9889601	446
9892273	9892718	9893163	9893608	9894050	445
9896722	9897167	9897612	9898056	9898501	445
9901168	9901612	9902056	9902500	9902944	444
9905608	9906052	9906496	9906940	9907383	444
9910044	9910488	9910931	9911374	9911818	443
9914476	9914919	9915362	9915805	9916247	443
9918903	9919345	9919788	9920230	9920673	442
9923326	9923768	9924210	9924651	9925093	442
9927744	9928185	9928627	9929068	9929510	442
9932157	9932598	9933039	9933480	9933921	441
9936566	9937007	9937448	9937888	9938329	441
9940971	9941411	9941851	9942291	9942731	440
9945371	9945811	9946251	9946690	9947130	440
9949767	9950206	9950645	9951085	9951524	440
9954158	9954597	9955036	9955474	9955913	439
9958545	9958983	9959422	9959860	9960298	439
9962927	9963365	9963803	9964241	9964679	438
9967305	9967743	9968180	9968618	9969055	438
9971679	9972116	9972553	9972990	9973427	437
9976048	9976485	9976921	9977358	9977794	437
9980413	9980849	9981285	9981721	9982157	437
9984773	9985209	9985645	9986080	9986516	436
9989129	9989564	9990000	9990435	9990870	435
9993481	9993916	9994350	9994785	9995220	435
9997828	9998262	9998697	9999131	9999566	435

the LOGARITHMS.

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A TABLE OF Proportional Parts.

Diff.	1	2	3	4	5	6	7	8	9
44	4	9	13	18	22	26	31	35	40
46	5	9	14	18	23	28	32	37	41
48	5	10	14	19	24	29	34	38	43
50	5	10	15	20	25	30	35	40	45
52	5	10	16	21	26	31	36	42	47
54	5	11	16	22	27	32	38	43	49
56	6	11	17	22	28	34	39	45	50
58	6	12	17	23	29	35	41	46	52
60	6	12	18	24	30	36	42	48	54
62	6	12	19	25	31	37	43	50	56
64	6	13	19	26	32	38	45	51	58
66	7	13	20	26	33	40	46	53	59
68	7	14	20	27	34	41	48	54	61
70	7	14	21	28	35	42	49	57	63
72	7	14	22	29	36	43	50	58	65
74	7	15	22	30	37	44	52	59	67
76	8	15	23	30	38	46	53	61	69
78	8	16	23	31	39	47	55	62	70
80	8	16	24	32	40	48	56	64	72
82	8	16	25	33	41	49	57	66	74
84	8	17	25	34	42	50	59	67	76
86	9	17	26	34	43	52	60	69	77
88	9	18	26	35	44	53	62	70	79
90	9	18	27	36	45	54	63	72	81
92	9	18	28	37	46	55	64	74	83
94	9	19	28	38	47	56	66	75	85
96	10	19	29	38	48	58	67	77	86
98	10	20	29	39	49	59	69	78	88
100	10	20	30	40	50	60	70	80	90
102	10	20	31	41	51	61	71	82	92
104	10	21	31	42	52	62	73	83	94
106	11	21	32	42	53	64	74	85	95
108	11	22	32	43	54	65	76	86	97
110	11	22	33	44	55	66	77	88	99
112	11	22	34	45	56	67	78	90	101
114	11	23	34	46	57	68	80	91	103
116	12	23	35	46	58	70	81	93	104
118	12	24	35	47	59	71	83	94	106
120	12	24	36	48	60	72	84	96	108
122	12	24	37	49	61	73	85	97	110
124	12	25	37	50	62	74	87	99	112
125	13	25	38	50	63	76	88	101	113

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Diff.	1	2	3	4	5	6	7	8	9
128	13	26	38	51	64	77	90	102	115
130	13	26	39	52	65	78	91	104	117
132	13	26	40	53	66	79	92	106	119
134	13	27	40	54	67	80	94	107	121
136	14	27	41	54	68	82	95	109	122
138	14	28	41	55	69	83	97	110	124
140	14	28	42	56	70	84	98	112	126
142	14	28	43	57	71	85	99	114	128
144	14	29	43	58	72	86	101	115	130
146	15	29	44	58	73	88	102	117	131
148	15	30	44	59	74	89	104	118	133
150	15	30	45	60	75	90	105	120	135
152	15	30	46	61	76	91	106	122	137
154	15	31	46	62	77	92	108	123	139
156	16	31	47	62	78	94	109	125	140
158	16	32	47	63	79	95	111	126	142
160	16	32	48	64	80	96	112	128	144
162	16	32	49	65	81	97	113	130	146
164	16	33	49	66	82	98	115	131	148
166	17	33	50	66	83	100	116	133	149
168	17	34	50	67	84	101	118	134	151
170	17	34	51	68	85	102	119	136	153
172	17	34	52	69	86	103	120	138	155
174	17	35	52	70	87	104	122	139	157
176	18	35	53	70	88	106	123	141	158
178	18	36	53	71	89	107	125	143	160
180	18	36	54	72	90	108	126	144	162
182	18	36	55	73	91	109	127	146	164
184	18	37	55	74	92	110	129	147	166
186	19	37	56	74	93	112	130	149	167
188	19	38	56	75	94	113	132	150	169
190	19	38	57	76	95	114	133	152	171
192	19	38	58	77	96	115	134	154	173
194	19	39	58	78	97	116	136	155	175
196	20	39	59	78	98	118	137	157	176
198	20	40	59	79	99	119	139	158	178
200	20	40	60	80	100	120	140	160	180
202	20	40	61	81	101	121	141	162	182
204	20	41	61	82	102	122	143	163	184
206	21	41	62	82	103	124	144	165	185
208	21	42	62	83	104	125	146	166	187
210	21	42	63	84	105	126	147	168	189
212	21	42	64	85	106	127	148	170	191
214	21	43	64	86	107	128	150	171	193
216	22	43	65	86	108	130	151	173	194
218	22	44	65	87	109	131	153	174	196
220	22	44	66	88	110	132	154	176	198
222	22	44	67	89	111	133	155	178	200
224	22	45	67	90	112	134	157	179	202
226	23	45	68	90	113	136	158	181	203
228	23	46	68	91	114	137	160	182	205
230	23	46	69	92	115	138	161	184	207
232	23	46	70	93	116	139	162	186	209
234	23	47	70	94	117	140	164	187	211
236	24	47	71	94	118	142	165	189	212
238	24	48	71	95	119	143	167	190	214
240	24	48	72	96	120	144	168	192	216
242	24	48	73	97	121	145	169	194	218
244	24	49	73	98	122	146	171	195	220
246	25	49	74	98	123	148	172	197	221
248	25	50	74	99	124	149	174	198	223
250	25	50	75	100	125	150	175	200	225
252	25	50	76	101	126	151	176	202	227
254	25	51	76	102	127	152	177	203	229
256	26	51	77	102	128	154	179	205	230
258	26	52	77	103	129	155	181	206	232

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Diff.	1	2	3	4	5	6	7	8	9
260	26	52	78	104	130	156	182	208	234
262	26	52	79	105	131	157	183	210	236
264	26	53	79	106	132	158	185	211	238
266	27	53	80	106	133	160	186	213	239
268	27	54	80	107	134	161	188	214	241
270	27	54	81	108	135	162	189	216	243
272	27	54	82	109	136	163	190	218	245
274	27	55	82	110	137	164	192	219	247
276	28	55	83	110	138	166	193	221	248
278	28	56	83	111	139	167	195	222	250
280	28	56	84	112	140	168	196	224	252
282	28	56	85	113	141	169	197	226	254
284	28	57	85	114	142	170	199	227	256
286	29	57	86	114	143	172	200	229	257
288	29	58	86	115	144	173	202	230	259
290	29	58	87	116	145	174	203	232	261
292	29	58	88	117	146	175	204	234	263
294	29	59	88	118	147	176	206	235	265
296	30	59	89	118	148	178	207	237	267
298	30	60	89	119	149	179	209	238	268
300	30	60	90	120	150	180	210	240	270
302	30	60	91	121	151	181	211	242	272
304	30	61	91	121	152	182	213	243	274
306	31	61	92	122	153	184	214	245	275
308	31	62	92	123	154	185	216	246	277
310	31	62	93	124	155	186	217	248	279
312	31	62	94	125	156	187	218	250	281
314	31	63	94	126	157	188	220	251	283
316	32	63	95	126	158	190	221	253	284
318	32	64	95	127	159	191	223	254	286
320	32	64	96	128	160	192	224	256	288
322	32	64	97	129	161	193	225	258	290
324	32	65	97	130	162	194	227	259	292
326	33	65	98	130	163	196	228	261	293
328	33	66	98	131	164	197	230	262	295
330	33	66	99	132	165	198	231	264	297
332	33	66	100	133	166	199	232	266	299
334	33	67	100	134	167	200	234	267	301
336	34	67	101	134	168	202	235	269	302
338	34	68	101	135	169	203	237	270	304
340	34	68	102	136	170	204	238	272	306
342	34	68	103	137	171	205	239	274	308
344	34	69	103	138	172	206	241	275	310
346	35	69	104	138	173	208	242	277	311
348	35	70	104	139	174	209	244	278	313
350	35	70	105	140	175	210	245	280	315
352	35	70	106	141	176	211	246	282	317
354	35	71	106	142	177	212	248	283	319
356	36	71	107	142	178	214	249	285	320
358	36	72	107	143	179	215	251	286	322
360	36	72	108	144	180	216	252	288	324
362	36	72	109	145	181	217	253	290	326
364	36	73	109	146	182	218	255	291	328
366	37	73	110	146	183	220	256	293	329
368	37	74	110	147	184	221	258	294	331
370	37	74	111	148	185	222	259	296	333
372	37	74	112	149	186	223	260	298	335
374	37	75	112	150	187	224	262	299	337
376	38	75	113	150	188	226	263	301	338
378	38	76	113	151	189	227	265	303	339
380	38	76	114	152	190	228	266	304	342
382	38	76	115	153	191	229	267	306	344
384	38	77	115	154	192	230	269	307	346
386	39	77	116	154	193	232	270	309	347
388	39	78	116	155	194	233	272	310	349
390	39	78	117	156	195	234	273	312	351

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Diff.	1	2	3	4	5	6	7	8	9
392	39	78	118	157	196	235	274	314	353
394	39	79	118	158	197	236	276	315	355
396	40	79	119	158	198	238	277	317	356
398	40	80	119	159	199	239	279	318	358
400	40	80	120	160	200	240	280	320	360
402	40	80	121	161	201	241	281	322	362
404	40	81	121	162	202	242	283	323	364
406	41	81	122	162	203	244	284	325	365
408	41	82	122	163	204	245	286	326	367
410	41	82	123	164	205	246	287	328	369
412	41	82	124	165	206	247	288	330	371
414	41	83	124	166	207	248	290	331	373
416	42	83	125	166	208	250	291	333	374
418	42	84	125	167	209	251	293	334	376
420	42	84	126	168	210	252	294	336	378
422	42	84	127	169	211	253	295	338	380
424	42	85	127	170	212	254	297	339	382
426	43	85	128	170	213	256	298	341	383
428	43	86	128	171	214	257	300	342	385
430	43	86	129	172	215	258	301	344	387
432	43	86	130	173	216	259	302	346	389
434	43	87	130	174	217	260	304	347	391
436	44	87	131	174	218	262	305	349	392
438	44	88	131	175	219	263	307	350	394
440	44	88	132	176	220	264	308	352	396
442	44	88	133	177	221	265	309	354	398
444	44	89	133	178	222	266	311	355	400
446	45	89	134	178	223	268	312	357	401
448	45	90	134	179	224	269	314	358	403
450	45	90	135	180	225	270	315	360	405
452	45	90	136	181	226	271	316	362	407
454	45	91	136	182	227	272	318	363	409
456	46	91	137	182	228	274	319	365	410
458	46	92	137	183	229	275	321	366	412
460	46	92	138	184	230	276	322	368	414
462	46	92	139	185	231	277	323	370	416
464	46	93	139	186	232	278	325	371	418
466	47	93	140	186	233	280	326	373	419
468	47	94	140	187	234	281	328	374	421
470	47	94	141	188	235	282	329	376	423
472	47	94	142	189	236	283	330	378	425
474	47	95	142	190	237	284	332	379	427
476	48	95	143	190	238	286	333	381	428
478	48	96	143	191	239	287	335	382	430
480	48	96	144	192	240	288	336	384	432
482	48	96	145	193	241	289	337	386	434
484	48	97	145	194	242	290	339	387	436
486	49	97	146	194	243	292	340	389	437
488	49	98	146	195	244	293	342	390	439
490	49	98	147	196	245	294	343	392	441
492	49	98	148	197	246	295	344	394	443
494	49	99	148	198	247	296	346	395	445
496	50	99	149	198	248	298	347	397	446
498	50	100	149	199	249	299	349	398	448
500	50	100	150	200	250	300	350	400	450
502	50	100	151	201	251	301	351	402	452
504	50	101	151	202	252	302	353	403	454
506	51	101	152	202	253	304	354	405	455
508	51	102	152	203	254	305	356	406	457
510	51	102	153	204	255	306	357	408	459
512	51	102	154	205	256	307	358	410	461
514	51	103	154	206	257	308	360	411	463
516	52	103	155	206	258	310	361	413	464
518	52	104	155	207	259	311	363	414	466
520	52	104	156	208	260	312	364	416	468
522	52	104	157	209	261	313	365	418	470

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Diff.	1	2	3	4	5	6	7	8	9
524	52	105	157	210	262	314	367	419	472
526	53	105	158	210	263	316	368	421	473
528	53	106	158	211	264	317	370	422	475
530	53	106	159	212	265	318	371	424	477
532	53	106	160	213	266	319	372	426	479
533	53	107	160	214	267	320	374	427	481
536	54	107	161	214	268	322	375	429	482
538	54	108	161	215	269	323	377	430	484
540	54	108	162	216	270	324	378	432	486
542	54	108	163	217	271	325	379	434	488
544	54	109	163	218	272	326	381	435	490
546	55	109	164	218	273	328	382	437	491
548	55	110	164	219	274	329	384	438	493
550	55	110	165	220	275	330	385	440	495
552	55	110	166	221	276	331	386	442	497
554	55	111	166	222	277	332	388	443	499
556	56	111	167	222	278	334	389	445	500
558	56	112	167	223	279	335	391	446	502
560	56	112	168	224	280	336	392	448	504
562	56	112	169	225	281	337	393	450	506
564	56	113	169	226	282	338	395	451	508
566	57	113	170	226	283	340	396	453	509
568	57	114	170	227	284	341	398	454	511
570	57	114	171	228	285	342	399	456	513
572	57	114	172	229	286	343	400	458	515
574	57	115	172	230	287	344	401	459	516
576	58	115	173	230	288	346	403	461	518
578	58	116	173	231	289	347	405	462	520
580	58	116	174	232	290	348	406	464	522
582	58	116	175	233	291	349	407	466	524
584	58	117	175	234	292	350	409	467	526
586	59	117	176	234	293	352	410	469	527
588	59	118	176	235	294	353	412	470	529
590	59	118	177	236	295	354	413	472	531
5,2	59	118	178	237	296	355	414	474	533
594	59	119	178	238	297	356	416	275	535
596	60	119	179	238	298	358	417	477	536
598	60	120	179	239	299	359	419	478	538
600	60	120	180	240	300	360	420	480	540
602	60	120	181	241	301	361	421	482	542
604	60	121	181	242	302	362	423	483	544
606	61	121	182	242	303	364	424	485	545
608	61	122	182	243	304	365	426	486	547
610	61	122	183	244	305	366	427	488	549
612	61	122	184	245	306	367	428	490	551
614	61	123	184	246	307	368	430	492	553
616	62	123	185	246	308	370	431	493	554
618	62	124	185	247	309	371	433	494	556
620	62	124	186	248	310	372	434	496	558
622	62	124	187	249	311	373	435	498	560
624	62	125	187	250	312	374	437	499	562
626	63	125	188	250	313	376	438	501	563
628	63	126	188	251	314	377	440	502	565
630	63	126	189	252	315	378	441	504	567
632	63	126	190	253	316	379	442	506	569
634	63	127	190	254	317	380	444	507	571
636	64	127	191	254	318	382	445	509	572
638	64	128	191	255	319	383	447	510	574
640	64	128	192	256	320	384	448	512	576
642	64	128	193	257	321	385	449	514	578
644	64	129	193	258	322	386	451	515	580
646	65	129	194	258	323	388	452	517	581
648	65	130	194	259	324	389	454	518	583
650	65	130	195	260	325	390	455	520	585
652	65	130	196	261	326	391	456	522	587
654	65	131	196	262	327	392	458	523	580

Diff.	1	2	3	4	5	6	7	8	9
656	66	131	197	262	328	394	459	525	590
658	66	132	197	263	329	395	461	526	592
660	66	132	198	264	330	396	462	528	594
662	66	132	199	265	331	397	463	530	596
664	66	133	199	266	332	398	465	531	598
666	67	133	200	266	333	400	466	533	599
668	67	134	200	267	334	401	468	534	601
670	67	134	201	268	335	402	469	536	603
672	67	134	202	269	336	403	470	538	605
674	67	135	202	270	337	404	472	539	607
676	68	135	203	270	338	406	473	541	608
678	68	136	203	271	339	407	475	542	610
680	68	136	204	272	340	408	476	544	612
682	68	136	205	273	341	409	477	546	614
684	68	137	205	274	342	410	479	547	616
686	69	137	206	274	343	412	480	549	617
688	69	138	206	275	344	413	482	550	619
690	69	138	207	276	345	414	483	552	621
692	69	138	208	277	346	415	484	554	623
694	69	139	208	278	347	416	486	555	625
696	70	139	209	278	348	417	487	557	626
698	70	140	209	279	349	419	489	558	628
700	70	140	210	280	350	420	490	560	630
702	70	140	211	281	351	421	491	562	632
704	70	141	211	282	352	422	492	563	634
706	71	141	212	282	353	424	494	565	635
708	71	142	212	283	354	425	496	566	637
710	71	142	213	284	355	426	497	568	639
712	71	142	214	285	356	427	498	570	641
714	71	143	214	286	357	428	500	571	643
716	72	143	215	286	358	430	501	573	644
718	72	144	215	287	359	431	503	574	646
720	72	144	216	288	360	432	504	576	648
722	72	144	217	289	361	433	505	578	650
724	72	145	217	290	362	434	507	579	652
726	73	145	218	290	363	436	508	581	653
728	73	146	218	291	364	437	510	582	655
730	73	146	219	292	365	438	511	584	657
732	73	146	220	293	366	439	512	586	659
734	73	147	220	294	367	440	514	587	661
736	74	147	221	294	368	442	515	589	662
738	74	148	221	295	369	443	517	590	664
740	74	148	222	296	370	444	518	592	666
742	74	148	223	297	371	445	519	594	668
744	74	149	223	298	372	446	521	595	670
746	75	149	224	298	373	448	522	597	671
748	75	150	224	299	374	449	524	598	673
750	75	150	225	300	375	450	525	600	675
752	75	150	226	301	376	451	526	602	677
754	75	151	226	302	377	452	528	603	679
756	76	151	227	302	378	454	529	605	680
758	76	152	227	303	379	455	531	606	682
760	76	152	228	304	380	456	532	608	684
762	76	152	229	305	381	457	533	610	686
764	76	153	229	306	382	458	535	611	688
766	77	153	230	306	383	460	536	613	689
768	77	154	230	307	384	461	538	614	691
770	77	154	231	308	385	462	539	616	693
772	77	154	232	309	386	463	540	618	695
774	77	155	232	310	387	464	542	619	697
776	78	155	233	310	388	466	543	621	699
778	78	156	233	311	389	467	545	622	700
780	78	156	234	312	390	468	546	624	702
782	78	156	235	313	391	469	547	626	704
784	78	157	235	314	392	470	549	627	706
786	79	157	236	314	393	472	550	629	707

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Diff.	1	2	3	4	5	6	7	8	9
788	79	158	236	315	394	473	552	630	709
790	79	158	237	316	395	474	553	632	711
792	79	158	238	317	396	475	554	934	713
794	79	159	238	318	397	477	556	635	715
796	80	159	239	318	398	478	557	637	717
798	80	160	239	319	399	479	559	638	718
800	80	160	240	320	400	480	560	640	720
802	80	160	241	321	401	481	561	642	722
804	80	161	241	322	402	482	563	643	724
806	81	161	242	322	403	484	564	645	725
808	81	162	242	323	404	485	566	646	727
810	81	162	243	324	405	486	567	648	729
812	81	162	244	325	406	487	568	650	731
814	81	163	244	325	407	488	570	651	733
816	82	163	245	326	408	490	571	653	734
818	82	164	245	327	409	491	572	654	736
820	82	164	246	328	410	492	574	656	738
822	82	164	247	329	411	493	575	658	740
824	82	165	247	330	412	494	577	659	742
826	83	165	248	330	413	496	578	661	743
828	83	166	248	331	414	497	580	662	745
830	83	166	249	332	415	498	581	664	747
832	83	166	250	333	416	499	582	666	749
834	83	167	250	334	417	500	584	667	751
836	84	167	251	334	418	502	585	669	753
838	84	168	251	335	419	503	587	670	754
840	84	168	252	336	420	504	588	672	756
842	84	168	253	337	421	505	589	674	758
844	84	169	253	338	422	506	591	675	760
846	85	169	254	338	423	508	592	677	761
848	85	170	254	339	424	509	594	678	763
850	85	170	255	340	425	510	595	680	765
852	85	170	256	341	426	511	596	682	767
854	85	171	256	342	427	512	598	683	769
856	86	171	257	342	428	514	599	685	771
858	86	172	257	343	429	515	601	686	773
860	86	172	258	344	430	516	602	688	774
862	86	172	259	345	431	517	603	690	776
864	86	173	259	346	432	518	605	691	778
866	87	173	260	346	433	520	606	693	779
868	87	174	260	347	434	521	608	694	781
870	87	174	261	348	435	522	609	696	783
872	87	174	262	349	436	523	611	698	785
874	87	175	262	350	437	524	612	699	787
876	88	175	263	350	438	526	613	701	789
878	88	176	263	351	439	527	615	702	791
880	88	176	264	352	440	528	616	704	793
882	88	176	265	353	441	529	617	706	795
884	88	177	265	354	442	530	619	707	796
886	89	177	266	354	443	532	620	709	797
888	89	178	266	355	444	533	622	710	799
890	89	178	267	356	445	534	623	712	801
892	89	178	268	357	446	535	624	714	803
894	89	179	268	358	447	536	626	715	805
896	90	179	269	358	448	538	627	717	806
898	90	180	269	359	449	539	629	718	808
900	90	180	270	360	450	540	630	720	810
903	90	181	271	361	451	542	632	722	813
906	91	181	272	363	453	544	634	725	815
909	91	182	273	364	454	545	636	727	818
912	91	182	274	365	456	547	638	730	821
915	91	183	274	366	457	549	640	732	823
918	92	184	275	367	459	551	643	734	826
921	92	184	276	368	460	553	645	737	829
924	92	185	277	370	462	554	647	739	832
927	93	185	278	371	463	556	649	742	834

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Diff.	1	2	3	4	5	6	7	8	9
930	93	186	279	372	465	558	651	744	837
933	93	187	280	373	466	560	653	746	839
936	94	187	281	374	468	562	655	749	842
939	94	188	282	376	469	563	657	751	845
942	94	188	283	377	471	565	659	754	848
945	94	189	283	378	472	567	661	755	850
948	95	190	284	379	474	569	664	758	853
951	95	190	285	380	475	571	666	761	856
954	95	191	286	382	477	572	668	763	859
957	96	191	287	383	478	574	670	766	861
960	96	192	288	384	480	576	672	768	864
963	96	193	289	385	481	578	674	770	867
966	97	193	290	386	483	580	676	773	869
969	97	194	291	388	484	581	678	775	872
972	97	194	292	389	486	583	680	778	875
975	97	195	292	390	487	585	682	780	878
978	98	196	293	391	489	587	685	782	880
981	98	196	294	392	490	589	687	785	883
984	98	197	295	394	492	590	689	787	886
987	99	197	296	395	493	592	691	790	888
990	99	198	297	396	495	594	693	792	891
993	99	199	298	397	496	596	695	794	894
996	99	199	299	398	498	598	697	797	897
999	100	200	300	400	499	599	699	799	899
1005	100	201	301	402	502	603	703	804	904
1009	101	202	303	404	504	605	706	807	908
1013	101	203	304	405	505	608	709	810	912
1017	102	203	305	407	508	610	712	814	915
1021	102	204	306	408	510	613	715	817	919
1025	102	205	307	410	512	615	717	820	923
1029	103	206	309	412	514	617	720	823	925
1033	103	207	310	413	516	620	723	826	930
1037	104	207	311	415	518	622	726	830	933
1041	104	208	312	416	520	625	729	833	937
1045	104	209	313	418	522	627	731	836	941
1049	105	210	315	420	524	629	734	839	944
1053	105	211	316	421	526	632	737	842	948
1057	106	211	317	423	528	634	740	846	951
1061	106	212	318	424	530	637	743	849	955
1065	106	213	319	426	532	639	745	852	959
1069	107	214	321	428	534	641	748	855	962
1073	107	215	322	429	536	644	751	858	966
1077	108	215	323	431	538	646	754	862	969
1081	108	216	324	432	540	649	757	865	973
1085	108	217	325	434	542	651	759	868	977
1089	109	218	327	436	544	653	762	871	980
1093	109	219	328	437	546	656	765	874	984
1097	110	219	329	439	548	658	768	878	987
1101	110	220	330	440	550	661	771	881	991
1105	110	221	331	442	552	663	773	884	994
1109	111	222	333	444	554	665	776	887	998
1113	111	223	334	445	556	668	779	890	1002
1117	112	223	335	447	558	670	782	894	1005
1121	112	224	336	448	560	673	785	897	1009
1125	112	225	337	450	562	675	787	900	1013
1129	113	226	339	452	564	677	790	903	1016
1133	113	227	340	453	566	680	793	906	1020
1137	114	227	341	455	568	682	795	910	1023
1141	114	228	342	456	570	685	799	913	1027
1145	114	229	343	458	572	687	801	916	1031
1149	115	230	345	460	574	689	804	919	1034
1153	115	231	346	461	576	692	807	922	1038
1157	116	231	347	463	578	694	810	926	1041
1161	116	232	348	464	580	697	813	929	1045
1165	116	233	349	466	582	699	815	932	1049
1169	117	234	351	468	584	701	818	935	1052

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Diff.	1	2	3	4	5	6	7.	8	9
1173	117	235	352	469	586	704	821	938	1056
1177	118	235	353	471	588	706	824	942	1059
1181	118	236	354	472	590	709	827	945	1063
1185	118	237	355	474	592	711	829	948	1067
1189	119	238	357	476	594	713	832	951	1070
1193	119	239	358	477	596	716	835	954	1074
1197	120	239	359	479	598	718	838	958	1077
1201	120	240	360	480	600	721	841	961	1081
1205	120	241	361	482	602	723	843	964	1084
1209	121	242	363	484	604	725	846	967	1088
1213	121	243	364	485	606	728	849	970	1092
1217	122	243	365	487	608	730	852	974	1095
1221	122	244	366	488	610	732	855	977	1099
1225	122	245	367	490	612	735	857	980	1102
1229	123	246	369	492	614	737	860	983	1106
1233	123	247	370	493	616	740	863	986	1110
1237	124	247	371	495	618	742	866	990	1113
1241	124	248	372	496	620	745	869	993	1117
1245	124	249	373	498	622	747	871	996	1120
1249	125	250	375	500	624	749	874	999	1124
1253	125	251	376	501	626	752	877	1002	1128
1257	126	251	377	503	628	754	880	1006	1131
1260	126	252	378	504	630	756	882	1008	1134
1263	126	253	379	505	631	758	884	1010	1137
1267	127	253	380	507	633	760	887	1014	1140
1271	127	254	381	508	635	763	890	1017	1144
1235	127	255	382	510	637	765	892	1020	1147
1279	128	256	384	512	639	767	895	1023	1151
1283	128	257	385	513	641	770	898	1026	1155
1287	129	257	386	515	643	772	901	1030	1158
1291	129	258	387	516	645	775	904	1033	1162
1295	129	259	388	518	647	777	906	1036	1165
1299	130	260	389	520	649	779	909	1039	1169
1303	130	261	391	521	651	782	912	1042	1173
1307	131	261	392	523	653	784	915	1046	1176
1311	131	262	393	524	655	787	918	1049	1180
1315	131	263	394	526	657	789	920	1052	1183
1319	132	264	396	528	659	791	923	1055	1187
1323	132	265	397	529	661	794	926	1058	1191
1327	133	265	398	531	663	796	929	1062	1194
1331	133	266	399	532	665	799	932	1065	1198
1335	133	267	400	534	667	801	934	1068	1201
1339	134	268	402	536	669	803	937	1071	1205
1343	134	269	403	537	671	806	940	1074	1209
1347	135	269	404	539	673	808	943	1078	1212
1351	135	270	405	540	675	811	946	1081	1216
1355	135	271	406	542	677	813	948	1084	1219
1359	136	272	408	544	679	815	951	1087	1223
1363	136	273	409	545	681	818	954	1090	1227
1367	137	273	410	547	683	820	957	1094	1230
1371	137	274	411	548	685	823	960	1097	1234
1375	137	275	412	550	687	825	962	1100	1237
1379	138	276	414	552	689	827	965	1103	1241
1383	138	277	415	553	691	830	968	1106	1245
1387	139	277	416	555	693	832	971	1110	1248
1391	139	278	417	556	695	835	974	1113	1252
1395	140	279	418	558	697	837	976	1116	1255
1399	140	280	420	559	699	839	979	1119	1259
1403	140	281	421	561	701	842	982	1122	1263
1407	141	281	422	563	703	844	985	1126	1266
1411	141	282	423	564	705	847	988	1129	1270
1415	141	283	424	566	707	849	990	1132	1273
1420	142	284	426	568	710	852	994	1136	1278
1425	142	285	427	570	712	855	997	1140	1282
1430	143	286	429	572	715	858	1001	1144	1287
1435	143	287	430	574	717	861	1004	1148	1291

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Diff.	1	2	3	4	5	6	7	8	9
1440	144	288	432	576	720	864	1008	1152	1296
1445	144	289	433	578	722	867	1011	1156	1300
1450	145	290	435	580	725	870	1015	1160	1305
1455	145	291	436	582	727	873	1018	1164	1309
1460	146	292	438	584	730	876	1022	1168	1314
1465	146	293	439	586	732	879	1025	1172	1318
1470	147	294	441	588	735	882	1029	1176	1323
1475	147	295	442	590	737	885	1032	1180	1327
1480	148	296	444	592	740	888	1036	1184	1332
1485	148	297	445	594	742	891	1039	1188	1336
1490	149	298	447	596	745	894	1043	1192	1341
1495	149	299	448	598	747	897	1046	1196	1345
1500	150	300	450	600	750	900	1050	1200	1350
1505	150	301	451	602	752	903	1053	1204	1354
1510	151	302	453	604	755	906	1057	1208	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	921	1074	1228	1381
1540	154	308	462	616	770	924	1078	1232	1386
1545	154	309	463	618	772	927	1081	1236	1390
1550	155	310	465	620	775	930	1085	1240	1395
1555	155	311	466	622	777	933	1088	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	628	785	942	1099	1256	1413
1575	157	315	472	630	787	945	1102	1260	1417
1580	158	316	474	632	790	948	1106	1264	1422
1585	158	317	475	634	792	949	1109	1268	1426
1590	159	318	477	636	795	954	1113	1272	1431
1595	159	319	478	638	797	957	1116	1276	1435
1600	160	320	480	640	800	960	1120	1280	1440
1605	160	321	481	642	802	963	1123	1284	1444
1610	161	322	483	644	805	966	1127	1288	1449
1615	161	323	484	646	807	969	1130	1292	1453
1620	162	324	486	648	810	972	1134	1296	1458
1625	162	325	487	650	812	975	1137	1300	1462
1630	163	326	489	652	815	978	1141	1304	1467
1635	163	327	490	654	817	981	1144	1308	1471
1640	164	328	492	656	820	984	1148	1312	1476
1645	164	329	493	658	822	987	1151	1316	1480
1650	165	330	495	660	825	990	1155	1320	1485
1655	165	331	496	662	827	993	1158	1324	1489
1660	166	332	498	664	830	996	1162	1328	1494
1665	166	333	499	666	832	999	1165	1332	1498
1670	167	334	501	668	835	1002	1169	1336	1503
1675	167	335	502	670	837	1005	1172	1340	1507
1680	168	336	504	672	840	1008	1176	1344	1512
1685	163	337	505	674	842	1011	1179	1348	1516
1690	169	338	507	676	845	1014	1183	1352	1521
1695	169	339	508	678	847	1017	1186	1356	1525
1700	170	340	510	680	850	1020	1190	1360	1530
1705	170	341	511	682	852	1023	1193	1364	1534
1710	171	342	513	684	855	1026	1197	1368	1539
1715	171	343	514	686	857	1029	1200	1372	1543
1720	172	344	516	688	860	1032	1204	1376	1548
1725	172	345	517	690	862	1035	1207	1380	1552
1730	173	346	519	692	865	1038	1211	1384	1557
1735	173	347	520	694	867	1041	1214	1388	1561
1740	174	348	522	696	870	1044	1218	1392	1566
1745	174	349	523	698	872	1047	1221	1396	1570
1750	175	350	525	700	875	1050	1225	1400	1575
1755	175	351	526	702	877	1053	1228	1404	1579
1760	176	352	528	704	886	1036	1232	1408	1584
1765	176	353	529	706	882	1059	1235	1412	1588

Diff.	1	2	3	4	5	6	7	8	9
1770	177	354	531	708	885	1062	1239	1416	1593
1775	177	355	532	710	887	1065	1242	1420	1597
1780	178	356	534	712	890	1068	1246	1424	1602
1785	178	357	555	714	892	1071	1249	1428	1606
1790	179	358	537	716	895	1074	1253	1432	1611
1795	179	359	548	718	897	1077	1256	1436	1615
1800	180	360	540	720	900	1080	1260	1440	1620
1805	180	361	541	722	902	1083	1263	1444	1624
1810	181	362	543	724	905	1086	1267	1448	1629
1815	181	363	544	726	907	1089	1270	1452	1633
1820	182	364	546	728	910	1092	1274	1456	1638
1825	182	365	547	730	912	1095	1277	1460	1642
1830	183	366	549	732	915	1098	1281	1464	1647
1835	183	367	550	734	917	1101	1284	1468	1651
1840	184	368	552	736	920	1104	1288	1472	1656
1845	184	369	553	738	922	1107	1291	1476	1660
1850	185	370	555	740	925	1110	1295	1480	1665
1855	185	371	556	742	927	1113	1298	1484	1669
1860	186	372	558	744	930	1116	1302	1488	1674
1865	186	373	559	746	932	1119	1305	1492	1678
1870	187	374	561	748	935	1122	1309	1496	1683
1875	187	375	562	750	937	1125	1312	1500	1687
1880	188	376	564	752	940	1128	1316	1504	1692
1885	188	377	565	754	942	1131	1319	1508	1696
1890	189	378	567	756	945	1134	1323	1512	1701
1895	189	379	568	758	947	1137	1326	1516	1705
1900	190	380	570	760	950	1140	1330	1520	1710
1905	190	381	571	762	952	1143	1333	1524	1714
1910	191	382	573	764	955	1146	1337	1528	1719
1915	191	383	574	766	957	1149	1340	1532	1723
1920	192	384	576	768	960	1152	1344	1536	1728
1925	192	385	577	770	962	1155	1347	1540	1732
1930	193	386	579	772	965	1158	1351	1544	1737
1935	193	387	580	774	967	1161	1354	1548	1741
1940	194	388	582	776	970	1164	1358	1552	1746
1945	194	389	583	778	972	1167	1361	1556	1750
1950	195	390	585	780	975	1170	1365	1560	1755
1955	195	391	586	782	977	1173	1368	1564	1759
1960	196	392	588	784	980	1176	1372	1568	1764
1965	196	393	589	786	982	1179	1375	1572	1768
1970	197	394	591	788	985	1182	1379	1576	1773
1975	197	395	592	790	987	1185	1382	1580	1777
1980	198	396	594	792	990	1188	1386	1584	1782
1985	198	397	595	794	992	1191	1389	1588	1786
1990	199	398	597	796	995	1194	1393	1592	1791
1995	199	399	598	798	997	1197	1396	1596	1795
2000	200	400	600	800	1000	1200	1400	1600	1800
2010	201	402	603	804	1005	1206	1407	1608	1809
2020	202	404	606	808	1010	1212	1414	1616	1818
2030	203	406	609	812	1015	1218	1421	1624	1827
2040	204	408	612	816	1020	1224	1428	1632	1836
2050	205	410	615	820	1025	1230	1435	1640	1845
2060	206	412	618	824	1030	1236	1442	1648	1854
2070	207	414	621	828	1035	1242	1449	1656	1863
2080	208	416	625	832	1040	1248	1456	1664	1872
2090	209	418	627	836	1045	1254	1463	1672	1881
2100	210	420	630	840	1050	1260	1470	1680	1890
2110	211	422	633	844	1055	1266	1477	1688	1899
2120	212	424	636	848	1060	1272	1484	1696	1908
2130	213	426	639	852	1065	1278	1491	1704	1917
2140	214	428	642	856	1070	1284	1498	1712	1926
2150	215	430	645	860	1075	1290	1505	1720	1935
2160	216	432	648	864	1080	1295	1512	1728	1944
2170	217	434	651	868	1085	1302	1519	1736	1953
2180	218	436	654	872	1090	1308	1526	1744	1962
2190	219	438	657	876	1095	1314	1533	1752	1971

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Diff.	1	2	3	4	5	6	7	8	9
2200	220	440	660	880	1100	1320	1540	1760	1980
2210	221	442	663	884	1105	1326	1547	1768	1989
2220	222	444	666	888	1110	1332	1554	1776	1998
2230	223	446	669	893	1115	1338	1561	1784	2007
2240	224	448	672	896	1120	1344	1568	1792	2016
2250	225	450	675	900	1125	1350	1575	1800	2925
2260	226	452	678	904	1130	1356	1582	1808	2034
2270	227	454	681	908	1135	1362	1589	1816	2043
2280	228	456	684	912	1140	1368	1596	1824	2052
2290	229	458	687	916	1145	1374	1603	1832	2061
2300	230	460	690	920	1150	1380	1610	1840	2070
2310	231	462	693	924	1155	1386	1617	1848	2079
2320	232	464	696	928	1169	1392	1624	1856	2088
2330	233	466	699	932	1165	1398	1531	1864	2097
2340	234	468	702	936	1170	1404	1638	1872	2106
2350	235	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	238	476	714	952	1190	1428	1666	1904	2142
2390	239	478	717	956	1195	1434	1673	1912	2151
2400	240	480	720	960	1200	1440	1680	1920	2160
2410	241	482	723	964	1205	1446	1687	1928	2169
2420	242	484	726	968	1210	1452	1694	1936	2178
2430	243	486	729	972	1215	1458	1701	1944	2187
2440	244	488	732	976	1220	1464	1708	1952	2196
2450	245	490	735	980	1225	1470	1715	1960	2205
2460	246	492	738	984	1230	1476	1722	1968	2214
2470	247	494	741	988	1235	1482	1729	1976	2223
2480	248	496	744	992	1240	1488	1736	1984	2232
2490	249	498	747	996	1245	1494	1743	1992	2241
2500	250	500	750	1000	1250	1500	1750	2000	2250
2510	251	502	753	1004	1255	1506	1757	2008	2259
2520	252	504	756	1008	1260	1512	1764	2016	2268
2530	253	506	759	1012	1265	1518	1771	2024	2277
2540	254	508	762	1016	1270	1524	1778	2032	2286
2550	255	510	765	1020	1275	1530	1785	2040	2295
2560	256	512	768	1024	1280	1536	1792	2048	2304
2570	257	514	771	1028	1285	1542	1799	2056	2313
2580	258	516	774	1032	1290	1548	1806	2064	2322
2590	259	518	777	1036	1295	1554	1813	2072	2331
2600	260	520	780	1040	1300	1560	1820	2080	2340
2610	261	522	783	1044	1305	1566	1827	2088	2349
2620	262	524	786	1048	1310	1572	1834	2096	2358
2630	263	526	789	1052	1315	1578	1841	2104	2367
2640	264	528	792	1056	1320	1584	1848	2112	2376
2650	265	530	795	1060	1325	1590	1855	2120	2385
2660	266	532	798	1064	1330	1596	1862	2128	2394
2670	267	534	801	1068	1335	1602	1869	2136	2403
2680	268	536	804	1072	1340	1608	1876	2144	2412
2690	269	538	807	1076	1345	1614	1883	2152	2421
2700	270	540	810	1080	1350	1620	1890	2160	2430
2710	271	542	813	1084	1355	1626	1897	2168	2439
2720	272	544	816	1088	1360	1632	1904	2176	2448
2730	273	546	819	1094	1365	1638	1911	2184	2457
2740	274	548	822	1096	1370	1644	1928	2102	2466
2750	275	550	825	1100	1375	1650	1935	2200	2475
2760	276	552	828	1104	1380	1656	1942	2208	2484
2770	277	554	831	1108	1385	1662	1949	2215	2493
2780	278	556	834	1112	1390	1668	1955	2224	2502
2790	279	558	837	1116	1395	1674	1963	2232	2511
2800	280	560	840	1120	1400	1680	1970	2240	2520
2810	281	562	843	1124	1405	1686	1977	2248	2529
2820	282	564	846	1128	1410	1692	1984	2256	2538
2830	283	566	849	1132	1415	1698	1991	2264	2547
2840	284	568	852	1136	1420	1704	1998	2272	2556
2850	285	570	855	1140	1425	1710	2005	2280	2565

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Diff.	1	2	3	4	5	6	7	8	9
2860	286	572	858	1144	1430	1716	2002	2288	2574
2870	287	574	861	1148	1435	1722	2009	2296	2583
2880	288	576	864	1152	1440	1728	2016	2304	2592
2890	289	578	867	1156	1445	1734	2023	2312	2601
2900	290	580	870	1160	1450	1740	2030	2320	2610
2910	291	582	873	1164	1455	1746	2037	2328	2619
2920	292	584	876	1168	1460	1752	2044	2336	2628
2930	293	586	879	1172	1465	1758	2051	2344	2637
2940	294	588	882	1176	1470	1764	2058	2352	2646
2950	295	590	885	1180	1475	1770	2065	2360	2655
2960	296	592	888	1184	1480	1776	2072	2368	2664
2970	297	594	891	1188	1485	1782	2079	2376	2673
2980	298	596	894	1192	1490	1788	2086	2384	2682
2990	299	598	897	1196	1495	1794	2093	2392	2691
3000	300	600	900	1200	1500	1800	2100	2400	2700
3010	301	602	903	1204	1505	1806	2107	2408	2709
3020	302	604	906	1208	1510	1812	2114	2416	2718
3030	303	606	909	1212	1515	1818	2121	2424	2727
3040	304	608	912	1216	1520	1824	2128	2432	2736
3050	305	610	915	1220	1525	1830	2135	2440	2745
3060	306	612	918	1224	1530	1836	2142	2448	2754
3070	307	614	921	1228	1535	1842	2149	2456	2763
3080	308	616	924	1232	1540	1848	2156	2464	2772
3090	309	618	927	1236	1545	1854	2163	2472	2781
3100	310	620	930	1240	1550	1860	2170	2480	2790
3110	311	622	933	1244	1555	1866	2177	2488	2799
3120	312	624	936	1248	1560	1872	2184	2496	2808
3130	313	626	939	1252	1565	1878	2191	2504	2817
3140	314	628	942	1256	1570	1884	2198	2512	2826
3150	315	630	945	1260	1575	1890	2205	2520	2835
3160	316	632	948	1264	1580	1896	2212	2528	2844
3170	317	634	951	1268	1585	1902	2219	2536	2853
3180	318	636	954	1272	1590	1908	2226	2544	2862
3190	319	638	957	1276	1595	1914	2233	2552	2871
3200	320	640	960	1280	1600	1920	2240	2560	2880
3210	321	642	963	1284	1605	1926	2247	2568	2889
3220	322	644	966	1288	1610	1932	2254	2576	2898
3230	323	646	969	1292	1615	1938	2261	2584	2907
3240	324	648	972	1296	1620	1944	2268	2592	2916
3250	325	650	975	1300	1625	1950	2275	2600	2925
3260	326	652	978	1304	1630	1956	2282	2608	2934
3270	327	654	981	1308	1635	1962	2289	2616	2943
3280	320	656	984	1312	1640	1968	2296	2624	2952
3290	329	658	987	1316	1645	1974	2303	2632	2961
3300	330	660	990	1320	1650	1980	2310	2640	2970
3310	331	662	993	1324	1655	1986	2316	2648	2979
3320	332	664	996	1328	1660	1992	2324	2656	2988
3330	333	666	999	1332	1665	1998	2331	2664	2997
3340	334	668	1002	1336	1670	2004	2338	2672	3006
3350	335	670	1005	1340	1675	2010	2345	2680	3015
3360	336	672	1008	1344	1680	2016	2352	2688	3024
3370	337	674	1011	1348	1685	2022	2359	2696	3033
3380	338	676	1014	1352	1690	2028	2366	2704	3042
3390	339	678	1017	1356	1695	2034	2373	2712	3051
3400	340	680	1020	1360	1700	2040	2380	2720	3060
3410	341	682	1023	1364	1705	2046	2387	2728	3069
3420	342	684	1026	1368	1710	2052	2394	2736	3078
3430	343	686	1029	1372	1715	2058	2401	2744	3087
3440	344	688	1032	1376	1720	2064	2408	2752	3096
3450	345	690	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	349	698	1047	1396	1745	2094	2443	2792	3141
3500	350	700	1050	1400	1750	2100	2450	2800	3150
3510	351	702	1053	1404	1755	2106	2457	2808	3159

Diff.	1	2	3	4	5	6	7	8	9
3520	352	704	1056	1408	1760	2112	2464	2816	3168
3530	353	706	1059	1412	1765	2118	2471	2824	3177
3540	354	708	1062	1416	1770	2124	2478	2832	3186
3550	355	710	1065	1420	1775	2130	2485	2840	3195
3560	356	712	1068	1424	1780	2136	2492	2848	3204
3570	357	714	1071	1428	1785	2142	2499	2856	3213
3580	358	716	1074	1432	1790	2148	2506	2864	3222
3590	359	718	1077	1436	1795	2154	2513	2872	3231
3600	360	720	1080	1440	1800	2160	2520	2880	3240
3610	361	722	1083	1444	1805	2166	2527	2888	3249
3620	362	724	1086	1448	1810	2172	2534	2896	3258
3630	363	726	1089	1452	1815	2178	2541	2904	3267
3640	364	728	1092	1456	1820	2184	2548	2912	3276
3650	365	730	1095	1460	1825	2190	2555	2920	3285
3660	366	732	1098	1464	1830	2196	2562	2928	3294
3670	367	734	1101	1468	1835	2202	2569	2936	3303
3680	368	736	1104	1472	1840	2208	2576	2944	3312
3690	369	738	1107	1476	1845	2214	2583	2952	3321
3700	370	740	1110	1480	1850	2220	2590	2960	3330
3710	371	742	1113	1484	1855	2226	2597	2968	3339
3720	372	744	1116	1488	1860	2232	2604	2976	3348
3730	373	746	1119	1492	1865	2238	2611	2984	3357
3740	374	748	1122	1496	1870	2244	2618	2992	3366
3750	375	750	1125	1500	1875	2250	2625	3000	3375
3760	376	752	1128	1504	1880	2256	2632	3008	3384
3770	377	754	1131	1508	1885	2262	2639	3016	3393
3780	378	756	1134	1512	1890	2268	2646	3024	3402
3790	379	758	1137	1516	1895	2274	2653	3032	3411
3800	380	760	1140	1520	1900	2280	2660	3040	3420
3810	381	762	1143	1524	1905	2286	2667	3048	3429
3820	382	764	1146	1528	1910	2292	2674	3056	3438
3830	383	766	1149	1532	1915	2298	2681	3064	3447
3840	384	768	1152	1536	1920	2304	2688	3072	3456
3850	385	770	1155	1540	1925	2310	2695	3080	3465
3860	386	772	1158	1544	1930	2316	2702	3088	3474
3870	387	774	1161	1548	1935	2322	2709	3096	3483
3880	388	776	1164	1552	1940	2328	2716	3104	3492
3890	389	778	1167	1556	1945	2334	2723	3112	3501
3900	390	780	1170	1560	1950	2340	2730	3120	3510
3910	391	782	1173	1564	1955	2346	2737	3128	3519
3920	392	784	1176	1568	1960	2352	2744	3136	3528
3930	393	786	1179	1572	1965	2358	2751	3144	3537
3940	394	788	1182	1576	1970	2364	2758	3152	3546
3950	395	790	1185	1580	1975	2370	2765	3160	3555
3960	396	792	1188	1584	1980	2376	2772	3168	3564
3970	397	794	1191	1588	1995	2382	2779	3176	3573
3980	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	802	1203	1604	2005	2406	2807	3208	3609
4020	402	804	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	1230	1640	2050	2460	2870	3280	3690
4110	411	822	1233	1644	2055	2466	2877	3288	3699
4120	412	824	1236	1648	2060	2472	2884	3296	3708
4130	413	826	1239	1652	2065	2478	2891	3304	3717
4140	414	828	1242	1656	2070	2484	2898	3312	3726
4150	415	830	1245	1660	2075	2490	2905	3320	3735
4160	416	832	1248	1664	2080	2496	2912	3328	3744
4170	417	834	1251	1658	2085	2502	2919	3336	3753

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Diff.	1	2	3	4	5	6	7	8	9
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
4210	421	842	1263	1684	2105	2526	2947	3368	3789
4220	422	844	1266	1688	2110	2532	2954	3376	3798
4230	423	846	1269	1692	2115	2538	2961	3384	3807
4240	424	848	1272	1696	2120	2544	2968	3392	3816
4250	425	850	1275	1700	2125	2550	2975	3400	3825
4260	426	852	1278	1704	2130	2556	2982	3408	3834
4270	427	854	1281	1708	2135	2562	2989	3416	3843
4280	428	856	1284	1712	2140	2568	2996	3424	3852
4290	429	858	1287	1716	2145	2574	3003	3432	3861
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.

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AN
ACCOUNT
OF THE
Origine, Nature, Conſtruction, Uſes,
AND
Application of the preceeding TABLES
OF
LOGARITHMS.

THE 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 firſt 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 introduce here.

Logarithms (ſaith Dr. *Wallis* in his Algebra) were firſt of all invented, without any Example before 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 himſelf (with the Aſſiſtance of *Henry Briggs*, Profeſſor 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 deſervedly) by Learned Men.

Mr. *Briggs* upon the firſt Publication of it, was ſo 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 Vlacq*, *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.

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 Quadrant.

And whereas it was at his Choice to give to what Number he pleaſed the Logarithm 0, and whether to proceed by Way of Increaſe or Decreaſe, he choſe to make 0 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 0.

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 *Abundants*: 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 Sines (with the Differences there inſerted) may ſerve alſo for a Table of Tangents, and of Secants; ſo that this Canon is a compleat Canon, of Natural Sines, and of Logarithmical Sines, Tangents, and Secants.

He ſhews alſo how this Table may be applied to the Logarithms of Abſolute Numbers; but becauſe with ſome Trouble, he reſerves the fuller Account hereof to a farther Treatiſe.

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 Deſign (after Communication had with Mr. *Briggs*) of changing the Form of his Logarithms, making o, 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 o; 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 Characteriſtick: And between theſe he ſets the intermediate Logarithm for the Intermediate Numbers.

And conſequently the Logarithm of 1 being o, the Logarithm of Fractions leſs than 1, or of Numbers intermediate, between 1 and o, muſt be Negative Numbers, or Numbers leſs than o, which he calls Defective Logarithms, denoted by — (the Note of Negative) prefix'd.

Now theſe Defective 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 Affirmative.)

As for Example; The Fraction $\frac{3}{8}$, 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 $\frac{3}{8}$, which will be then the Negative Number,—0.4259687.

Log. 3.	0. 4771213.
Log. 8.	0. 9030900.
Log. $\frac{3}{8}$.	— 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
Log.	375 =2. 5740313
Log.	37|5=1. 5740313
Log.	3|75 =0. 5740313
Log.	0|375=$\bar{1}$. 5740313
Log.	0|0375=$\bar{2}$. 5740313

Which two Forms, tho' they ſeem different, and ſome 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 ſame. For, by ſudducting the lower Number from the upper.

$$\begin{array}{r} -1.\ 0000000 \\ +0.\ 5740313 \\ \hline \text{is} = -0.\ 4259687 \end{array}$$

And every one is left to his Liberty whether of the two Ways (or what other Equivalent thereunto) he ſhall pleaſe to uſe.

In this Method Mr. *Briggs* hath calculated a Table of Logarithms (publiſhed 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 Vlacq* (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 Characteriſtick. 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 Treatiſe 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 Vlacq*, 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 Crugerus* gives an Account in the Preface to his *Trigonometria Logarithmica*, Printed in the Year 1634, with his Logarithmical 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,

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Places, beside the *Characteristick*, 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 Practice.

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 few of those, who make constant Use of Logarithms to have attained an *Adequate Notion 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 amiss; being I suppose under the Apprehension of some great Difficulty therein.

For the Sake of such, 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 *Definition* of Logarithms, in order to render the ensuing Discourse more clear; the rather because the Old one *Numerorum proportionalium æqui-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 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 *Ratiunculæ*, 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 *Ratiunculæ*, proportional to each *Ratio*; we shall take the *Ratio* of Unity to any Number, to consist always of the same infinite Number of *Ratiunculæ*; 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 *Ratiuncula*; that is, the *Momentum* or *Fluxion* of the *Ratio* of Unity to the said Number: And seeing that in these continual Proportionals all the *Ratiunculæ* are equal; their Summ, or the whole *Ratio*, will be as the said *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 *Differentiola* 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, &c. infinitely; the Roots shall be the Logarithms invented by the Lord *Neper*; but if the said Index were 2302585, &c. 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 *impracticable*; yet by the Help of that admirable Invention of Sir *Isaac Newton*, whereby he determines the *Unciæ*, or Numbers prefixed to the Members composing Powers (on which chiefly depends the Doctrine 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) $\overline{p+pq}\,|^{\frac{1}{m}}$ or $\overline{1+q}\,|^{\frac{1}{m}}$, instead of $1 + \frac{1}{m}q + \frac{1-m}{2m^2}qq +$;

$\frac{1-3m+2mm}{6m^3}q^3 + \frac{1-6m+11m^2-6m^3}{24m^4}q^4$, &c. (which is the Root when m is Finite) becomes $1+\frac{1}{m}q - \frac{1}{2m}q^2 + \frac{1}{3m}q^3 + \frac{1}{4m}q^4 + \frac{1}{5m}q^5$, &c. m^2, being *Infinite*, and consequently whatever is divided thereby vanishing. Hence it follows that $\frac{1}{m}$ Multiplied into $q - \frac{1}{2}q^2 + \frac{1}{3}q^3 - \frac{1}{4}q^4 + \frac{1}{5}q^5$, &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 such Indices will be as $\frac{1}{m}$; or reciprocally as the *Indices*. And if the Index be taken 10000, &c. as in the Case of *Neper*'s Logarithms; they will be simple $q - \frac{1}{2}qq + \frac{1}{3}q^3 - \frac{1}{4}q^4 + \frac{1}{5}q^5 - \frac{1}{6}q^6$, &c.

Again, if the Logarithm of a Decreasing *Ratio* be sought, the Infinite *Root* of $1-q$, or $\frac{1}{1-q|m}$, is $1 - \frac{1}{m}q - \frac{1}{2m}q^2 - \frac{1}{3m}q^3 - \frac{1}{4m}q^4 - \frac{1}{5m}q^5 - \frac{1}{6m}q^6$ &c. whence the Decrement of the First of our infinite Number of Proportionals will be $\frac{1}{m}$ into $q+\frac{1}{2}q^2+\frac{1}{3}q^3+\frac{1}{4}q^4+\frac{1}{5}q^5 + \frac{1}{6}q^6$, &c. which therefore will be as the Logarithm of the *Ratio* of Unity to $1-q$.

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* being a and b, q becomes $\frac{b-a}{a}$, or the Difference divided by the lesser Term, when it's an *Increasing Ratio*; or $\frac{b-a}{b}$ 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 $\frac{1}{m} \times \frac{x}{b} + \frac{x^2}{2b^2} + \frac{x^3}{3b^3} + \frac{x^4}{4b^4} + \frac{x^5}{5b^5} + \frac{x^6}{6b^6}$, &c. or $\frac{1}{m} \times \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \frac{x^4}{4a^4} + \frac{x^5}{5a^5} - \frac{x^6}{6a^6}$, &c.

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 $\frac{z}{2}$ instead of $\frac{a}{2} + \frac{b}{2}$, the said *Arithmetical Mean*, the *Logarithms* of those *Rationes* will be by the foregoing Rule; $\frac{1}{m}$ into $\frac{x}{z} + \frac{x^2}{2z^2} + \frac{x^3}{3z^3} + \frac{x^4}{4z^4} + \frac{x^5}{5z^5} + \frac{x^6}{6z^6}$, &c. and $\frac{1}{m}$ into $\frac{x}{z} - \frac{x^2}{2z^2} + \frac{x^3}{3z^3} - \frac{x^4}{4z^4} + \frac{x^5}{5z^5} - \frac{x^6}{6z^6}$, &c. the Sum whereof $\frac{1}{m}$ into $\frac{2x}{z} * + \frac{2x^3}{3z^3} * + \frac{2x^5}{5z^5} * \frac{2x^7}{7z^7}$, &c. will 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 $\frac{2x}{z}$ suffices to seven Places of the Logarithm, 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 $\frac{1}{2}z$, and, of $\frac{z}{2}$ to b, is the *Ratio* of $a\ b$, to $\frac{z^2}{4}$; and half of that *Ratio* is that of $\sqrt{a\ b}$, to $\frac{z}{2}$; or of the Geometrical Mean to the Arithmetical. And consequently the Logarithm thereof will be the half Difference of the Logarithms of those *Rationes* viz. $\frac{1}{m}$ into $\frac{xx}{2zz} + \frac{x^4}{4z^4} + \frac{x^6}{6z^6} + \frac{x^8}{8z^8}$, &c. Which is a Theorem of good Dispatch to find the Logarithm of $\frac{z}{2}$.

But the same is yet much more advantageously performed, by a Rule derived from the foregoing; and

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and beyond which in my Opinion, Nothing better can be hoped. For the *Ratio* of $a\,b$, to $\frac{z^2}{4}$, or $\frac{a^2}{4} + \frac{a\,b}{2} + \frac{b\,b}{4}$, has the Difference of its Terms, $\frac{a^2}{4} - \frac{a\,b}{2} + \frac{b\,b}{4}$, or the Square of $\frac{a}{2} - \frac{b}{2} = \frac{x^2}{4}$, which in the present Case of finding the Logarithms of Prime Numbers, is always *Unity*: and calling the Sum of the Terms $\frac{z^2}{4} + a\,b = y^2$, the Logarithm of the *Ratio* of $\sqrt{a\,b}$, to $\frac{a}{2} + \frac{b}{2}$, or $\frac{z}{2}$ will be found $\frac{1}{m}$ in $\frac{1}{yy} + \frac{1}{3y^6} + \frac{1}{5y^{10}} + \frac{1}{7y^{14}} + \frac{1}{9y^{18}}$, &c. Which converges very much faster than any Theorem hitherto published for this Purpose.

Here note, that $\frac{1}{m}$ is all along applied to adapt these Rules to all Sorts of Logarithms. If m be 10000, &c. 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 z, 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	0.47712, 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, 08297, 29188, 38706, 82718, 01191
17	1.23044, 89213, 78273, 92854, 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

$$\frac{1}{22} - \frac{1}{968} + \frac{1}{31944} - \frac{1}{937024} + \frac{1}{25768160}, \text{ \&c.}$$

$$\text{or } \frac{1}{23} + \frac{1}{1058} + \frac{1}{36501} + \frac{1}{1119364} + \frac{1}{32181715}, \text{\&c.}$$

As likewise that of the *Ratio* of 23 to 24, by a like Process.

$$\frac{1}{23} - \frac{1}{1058} + \frac{1}{36501} - \frac{1}{1119364} + \frac{1}{32181715}, \text{ \&c.}$$

$$\text{or } \frac{1}{24} + \frac{1}{1152} + \frac{1}{41472} + \frac{1}{1327104} + \frac{1}{39813120}, \text{\&c.}$$

And this is the Result of the Doctrine of *Mercator*, as improved by the Learned Dr. *Wallis*.

But by the second Theorem, *viz.* $\frac{2x}{z} + \frac{2x^3}{3z^3} + \frac{2x^5}{5z^5}$, &c. The same Logarithms are obtained by fewer Steps; To wit.

$$\frac{2}{45} + \frac{2}{273375} + \frac{2}{922640625} + \frac{2}{2615686171875}, \text{ \&c.}$$

$$\text{\&} \ \frac{2}{47} + \frac{2}{311469} + \frac{2}{1146725035} + \frac{2}{3546361843241};$$

&c.

Which was invented and demonstrated in the *Hyperbolick Spaces* analogous to the Logarithms, by by the Excellent Mr. *James Gregory*, in his *Exercitationes Geometricæ*; and since further prosecuted 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,

$$\frac{1}{1058} + \frac{1}{1119364} + \frac{1}{888215334} + \frac{1}{626487882248}, \text{ \&c. or, } \frac{1}{1057} + \frac{1}{3542796579} + \frac{1}{659676558485285}, \text{ \&c.}$$

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 $\frac{5}{3}$ of that Square, and that Quotient by $\frac{7}{5}$ 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

	1.3613169612669061294500917266980 5
1057) 43429, &c.	41087462810146814347315886368
3 in 1117249) 41087, &c.	12258521544181829460074
$\frac{5}{3}$ in 1117249) 12258, &c.	6583235184376175
$\frac{7}{5}$ in 1117249) 65832, &c.	4208829765
$\frac{9}{7}$ in 1117249) 42088, &c.	2930
	Summ 1.3617278360175928788677771122511 7

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, &c.

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 *Hyperbolæ*, published at *Padua*, *Anno* 1667, wherein he applies his *Quadrature* of the *Hyperbola*, to the making of the Logarithms: In *p.* 48. 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 found 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.

From the Logarithm given to find what Ratio *it 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 $\overline{1+q}|^{\frac{1}{m}} - 1$, and that of the *Ratio* of 1, to $1-q$, to be $1 - \overline{1-q}|^{\frac{1}{m}}$: So the Logarithm which we will from henceforth call L, being given $1+L$, will be equal to $\overline{1+q}|^{\frac{1}{m}}$ in the one Case; and $1-L$, will be equal to $\overline{1-q}|^{\frac{1}{m}}$, in the other: Consequently $\overline{1+L}|^{m}$ will be equal to $1+q$, and $\overline{1-L}|^{m}$ to $1-q$; that is, according to Sir *Isaac Newton*'s said Rule, $1 + mL + \frac{m^2}{2}L^2 + \frac{m^3}{6}L^3 + \frac{m^4}{24}L^4 + \frac{m^5}{120}L^5$, &c. will be equal to $1+q$, and $1 - mL + \frac{m^2}{2}L^2 - \frac{m^3}{6}L^3 + \frac{m^4}{24}L^4 - \frac{m^5}{120}L^5$, &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 Logarithm what it will.

But

But if *Neper*'s Logarithm be given the Multiplication by m is saved (which Multiplication is indeed no other than reducing the other Species to his) and the Series will be more simple, *Viz*.

$$1 + L + \frac{L^2}{2} + \frac{L^3}{6} + \frac{L^4}{24} + \frac{L^5}{120}, \text{ \&c. or}$$

$$1 - L + \frac{L^2}{2} - \frac{L^3}{6} + \frac{L^4}{24} - \frac{L^5}{120}, \text{ \&c.}$$

This Series 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 $1 + L + \frac{L^2}{2} + \frac{L^3}{6}$, &c. $= a + aL + \frac{aL^2}{2} + \frac{aL^3}{6}$, &c. But if b were given, a would be 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 l; it will follow that the Logarithm L, answering to the Number, will be either a into $1 + l + \frac{l^2}{2} + \frac{l^3}{6} + \frac{l^4}{24} + \frac{l^5}{120}$, &c. or else b into $1 - l + \frac{l^2}{2} - \frac{l^3}{6} + \frac{l^4}{24} - \frac{l^5}{120}$, &c. wherein as l is less, the Series will converge the swifter. And if the first 20000 Logarithms be given to fourteen Places, there is rarely Occasion for the three first Steps of this Series, to find the Number to as many Places. But as for *Vlacq*'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 $a + mal$, in one Case; or else $b - bl$, or $b - mbl$ 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 it neither so 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 sort of Logarithms, with the only Variation of Writing, $\frac{1}{m}$ instead of 1, that is $a + \frac{al}{\frac{1}{m} - \frac{l}{2}}$, and $b - \frac{bl}{\frac{1}{m} + \frac{l}{2}}$, or $\frac{\frac{1}{m}a + \frac{al}{2}}{\frac{1}{m} - \frac{l}{2}}$, and $\frac{\frac{1}{m}b - \frac{lb}{2}}{\frac{1}{m} + \frac{l}{2}}$, which are easily resolved into Analogies, *Viz*.

As 43429, &c. $- \frac{l}{2}$: to 43429 $+ \frac{l}{2}$: : so is a to the Number sought. Or,

As 43429, &c. $+ \frac{l}{2}$: to 43429 $- \frac{l}{2}$: : so is b to the Number sought.

If more Steps of this Series be desired it will be found as follows.

$$a + \frac{al}{1 - \frac{l}{2}} - \frac{\frac{1}{12}al^3}{1 - l} + \frac{\frac{1}{35}al^5}{1 - 2l}, \text{ \&c.}$$

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 satisfy'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 Logarithm from 10. 0000000. And 'tis frequently of 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 any Case to be subtracted: For then adding their Arithmetical Complements, will answer the End as truly as subtracting the Logarithms themselves.

As suppose in the double Rule of Three, you had this Question about Interest.

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	=	8.0000000
Next under it the *Arith. Comp.* of the Logarithm of	365	=	7.4377071
The Logarithm of	6	=	0.7781512
The Logarithm of the Principal	5173	=	3.7137425
The Logarithm of the Days	321	=	2.5065050
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 *l.* As well as the Rule determines that Number to consist 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 easily 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 the Rate of Interest.	=	0.0253058
Which Logarithm multiplied by 12 makes	=	0.3036696
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.	=	31.94362

3. It will be very necessary rightly to understand the Use of the Tables of Logarithms with regard to Decimal Fractions. For the Rule for finding the Logarithm of a Fraction being; *To subtract 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 Numbers from 1 to 10, to be 10 or 100, from 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 four 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 Fraction* is required.

Example, The Logarithm of $\frac{3}{4}$ is found thus:	3 Log.	0.4771213
From which Subtract the Denominator,	4 Log.	0.6020600
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 answer to 75, 750, 7500, 075, 75, or any other Number, whose two significant Figures are 75, and those which follow or preceed, 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 Number,

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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 or sought, be less than an Unite.

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 sought.

Example, Let $4\frac{9}{12}$ be the Mixt Number given; this reduced to an Improper Fraction is $\frac{57}{12}$.

The Logarithm of the Numerator, *viz.* 57, is	1. 7558748
The Logarithm of the Denominator, *viz.* 12, is	1. 0791812
The Loarithm of $4\frac{9}{12}, = 4\frac{75}{100}$, whose Logarithm is	0. 6766936

If the Fraction annexed be a Decimal, seek for it as if it were a whole Number, observing to prefix to its Logarithm a suitable Index; which always is an Unit less than the Number of Places, in the whole Number to which it belongs; which is further illustrated by the adjoyning Table, where the Logarithms, except the Index, are the 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, or 97.

Numbers.		*Logarithms.*
47500	4.	6766936
4750	3.	6766936
475	2.	6766936
47.5	1.	6766936
4.75	0.	6766936
.475	99, or,	9.6766936
.0475	98, or,	8.6766936
.00475	97, or,	7.6766936

Of raising Powers by Logarithms.

Multiply the Logarithm of the Number given by the Index of the Power required, the Product will be the Logarithm of the Power sought: So the Logarithm of 32 = 1. 5051500 × 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 intercepted between the Place of Units, and the first significant 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 prefix'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 = .000000729, the Cube of .009, and the Index of the Logarithm of the Power, or Product is 3; therefore 6 Cyphers must preceed the first significant Figure of the natural Number; and 2, is prefix'd since the Index or Number multiplying was 3. But when the Number of Cyphers, preceeding the significant Figures of the Power or Product exceeds 10, 'tis necessary 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 0—1 be requir'd its Logarithm in the Table is 6.4637261; but in 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 .0000000000000000000006058383. Here the Figures 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 Power.

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 and Number prefixed by that Index, the Quotient is the Logarithm of the Root desired. *Ex. Gr.* If the *Cubo*—Cube Root or Root of the 6. Power of .0000000000000000000006058383, whose Logarithm is 78. 7823566, be demanded; prefix 6—1, *i. e.* 5 to its Index, it is then 578. 7823566; which being divided by 6, the Index proper to the Root sought, the Quotient is 96. 4637261, whose natural Number is .0002908882; 3 Cyphers preceeding the first Figure, because the Index 96, wants so much of 99. But when the Root of an absolute Number is required, there needs no Figure to be prefixed to the Index of its Logarithm; since 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 indif-

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indifferent Thing, whether 3, the Index of the Root to be Extracted, be prefixed or not, since that alters Nothing: For 3)36. 82993854(Quotes 12. 2764618, the Logarithm of 189, the Cube-Root sought.

Another Method to Raise any Power 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 sought: For instance 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, being always the same Number with the Index of the Product.

Again, Let the 6. 25 Power of .0032 be sought: The Logarithm of .0032 (as before) is 7. 5051500, and its Arithmetick Complement 2. 4948500 × 6. 25 = 15. 5928125, its Arithmetick Complement is 84. 4071875, which answers to .00000, 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 sought: For instance, 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.

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LOGISTICA *Linea*, is that which is otherwise called the *Logarithmick Line*; where the Ordinates apply'd in equal Parts of the Axis are in Geometrical Proportion.

LOGISTICK *Spiral*. See *Logarithmick Spiral*.

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 turned into Degrees will truly give the *Longitude*, or *Vice Versa*. Hence several Ways have been thought of to find the Longitude at Sea; the great *Desideratum* of the Art of Navigation. As by the *Eclipse* of the Moon, her *Transit* 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 practised a-shore with the greatest Exactness. For the Time of any one of these *Phænomena* 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 deficient Body into or out of the Shadow, is not to be made without Telescopes of such a Length as the Motion of the Ship will not permit 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 Capes 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 Impracticableness of the Method of Eclipses for finding the Longitude at Sea; have happily thought of doing it by a Clock or 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 set 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 stop its Motion entirely, I don't mention the Inconvenience arising from 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 skilful 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 rectify'd every Day to the Stars or Sun's Hour; and so will shew 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 ¾ of C. lb. of Iron which is melted and broken off from a Sow in the Fire of the *Finery*, 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 Neck.

LOQUELA *sine die*, was formerly the Term for an Inparlance or a Respite in Law; or for a Demur to an Indefinite Time.

LOT, or *Lothe*, is every thirteenth Dish of Lead in the *Derby-shire* Mine, which is a Duty paid to the King.

LOURGULARY, is a Word in *Statuto pro Stratis Lond.* printed *A. D.* 1573. *Art.* 43. and then signified, casting any corrupt Thing into it, to spoil or poyson the Water.

LUCRATIVE *Interest*, in the Civil Law, is such 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 signify a Silver Penny; or a *Sterling* or *Easterling* in a restrained Sense, 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 Moivre*.

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 more. 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, where they lie upon the *Vertebræ*: But before, where they touch the *Sternum* and *Ribs*, they are Convex.

The Colour of the Lungs in a *Fœtus* 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 *Mediastinum* before, and to the *Vertebræ* by the *Plura* behind, when it rises from the *Vertebræ* to the Heart, by the *Vena* and *Arteria Pulmonaris*; and sometimes to the *Pleura*, where it covers the Ribs, particularly in the left Side, and especially after a Pleurisy.

The *Lobes* of the *Lungs* are covered with a double Membrane; of which the *External* is a Production of the *Pleura*: and the *Internal*, not only covers immediately the Substance of the Lungs, but its inner *Lamina* fill up the Interstices which are below the Bunches of the small *Lobes* with little vesicular 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*. Each little *Lobe* contains within its own proper Membrane an infinite Number of little orbicular Vessels, which leave small Interstices between them; and which are full of small Membranes, like those which tie the Lobes together.

The Extremities of the Branches of the Wind-pipe open into the Cavities of Vesicles, which are probably formed by its Membranes; but the Capillary Blood-vessels are only spread upon the Vesicles like a Net, with frequent and large Inosculations.

The Vessels which enter the Lungs are the *Trachea* or *Aspera Arteria*, by which we draw in and expire Air: And the *Arteria Pulmonalis*, which comes from the *Right Ventricle*, and the *Vena Pulmonalis*, whose Trunk opens into the *left Auricle* 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. Where-ever there is a Branch of the *Trachea*, there is also a Branch of the Vein and Artery, and the *Trachea* is always in the middle.

On the Branches of the *Trachea* (which they call the *Bronchi* or *Bronchia*) runs a small Artery called by *Ruysh*, *Arteria Bronchialis*, and a small Vein, which *Sonnichellius* calls *Vena Pneumonica*: The Artery comes from the *Aorta*, the Vein from the *Subclavian*.

The Blood in the *Arteria Pulmonalis* 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 *Lymphaticks*; which discharge themselves into the *Thoracick Duct*; but they are smaller, and make more frequent Inosculations, almost than any other.

This is the Passage of the Vessels thro' the Lungs; but because the *Trachea* hath a particular Structure, it demands a particular Examination.

The *Trachea* then, or *Aspera Arteria*, is a Canal situated in the first part of the Neck, before the *Oesophagus*; its upper End is called *Larynx*, from whence it descends to the 4th *Vertebra* of the Back, where it divides and enters the Lungs; this Canal is made of Annular Cartilages, at small and equal Distances from one another: And these grow smaller still as they approach the Lungs; and those of the *Bronchi* 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 Part, which is contiguous to the *Oesophagus*, is membranous, that they may the better contract, dilate, and give Way to the Aliments, as they go down the *Oesophagus*. But the Cartilages of the *Bronchi* are compleatly Annular; yet their Capillary Branches have no Cartilages; but instead of them small circular Ligaments which are at pretty large Distances from one another. The use of the Cartilages is to keep the Passage for the Air always open; but in the Capillary *Bronchi*, they would hinder the subsiding of the Vessels.

These Cartilages are tied together by two Membranes, the one *External* the other *Internal*. The External is composed of circular Fibres, and covers the whole *Trachea* 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 *Trachea*, 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 second 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 *Carotides*; and the Nerves of the *Recurrent*.

From the Structure of the Lungs thus described, Dr. *Pitcairn* hath deduced Mechanically the great effect, they by means of the Air produce upon the Blood. For while the *Fœtus* is in the Womb, the Vesicles 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 *Trachea*, and blows up the Vesicles into their Spherical Figures; by which Means, the Pressure or Compression being taken off from the Blood-vessels, 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 Capillary 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.

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But tho' 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 Pneumatical Experiments*, shews us, That Animals cannot live when shut up in common Air, tho' by a Gauge he hath found it to retain its wonted Pressure; and tho' the Receiver hath been immersed in Water cooled with a Solution of *Sal Armoniac.* 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 pressing in more fresh Air.

3. It may be demonstrated, (saith the same Dr. *Keill*) 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 Vesiculæ* formed by the Coats of the small Branches of the *Trachea*; so that they may be considered, when blown up, as so many fine Tubes ending in fine hollow Spheres. On the Sides of these *Vesiculæ*, the Blood-vessels are spread in a fine Net-work: But before the *Fœtus* is brought to light, these *Vesiculæ* lie flat on one another, and by their Pressure on the Blood-vessels hinder its Passage thro' them; but as soon as the *Fœtus* enjoys the Benefit of the Air, that doth by its *Weight* and *elastick Force*, rush in thro' the Pipes of the *Trachea* into these *Vesiculæ* 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 Elastick Fluid, the Air, is thrust out of those *Vesiculæ* thro' the *Trachea* in Expiration, these *Vesiculæ* 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 Passages of the Capillary Vessels.

And there seems to be a yet more considerable Use of this *Natural Function* behind; which is, *to form those Elastick 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, *Ramenta* of a thick Consistence (which is probably the unformed Part of the Chyle and Aliment) and these Globules of which we are now speaking, tho' sometimes they are of different Colours, as *White, Blue, Purple*: This any one may discover with an ordinary Microscope. Now 'tis certain that these Globules may be *burst*, as in Obstructions; and all *exhausted*, as in violent *Hæmorrhages*, and yet be all recovered and recruited again; wherefore they must be *formed*, somewhere in the Body, from the Chyle. And since 'tis certain that they are not *solid* Particles, as appears both by Ocular Inspection and Truth; also that they do actually change their Globular Figures into those of *Oblong Sphæroides*, 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 little Bubbles blown from the viscid Part 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 *those two Veins only*, which are just returning into the Heart immediately to be sent into the Lungs. For since 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 grosser Element cannot, yet this finer Fluid, (by the vast Force used in Expiration) may be thrust in thro' the Sides of these *Vesiculæ*, to the Blood-vessels. And since 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 thro' the Sides of the Blood-vessels, but in the *Lungs*: 'tis very probable these *Globules* are there 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 Ventricle* of the Heart to the Lungs, and is spread upon the Sides of the *Vesiculæ* thereof in little fine Tubes: this fine fluid Elastick being squeezed, in the Act of Expiration, thro' a Pore, continued thro' the *Vesicle* of the Lungs and the Side of the Blood-vessels, 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 it 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 Artery; 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 Motions 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 Causes) whenever they come to the Lungs they are new formed again; whereby the Circulation is render'd constant and uniform. For should these Bubbles be all destroy'd, there must of Necessity rise a general Obstruction in all the Capillary Arteries. An Instance of the Formation 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

of Oyl. *Vid. Cheyne's Phil. Princip. of Natural Religion, p.* 214.

LUNI-SOLAR *Year*, 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, } was a base Sort of Coin
LUSHBOROW, } 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 and sow.

LYMPHÆDUCTS, 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 fine 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 *still a Gland* whilst it suffers 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 *Lymphatick 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 Lymphæducts running 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 vesicular 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 Lymphæducts 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 *Glandulæ Inguinales, Sacræ, Lumbares, Mesentericæ,* and *Hepaticæ*; all which send out new Lymphæducts which pour their *Lympha* into the *Receptaculum Chyli*, as those of the Chest, Head and Arms do into the *Ductus Thoracicus*, Jugular and Subclavian Veins. The Design of the Lymphæducts emtying themselves into the conglobate Glands seems to be, that the slow *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. See *Keill's Anatomy*. p. 52.

MAG MAG

MACE-GRIEF, alias *Macegreffe, Machecarii*; are such as willingly and knowingly buy or sell stollen Flesh.

MAGAZINE or *Arsenal*, is the Place in Fortified Towns, *&c.* where all sorts 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. 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 Iron Wire would, upon being bent round into a Ring, or coil'd round upon a Stick, *&c.* most times quite lose its Verticity, and always have it much diminished thereby. But yet, that if the whole length of the Wire were not entirely bent, so that the Ends of it, tho' but for the length of one tenth of an Inch, were left strait; then the Verticity 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 abovesaid, 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 found in Fact to be true of our noble large *Loadstone* which is kept in the Repository at *Gresham 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 four Foot.

He found also, that *twisting* 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 *Loadstone* along near the Sides of the Wire, in some Places it would attract

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 *splitting* or *cleaving* the Wire would do; and in particular, whether split Wires would have the same Properties as *Loadstones* cut asunder, and he found the *Phænomena* of this Experiment very odd; for sometimes the Poles of the Wire so split would be quite chang'd; 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 side 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 side 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, *'tis 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 side, was attracted only by the Pole that touched it.

MAILE, was anciently a Kind of Money, as some 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 *Rent*. This latter in the North is called *Black-mail*. See *Black-mail* in Vol. 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 *Maletolte*; 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. 'tis appointed, that Nothing for hereafter shall be taken of Sacks of Wooll, under the Pretence of *Maletent*. It seems to come from *malum Telonium*.

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 killing 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 Universities.

MANNER; besides what hath been said about *Manner*, I must take notice that they say in *Architecture*, That an Order Heroically and Gigantically 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 *solemn* 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 Tithes.

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 Subsistence.

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 *Lambert*'s *Αρχαιονομία*, *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 sued him when he might enter without Suit; or or when he granted him an Annuity or Leased Land to him for Years, or for Life, *&c.*

MANU-OPERA, are stollen Goods taken upon a Thief apprehended in the Fact.

MANU-PASTUS, in the Law Dialect is often used for a Domestick Servant, one fed 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 said to do it *propria manu*; but if he brought 3 or more Witnesses to swear for him, he was said *tertia manu jurare.*

MARCHET } *Mulieris*, the same with *Mer-*
MARCHETA } *chetum.*

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 signifies a Bound or Limit; and those Noblemen who lived near these *Marches* are frequently in our Statutes called *Marchers.*

MARITAGIUM *habere*, signified formerly to have the free Disposal of an Heiress in Marriage, which was a Favour granted by the King, who was the Guardian of all Wards or Heirs in Minority, 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 six 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 such before in the *Saxons* Time, and with some *Mark* or 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. signif. saith, a Mark signifies an Ounce Weight, whereof the Drachm is the eighth Part, as the Ounce is the eighth of the Mark.

MARQUIS or } 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 Praefectus 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: And 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.* 2. *c.* 24.

MASTER *of the Horse*, hath the Rule and Charge of the King's Stable: This Officer is very honourable, and usually a Nobleman, is mentioned 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. He 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 Officers.

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 Plate used 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 Garment.

MASTER *of the Houshold.* This Officer is called *Grand Master*, &c. and *Lord Steward of the King's Houshold* in 32 *H.* 8. 39. And in the first of Q. M. and ever since he is called *Lord Steward*, &c. and under him there is a principal Officer called by this Name of the *Master of the Houshold.*

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-*

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Puddle-wharf 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, &c. and the Charge and Delivery out of all Scarlet Liveries belonging to the King or Queen. He is mentioned in 39 *Eliz*. 7.

MATERIA *Subtilis*, in the Cartesian Philosophy is what is produced by the grinding or rubbing 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. Besides 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 generally.

Francisci Laurens Specimina Mathematica, &c.
Andreæ Tacquet Opera Mathematica, Antw. 1669.
The Works of Monsieur Fermat.
Dr. *Wallis*'s *Mathematical Works*, in 3 Vol. Fol. *Oxon*.
De Chales Cursus Mathematicus, 3 Vol. Fol. *Lugd*. 1674.
A Math. Compendium, by Sir *Jonas Moore*. *Lond*. 1674. *Twelves*.
Elements de Mathematiques, ou Principes Generaux de toutes les Sciences qui ont les Grandeurs pour Object. par J. P. a Paris, 1675. 4to.
Steph. de Angelis de Infinitis Spiralibus Inversis Infinitis Hyperbolis aliisque Geometricis Batavii. 4to.
P. Gregii a St. Vincentio opus Geometr. Quadratura Circuli & Sect. Coni. Antw. 1647. Fol.
Leybourn's *Cursus Mathematicus*. Lond. 1690. Fol.
Simon Stevin Les Oeuvres Mathematiques. Leyden, 1694. Fol.
Clavius's *Opera Mathematica*. Fol.
Mr. *Hayes Fluxions*, London, 1704. Fol.
Foster's *Miscellanies*. Lond. 1659. Fol.
Pappus Alexandrinus's *Math. Collect. per Commandinum*, Bononiæ, 1650. Fol.
Sir *Jonas Moore*'s *System of Mathematicks*, 2 Vol. London, 1681. 4to.

Cavallerii Trigonometria.	Bononiæ.	1643	4to.
Directorum generale Uranometricum.		1632	
Exercitationes Geometricæ.		1647	
Geometria Indivisibilis Continuorum.		1635	

Barrow's *Lectiones Geometricæ et Opticæ*. Lond. 1669. 4to.
Sturmius's *Mathesis Enucleata*. 1 Vol. 8vo.
——*Juvenilis*. 2 Vol. 8vo.
Veteres Mathematici. Paris, 1693. Fol.
Math. Collections in *Eng*. from *Galileo*. Lond. 1661. Fol.
Hook's *Micrographical Lections et Opera Posthuma*.
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 *Matricula Clericorum*, which was a List or Catalogue of the officiating Clergy, and *Matricula Pauperum*, a Catalogue of the Poor to be received: and to this Day being Registred as a Member in the University of *Oxon* is called *Matriculation*.

MATROSSES, are Soldiers in the Train of Artillery, next below the Gunners: Their Duty is to assist the Gunners in Traversing, Spunging, Firing, and Loading of Guns, &c. They carry Fire-locks, and march along with the *Store-Waggons*.

MAUND, was anciently a Measure of Capacity with us, being a kind of great Basket or Hamper containing 8 Bales, or 2 Fatts. See the Book of Rates, *Fol*. 3.

MAXY, is the *Tin-miners* Term for a *Weed*, as they call it, of the *Marchasite* kind, from whence *Maxy* seems to be a Corruption. When the *Load* or Vein of Oar degenerates into this or any thing else that is not Tin, they call it a *Weed*.

MEASURES *of Capacity*. These (with us) both liquid and dry, were first made from Troy Weight. See 9 *H*. 3. 51 *H*. 3. 12 *H*. 7. &c. wherein it is enacted, that eight Pound *Troy* Weight of Wheat, gathered from the middle of the Ear, and well dried, should make one Gallon of *Wine Measure*, and that there should be but one Measure for Wine, Ale, and Corn throughout the Kingdom. See 14 *Ed*. 3. and 15 *Rich*. 2. But Custom in time hath prevailed against this, having altered *Measures* as well as *Weights*; no other but *Troy Weight* being appointed by our Laws to be used. (See 14 and 17 of *Ed*. 3.) 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 *Measures*, Vol. I.

Only let me add further from Mr. *John Ward*'s Arithmetick. *p*. 34. That tho' 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. are measured and sold, 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 *Tactometry*, *p*. 289. But 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 fit to continue the common *supposed* Contents 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 : : so $14\frac{7}{12}$ to $281\frac{1}{2}$, which is very near the Cubick Inches in the Ale Gallon. The Ale Quart contains $70\frac{1}{2}$ Cubick Inches; the Gallon will be 282.

Dry Measure seems to stand still in Proportion to the old Wine Gallon of 224 Cub. Inches. The common received Content of the Corn Gallon being $272\frac{1}{4}$. for as 12. $14\frac{7}{12}$: : 224. $272\frac{1}{4}$. and yet by an Act of Parliament made *A. D.* 1697, *it is appointed*, that *every round Bushel with a plain and even Bottom, being made* 18 *Inches and* $\frac{1}{2}$ *wide throughout, and* 8 *Inches deep, shall be esteemed a legal*

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 268¾ Cub. Inches.

MECHANICAL *Philosophy*, was that which the most ancient of the *Phœnician* and *Greek* Philosophers have adhered to for the Explication of the Phænomena of Nature; and these made use originally of no other *Principles*, than the Consideration of *Empty Space*, the *Doctrine of Atoms*, and in particular, the *Gravitation of Bodies*. These silently 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 Consideration. They have happily avoided aiming at any *Hypothesis* to explain the *Phænomena* of natural Effects, and leaving the *Philosophy of Causes* to Metaphysicks, they have rightly considered that it is the chief End, Design, and Business of Natural Philosophy to consider *Effects*; and by reasoning upon them and their various *Phænomena*, to proceed regularly at last to the *Causes* of Things; and especially to the Knowledge of the *First Cause*. And certain it is, that all true Progress and Proficiency in this Kind of Natural Philosophy, if it don't immediately lead us to the Knowledge of the *First Cause*, yet will surely bring us still nearer and nearer to it; and therefore is a most noble, excellent, and valuable Study. *Vid. Newt. Opt. Lat. Ed. p.* 315.

Authors on this Subject are,

Guidi Ubaldi Mechanicorum Liber. Venetiis, 1615. Fol.

Paulus Guldinus de Centro Gravitatis. Viennæ, 1635. Fol.

Christ. Hugenius de Motu Pendulorum. Paris, 1673. *Fol.*

Ejusdem Horologium Oscillatorium. Paris, 1673.

Gasp. Scotti Mechanica. Ejusdem Technica Curiosa. 1664.

Cassioli Mechanica.

Wilkin's Mathematical Magick.

Alphonsi Borelli de Vi Percussionis Bononiæ, 1677, & Lug. Bat. 1686. 4to.

Dr. *Wallis's Mechanica, sive de Motu. Tractatus Geometricus.*

Andreæ Boecleri Architectura curiosa nova & Amœnitates Hydrogogices cum 200 Fig. Ære incis. Norimbergæ. Fol.

——— *Theatrum Machinarum novum, exhibens Opera molaria & aquatica: cum Figuris.* Ibid. 1662. Fol.

M. Vitruvii de Architectura Libr. 10. cum Fig. Æneis Ed. opt. Amst. 1649. Fol.

Novo Teatro di Machine di vittorio Zonca. Padua. 1602. Fol.

Teatro di Machine di Jacobo Bestoni in Lioni. 1582.

Pauli Cassaci Mechanica. Lugd. Bat. 1684. 4to.

Alexandri Marchetti Exercitationes Mechanicæ. Pisis. 1669. 4to.

Heronis Alexandrini Spiritalium Liber. Amster. 1680. 4to.

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.

Mechanick Exercises, by *Moxon*. Lond. 1677. 4to.

Recueil de diversis Pieces touchants quelques nouvelles Machines par D. Papin, a Cassel. 1695. 8vo.

Mechanick Powers, by *Mandey* and *Moxon*. *Lon.*

Lucæ Valerii Lib. de Centro Gravitatis Solidorum. Rom. 1604.

Galileo de Mechanica & Motu locali Dialogi. Leyd. 1638.

MEMBRETTO, in Architecture, is the *Italian* Term for a *Pilaster*, that bears up an Arch. These are often *fluted*, 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 Cornishes and Freezes in Wainscot.

MEMORY. Dr. *Hook*, in his *Op. Posthum. 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 Conqueror* framed our Common Laws, with a Mixture of the Laws of *Normandy*; 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, 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.*

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-silver*: The Texture of which seems to consist of exceeding small, smooth, solid, spherical or spheroidical Particles; 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 *solid* 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

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ſhould be oval or ſpheroidical, their ſhorteſt Diameters muſt be of the Length of thoſe of the Particles of Light, or not much greater.

The Solidity of the Corpuſcles of *Mercury*, and the Smallneſs of the Interſtices left 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 Fire.

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 a Sea Chart according to the true Projection.* 2. Being joined with a Line of Chords, it ſerves for the Protraction and Reſolution of ſuch Right-lined 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 Chart* truly at Sea.

MESOLABIUM, See *Renati Tran. Fluſii Meſolabium; cui acceſſit pars altera de Analyſi & Miſcellanea. Leodii Eburonum*, 1668. *4to.*

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 aſſigned 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, ☉, ☾, ☿, ♄, ♀, ♂, and ♃; 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 applied 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.

2. *In Bodies of different Metal, but equal Magnitude, having the Weight of one, to find that of the reſt.*

This Probl. is the Converſe of the former, but not 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 Points 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 Metal, ſuppoſe a Sphere of Lead of* 16 d. *and whoſe Diameter is* a *(let* d *and* a *ſignify any Magnitudes or Lengths) to make another like it and of equal 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 ♄ belonging to Lead; then will the Parallel between the proper Points in ♂, be the Diameter of the Iron Sphere required: And this compared with the other Diameter in the Line of Solids, will give 23 d. 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. gr. that ſhall weigh thrice as much.*

Apply the Diameter *a* over in the proper Points of ♄; and then the Parallel between the proper Points of ♂ will give the Length of the Diameter of an equal Sphere of Iron; and this tripled will be the Diameter required.

See *Webſter*'s *Metallographia*. Lond. 1670. 4to.

Alonſo Barba's *Art of Metals*, Engliſhed by the E. of *Sandwich*. Part 1. & 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*, ſeems to have been anciently a Fine or Penalty paid by the Tenant to his Lord for his Neglect or Omiſſion of doing his cuſtomary Service. Perhaps it ſhould be written *Mittenſcep* from the *Saxon Mitten*, to meaſure, and *ceap*, Goods or Chattels.

MICROGRAPHY, is the Deſcription of the Parts and Properties of ſuch very ſmall Objects as are only diſcernable by Means of the Microſcope. On this Subject the late Dr. *Hook* hath written deſignedly in his *Micrography*, as hath alſo Dr. *Power*; 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 *Philoſ. 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. Tranſ. N.* 29. and the manner how it is to be applied to a Teleſcope ſhewed. And Mr. *Flamſtead* in *N.* 96. ſaith, that by the Micrometer and a Teleſcope of but 14 Foot he could take the Diameters of the Planets and their Diſtances 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. *Dunſtan*'s Church in *Fleetſtreet*. See its Uſe in finding the Sun's Horizontal Parallax, under the Word *Sun* in this Volume.

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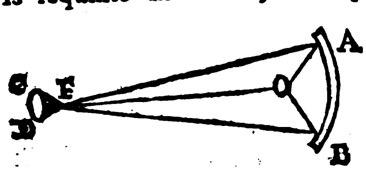
MICROSCOPE: By those excellent Observations and Experiments which the admirable Sir *If. Newton* hath made on Colours, he shews Ways to conjecture very accurately of the *Sizes* of the component Particles of Bodies by their Colours; and in the Description of those, he tells us, (*Book* 2. *Part* 3. *p.* 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 Instruments are or, can be so far improved, as with sufficient Distinctness to represent Objects five or six hundred Times bigger than at a Foot Distance 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 Particles 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. Transf.* 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 Distinctness 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 *Reflecting Piece of Metal*. For these Instruments seem as capable of Improvements as Telescopes; and perhaps more, because but one Piece of reflecting Metal is requisite in them; as is plain from this Figure; where



A B represents the Object Metal, C D the Eye-Glass, F their common *Focus*, and O the other *Focus* 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 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 *Convex-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 9 different *Magnifying-Glasses* are all set in Ivory, 8 of which are set in the manner express'd at M. The greatest Magnifier 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.* II.

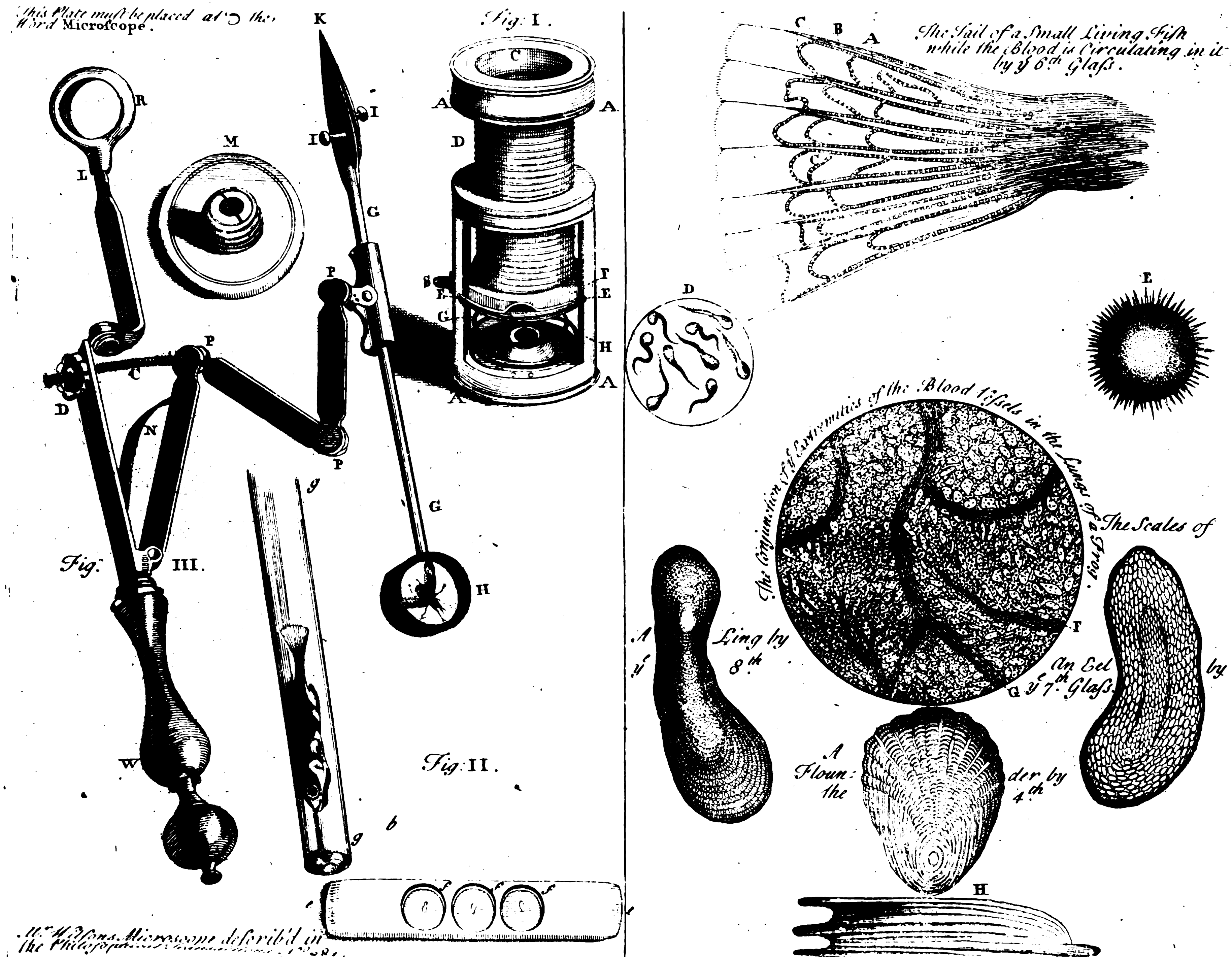
e e A flat Piece of Ivory, whereof there are 8 belonging to this Sett of Microscopes, (tho' any one who has a Mind to keep a Register of Objects may have as many of them as he pleases) in each of which there are three Holes f f f, wherein three or more Objects are placed between two thin *Glasses*, or Talks, when to be used with the greater Magnifiers.

The other *Instrument* Fig. III. is made of Brass or Prince's Metal, with Joints P P P, to turn easily any Way with a small Pair of Tongs G G, 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 G G, 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 P P, 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 e e, or *Sliders*, (if you please to call them so) and slide 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 o o, (the hollow Screw in the End of the Body of your Microscope) the 3*d*, 4*th*, 5*th*, 6*th*, or 7*th 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 screwing it nearer or farther off.

After


This Plate must be placed at ☽ the Word Microscope.
Fig: I.
Fig: II.
Fig: III.
The Tail of a Small Living Fish while the Blood is Circulating in it by ÿ 6th Glass.
The Conjunction of ÿ Extremities of the Blood Vessels in the Lungs of a Frog.
The Scales of
A Ling by ÿ 8th
A Flounder by the 4th
An Eel by ÿ 7th Glass.
Mr. Wilsons Microscope describ'd in the Philosop

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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* that will creep away, or such Objects as one intend to keep, they may be placed between the two *Register-Glasses* f f. For by taking out (with the Point of a Penknife or small Plyers) the Ring that keeps in the *Glass* f f, where the Object lies *they* 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 f, and applied as before, will be seen very easily.

As to the First, Second, and Third *Magnifying-Glasses*, 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'd at g 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 receiv'd easily into that little Cavity G of the *Brass-Plate*, fastened to the Leather F, under the other two thin Plates of Brass E E: When the *Tail* of your *Fish* lies flat 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 *Frog's Foot*, chuse such a *Frog* as will just go into your *Tube*, then with a little Stick, *&c.* expand the *Hinder Foot* of the Frog, and apply it close to the Side of the Tube, observing that no Part of the *Frog* 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; but you may see the Circulation in the Tails of *Water-Newts* with the 6th and 7th *Glass*, by reason the Globules of the Blood of those *Newts* 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 Transactions*, Page 1184.

N. B. The *Circulation* cannot be so well seen by the First, Second, and Third Magnifiers, 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 Instrument* W, Fig. III. may be screwed, and serve for a Handle to this Ivory one also.

The *Glass*, plac'd 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 Magnifier, for greater Objects, such as Flies 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 *Objects*, 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 Reflection 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 practis'd 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 docebit*.

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 finding 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 g g.

D the *Animalcula* in *Semine masculino*, by the first Glass,

E one

E one of the *Farina* of the Flower of *Mallows*, which magnified is the *Area* represented at D.

F 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*, *Newts*, *&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 several 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 Captain 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 *Glandulæ*, 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 *Litharge*, 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 six 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 see 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 *Assay-Master* 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 *Blanchers*, 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 nailed 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 such Religious Houses, as had obtained from *Rome* the Privilege of wearing the Mitre, Ring, Crosier, 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 summoned 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 Interpreter.*

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*, sixteenth 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. Transf.* N. 238. by Dr. *Wallis.*

MONOPOLIZERS, are such Persons as combine together to engross, and to raise the Price of Goods.

MONSOONS, are shifting Trade Winds in the *E. Indian Ocean*, which blows periodically, some

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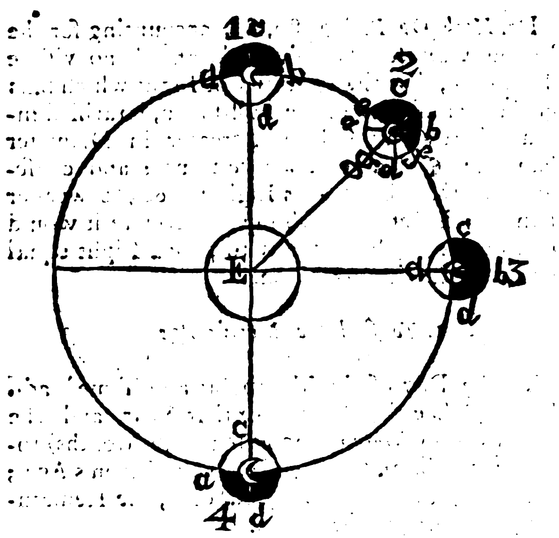
for half a Year one way, others but for 3 Months, and then shift and blow for 6 or 3 Months directly contrary.

MOON. The Reason why the ☾ always shews the same Face towards us, is because she revolves round her Axis in the Time of her Periodical Month.

For if in moving in her Orbit round the Earth she did not do so, but that the Horizon of the Disk *a b* kept always parallel to it self in all Positions, 'tis plain, that as the Moon moves on in her Orbit, new Parts of the former dark Hemisphere will begin to be enlighned (or rendred visible to us ;) as appears plain from the Figure annexed. For suppose the Moon to have moved in her Orbit from 1 to 2, and that her Diameter *a b* keeps parallel to its self in its first Situation ; then her visible Hemisphere 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 a d*, instead of *a d b*, as at first : And lastly, when the Moon is at 4, her visible Hemisphere will be *a c b*, which in the first Position was totally invisible. And this can't be otherwise, 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 Diameter *a b* shall always be in a Normal Position to the Line E ☾ ; as in the 2d and 3d Positions *e f* and *c d* are ; 'tis plain the Moon must by such a Motion round her Axis, always shew the same Face to you, as in Fact (abstracting from her Vibrations, &c.) she really doth.



The annual Regression of the Moon's Nodes is 25 Dregrees, and the *Nutation of her Orbit* about 20 Minutes.

The Phænomena of the Moon, on which, as Foundations, the Lunar Astronomy is built, are such 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.

2. But yet the Moon doth not move accurately in the same Plane of the Ecliptick, deviating sometimes a little to the *North*, and sometimes to the *South* ; as is apparent from her Meridian Altitudes. The Plane of her Orbit being inclined to that of the Ecliptick, and intersecting it in two Points, which are called the Moon's *Nodes*.

3. The Phases of the Moon are continually changing ; sometimes she cannot be seen at all, then she appears horned, bisected, gibbous, and at last *round* or *full* : And so 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, tho' not at every one ; and that of the Moon only when she is at the Full, tho' not at every Full-moon ; as is plain from the Reason and Nature of Eclipses.

5. 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 Reflection 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 ; wherefore, &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 Distance from the Earth will be very different, as she 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

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 Earth's *Perihelia* 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 *Perigæum* than in her *Apogæum*; 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 *Perigæa*, and of her Tardity in her *Apogæa* in the Syzygies of the *Apses* than in the Quadratures.

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 Ecliptick is swiftest (*cæteris paribus*) when she is in the Syzygies, and slowest when she is in her Quadratures to the Sun.

The Reason of which is to be had, not from any System of Astronomy, but from the Physical Principles of the *Newtonian* Philosophy.

10. That Place where the Moon appears least, and where her Motion is slowest, doth not keep always in the same Degree of the Ecliptick, but moves sensibly forward, or *in Consequentia*.

For tho' her *Apogæum* go forward in the Syzygies, and backward in the Quadratures, yet because the former Motion is near twice as swift as the latter, the Excess in the whole Revolution of the *Apses* must be forward, and consequently the *Apogæum* will move on *in Consequentia*, as by Observation 'tis found it really doth.

11. The Latitude of the Moon is moveable or changeable, being sometimes greater and sometimes lesser (according to the various Position of her Orbit to the Sun) even in the same Degree of proper Longitude.

This Difference of Latitude arises from the various Inclination of the Plane of the Moon's Orbit to that of the Ecliptick. 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 Position in Respect of the Sun.

And so it must be, since as was shewn above, the Excentricity of her Orbit is greater when the Line of the *Apses* 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 dissimilar to its self, whether you consider it in different Parts of the same Month, or in the similar Parts of different Months.

Nor is this strange, if you consider the 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 least Degree of Heat.

The Rays of Light have their Force decreased, (at least) as the Square of their Distance; and consequently the Force of the Sun's Rays reflected to us from the Moon, to those that come to us 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-diameter; 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 always turned towards the Earth.

The Reason of which is, that she turns round her own Axis, in the Time of her menstrual Motion round the Earth, as I have demonstrated 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 *Is. Newton*, I think, first discovered or communicated.

Dr. *Hook*, *Op. Post. p.* 80, 81. 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 ☾ before it arrive to us; and consequently, that the Moon's Light is 104368 weaker than the Light of the Sun: 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 *Epact* (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; 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	30
The Moon's Age	17 Days.

If the Time proposed had been between *Jan.* 1. and *March* the first, you must have used the *Epact* for the Year before.

2. To

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.

Example. May 26. 1708.

Moon's Age 17 Days.
Deduct 15

2
Multiply by 4

Divide by 5) 8 (1 hour, 36 m.
5

3
Multiply by 12

36 Minutes.

3. *To find the Time of the Moon's Shining.*

Multiply 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.

Moon's Age 17 Days
48

136
68

60) 816 (13 *h.* 36 *m.*
60

From 24 *Hours*
Subtract 13 *h.* 36 *m.*

216
180

Remains the Time of her Shining. 10 *h.* 24 *m.*

36

4. *To find how many Signs and Degrees the Moon is departed from the Sun since her last Conjunction with him, or since the last New-moon.*

Double the Moon's Age, and divide the Product by 5, the Quotient 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.

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 Refractions, 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 above the Horizon of the Observer must be taken in Degrees and Minutes. The Difference between those two Altitudes 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 Altitude to Radius : : so is the Quantity of the present Parallax, to the Moon's Horizontal Parallax.

2. Without Astronomical Calculation, the Moon's Parallax may be thus found: Let her Diameter 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 Analogy. 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 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 *Actions* or *Acts*, are such as render the Rational and Free Agent *good* or *evil*, and consequently rewardable and punishable, because he doth them.

MORESK-Work or *Morisko-Work*, is a kind of Antick-work in Painting or Sculpture, after the Manner of the *Moors*, consisting 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 *Tubæ Fallopianæ*; 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.

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 *Mortaise*, is the Workmens Word in Architecture for the Hole made in one Piece of Timber to receive the Tennon of another Piece.

MORTMAIN *Statute*: There was a Statute made in 7 *Ed.* 1. *de Terris in manum mortuam non 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 dispenced 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 Dignity and Revenues of the Crown. This Law is now relaxed by *Stat.* 39 *Eliz. c.* 5. of giving Lands to Hospitals; and by 14 of *Car.* II. *c.* 9. about purchasing Lands and Tenements for the Poor within *London* and *Westminster*.

MOSAIC *Work*, is corruptly so called; it should be *Musaick*; in Latin *musivum Opus*, and sometimes 'tis called also *Pavimenta Tessolata*.

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 such (that is, no Body whatever) can either move of it self, or alter the Direction of its Motion, because 'tis entirely passive 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 since all Motion is originally and naturally rectilinear, 'tis 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 Direction with that of the moving Force, because 'tis from *That* only that the Motion arises; and Bodies once in Motion, cannot change their Direction of themselves.

And if a Body be already in Motion, the Motion 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 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 tho' of a Tin Colour, yet is of an Iron Nature, as hath been found by applying a *Magnet* to it.

MUD-SUCKERS, *Limisugæ*, are a Sort of Water-Fowl which suck out of the Mud of Channels, *&c.* 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 signifies the *Lawful Issue* preferred before an elder Brother born out of Matrimony. Others will have it to be derived, *quasi ex muliere natus & non ex concubina*; 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 set the *Place of Unites* in the *Multiplier* under that Figure of the *Multiplicand*, whose Place you intend to keep in the Product. Thus 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 *Multiplier*, under 5 the 4th Place of Decimals in the *Multiplicand*. Thus,

```
 3.141592
 8347.25
 ---------
 157 0796
   6 2832
   2 1991
     1257
       94
       25
 ---------
 165.6995
```

The Product with 4 places of Decimals only.

After this place all the other Figures of the Multiplier in a contrary Order; *viz.* the 5 Tens in 52 to the Right-hand in the Place of Unites, and all the Decimal Parts to the Left-hand, as you see in the Example. Then in multiplying begin always at the Figure in the *Multiplicand* that stands over the Figure you multiply by; setting 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 the Multiplicand, which you begin with.

Thus

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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 Multiplication.

Then with the next Figure 2, say 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 say, 7 times 1 is 7, but from the Consideration 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 consisting of Integers without Decimal Parts.

First write down the Multiplicand, and then set 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 directed; proceeding also with each single Figure, as is there taught.

```
257.356
 84.67
-------
18015
 1544
  103
   20
-------
19682   The Product clear of Fractions.
-------
```

MULTONES *Auri*, were formerly Pieces of Gold Coin imprest with the Figure of a Sheep or Lamb (perhaps the *Agnus Dei*) from whence they had this Name, *Multo* being then used for a Sheep, as *Mutto* and *Muto* was also, whence our Word *Mutton*. 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 found in the *Tin-mines*, of a Colour white, yellow, or green. They 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 easily known by its brown sad-coloured glittering, and by its soon colouring your Fingers. Some say 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 short 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 some fixt Parts of the Body. Every one of these Fibres consists of a prodigious Number of lesser *Fibrillæ*, which are so many very slender *elastick Canals* bound about by small transverse parallel Threads, which divide these hollow *Fibrillæ* into so many elastick *Cystes* 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 *Vesiculæ*, with the Blood, doth very probably (it having an acid Taste, and therefore consisting of Particles which are pointed and so 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 *Vesiculæ*, 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 Animal Spirits are in sufficient Plenty.

MUSCULUS *Tubæ novus Valsalvæ* vel *Palato-Salpingæus*, a Muscle arising broad and tendinous 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 Pteregoidæus internus*, and is inserted carnons into all the membranous, fleshly, and cartilaginous Parts of the Tube. Its Use is to dilate and keep open this Channel. *Myogr. comparatæ Specim, p.* 47.

MUSCULUS *Auriculæ Anterior*, is a new (5*th*) Muscle of the *Auricle*, and added to the four before discovered by *Casserius*, 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 emaciated Bodies he
MUSCULUS *Anti-Tragius* } owns these are not to be seen.

MUSICK. What follows is a brief Account of the *Elements of Musick*, communicated by the ingenious Mr. *John Perks*.

The Thing considered 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 Percussion of some solid Body, as a Bell, String, Pipe, *&c.*

This Trembling of the Air is quick or slow, 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 flat.

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 sounding String keeping the same Note to the last, shews, that its Vibrations are in equal Time from the greatest to the least Ranges of its motion.

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The ſhorter a muſical String is, *cæteris 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 *twice* the Length gives (*cæteris paribus*) *half* the Quickneſs of Pulſes (or *half* 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.

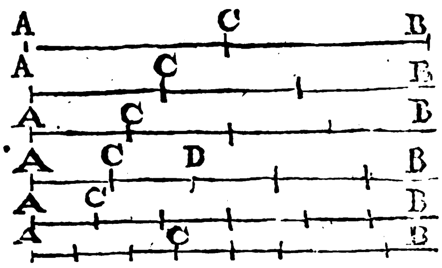

Fig. 1. *Fig.* 2. *Fig.* 3. *Fig.* 4. *Fig.* 5. *Fig.* 6.

Fig. 1. Let A B 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 *Octave* or *Eighth* to the Note of the whole String A B when unſtopt. CB is in length to A B as 1 to 2; and the *Vibrations* of C B to thoſe of A B (in the ſame Time) as 2 to 1. Hence the Proportion of an *Octave* 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 ſtop'd in C, the Part C B will ſound 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 ſound 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 ſixth 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 $\frac{3}{5}$ of A B, B D will ſound a *Greater Sixth* to A B.

If C B (*Fig.* 6.) be $\frac{5}{8}$ of A B, C D will ſound a *Leſſer Sixth* to A B.

From what hath been ſaid it follows, that

If Pulſes of the Acuter Note be equal in Time to	Of the lower Note the Concord is	
2	1	*An Eighth or Octave.*
3	2	*A Fifth.*
4	3	*A Fourth.*
5	4	*A greater Third.*
6	5	*A leſſer Third.*
5	3	*A greater Sixth.*
8	5	*A leſſer Sixth.*

When two Notes in any of the precedent Proportions one to another, are ſounded together; their Sounds are agreeable and pleaſing to the Ear, and are therefore called *Concords*. Of theſe the Eighth and Fifth are called *Perfect Concords*; Thirds and Sixths are called *Imperfect 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 *Octave* 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 ſounding 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 *perfect* is the Harmony. And conſequently if their Pulſes be of *Incommenſurable Velocities*, the *Diſcord* will be in the *higheſt 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 *Octaves* 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 uniformly 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.

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*

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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 $\frac{3}{2}$, that of a Fourth by $\frac{4}{3}$: Compound theſe Proportions, ſo $\frac{3}{2} \times \frac{4}{3} = \frac{12}{6} = \frac{2}{1}$, which is the Proportion of an *Octave*: 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 $\frac{3}{2}$ by $\frac{4}{3}$ [$\frac{4}{3}$) $\frac{3}{2}$ (= $\frac{9}{8}$] it gives $\frac{8}{9}$, which is therefore the Proportion of a greater Tone by which a Fifth and Fourth differ.

To find the Difference between a Greater Sixth and a Fifth; Divide $\frac{5}{3}$ (the Proportion of a Greater Sixth) by $\frac{3}{2}$ (that of a Fifth) it gives $\frac{10}{9}$ [$\frac{3}{2}$) $\frac{5}{3}$ (= $\frac{10}{9}$] which is the Proportion of a *Leſſer Tone*.

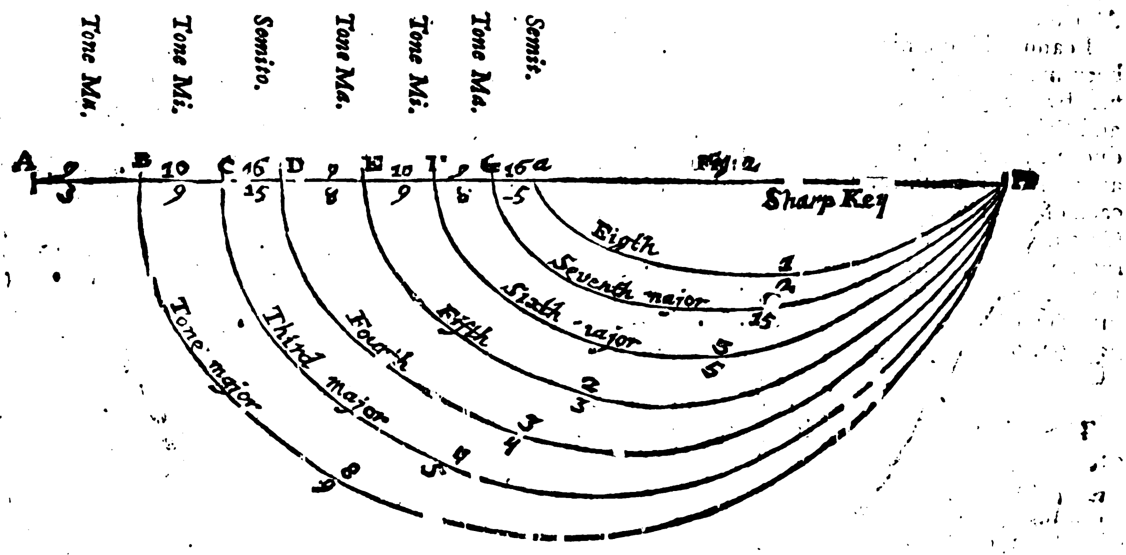
To find the Difference of a Fourth and Greater Third, Divide $\frac{4}{3}$ by $\frac{5}{4}$ [$\frac{5}{4}$) $\frac{4}{3}$ (= $\frac{16}{15}$] it gives $\frac{16}{15}$, which is therefore the Proportion of a *Semi-tone* (or leſſer gradual Interval) by which a greater Third and Fourth differ. In like manner 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*.

The *Key* is the Principal or Fundamental Note of a Tune, to which the reſt have proper Relations, 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 2*d*, 4*th*, and 5*th* 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 Sharp Key.



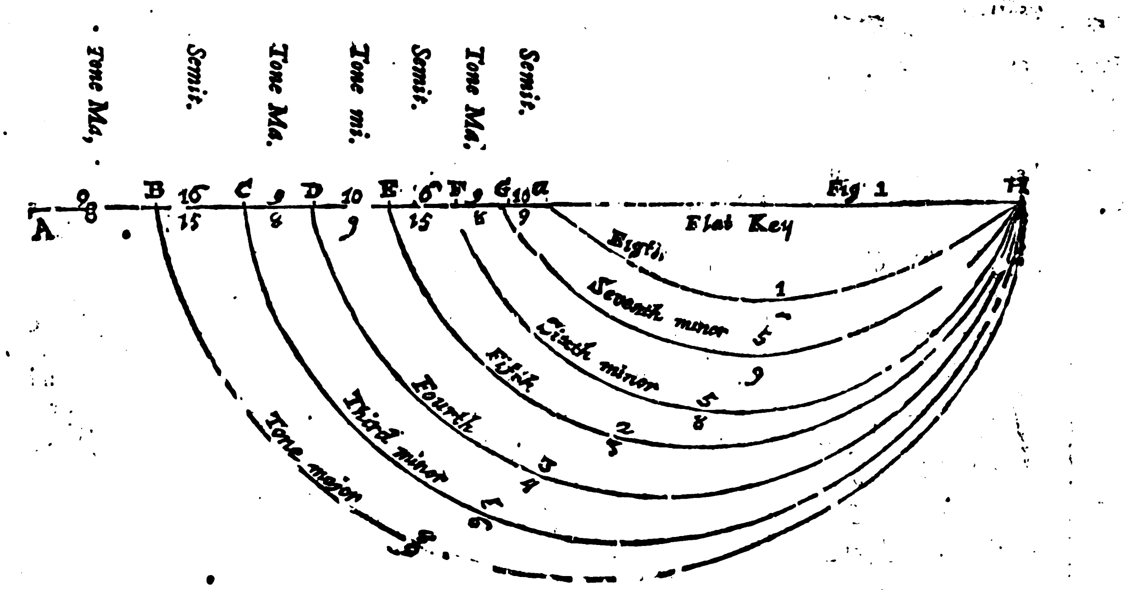


Fig. 1. A H is the whole String, whoſe Sound gives the Key-Note; B, C, D, &c. ſhew the Diviſions (or Stops) to expreſs the Notes of a Flat Key.

The Numbers ſet to each little Part of the Line, ſhew the Proportions of the next immediate Notes one to another, and alſo of the Length of Strings from theſe Diviſions to H: So $\frac{10}{9}$ ſtanding between D and E, ſhews, that D H is to E H as 10 to 9; and ſo of the reſt.

Upon the Arched Lines is expreſs'd the Relation of the ſeveral Notes to the Key, and alſo of the ſounding founding Part to the whole String. So E H is $\frac{2}{3}$ of a whole String, and founds a Fifth to the Key. In like manner *Fig.* 2. fhews the Divifions in a Sharp Key.

Suppofe A H (*Fig.* 1.) be a Line 24 Inches long, then will A B be $2\frac{2}{3}$ Inches; A C 4 Inches, A D 6 Inches, A E 8 Inches, A F 9, A G 10 $\frac{2}{3}$ Inches, A a 12 Inches.

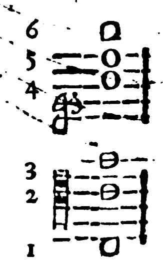
To exprefs the Notes of a *Sharp Key*, let A H (*Fig.* 2.) be a Line 24 Inches long. then is A B $2\frac{2}{3}$ Inches, A C $4\frac{4}{5}$ Inches, A D 6 Inches, A E 8 Inches, A F $9\frac{3}{5}$, A G $11\frac{1}{5}$, A a 12 Inches.

If a middle-fiz'd Gut-ftring be ftrained over a Line thus divided at about a fifth Part of an Inch Diftance from the Line, the Divifions mark'd in the Line will fhew where to ftop the String fo as to exprefs the feveral Notes.

Above and below the Eighth the Notes afcend and defcend in the fame order repeated, and therefore all Eights are called by the fame Names, and (in the *Gamut*) figned with the fame Letters of the Alphabet.

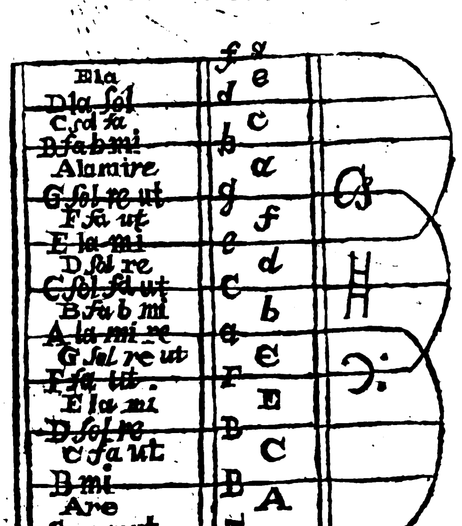
I cannot here omit two Obfervations that have been made relating to what has been faid: The firft by Sir *Ifaac Newton* in his Treatife of *Light* and *Colours*, where confidering the Colours produced by the Sun's Light paffing through a Triangular Glafs Prifm, and meafuring the Space that each of the feven Colours (Red, Orange, Yellow, Green, Blue, Indico, Violet) take up, he found the Divifions of the whole Length of the coloured Image, to be the fame with that of a *Monochord* into the Tones and Semitones of an *Octave*. See *pag.* 92. of his *Opticks*.

The other Obfervation is concerning the Proportions of the Notes in a full Clofe upon an *Organ* or *Harpfichord*, *viz.* That they are as the Numbers 1, 2, 3, 4, 5, 6, in order, beginning from the *Bafs*, as is here prick'd down.



All the Notes commonly ufed in Mufick are compriz'd in their Order in a Scale which is call'd

The GAMUT.



Sometimes Ledger Lines are added above and below, as Occafion requires.

In the firft Column are fet the Names by which the Keys, or Notes, are commonly called, as *Gamut, A re,* &c. In the fecond Column are fet the 7 Letters belonging to the feveral Lines and Spaces. The third Column contains the *Cliffs*, and fhews how many Degrees, or Notes, they are one above or below the other; which being known, the other Degrees of Diftance are eafily computed.

Five of thefe Lines, with their Spaces, are commonly fufficient for the pricking of a Tune; therefore is the whole Scale divided into 3 Syftems or Staves, compaffed in by arched Lines. Of thefe the lower 5 belong to the Bafs, and are diftinguifh'd by this Mark upon the Line of F. The uppermoft 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 upon the Line of C, which only is its proper Line, the other 4 being borrowed from the *Treble* and *Bafs*.

Of Sol-fa-ing, and Tuning Notes when prick'd down.

In learning to fing, it is neceffary 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 Ufe are but thefe 4 Monofyllables, *fol, la, mi, fa*; which yet muft (and has been) own'd incongruous*; for feven diftinct Notes fhould certainly have as many Notes to diftinguifh them by. I fhall therefore, after I have given a fhort Account of the Ufe of thofe Names, propofe another way of naming the Notes in Singing, which I judge (and have found by Experience) to be better.

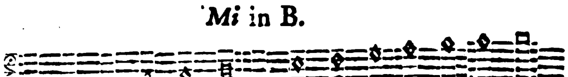
In order to *Sol-fa* a Tune, (that is, to name and tune the Notes right) the Place of *mi* muft be firft known, which is B in the Scale, as being the next Note above *three Tones* immediately fucceeding each other. In cafe of Flats (b) and Sharp (#) the Place of *mi* is found as in this Table.

When { B is / B and E are / B E and A are } *Flat, mi* ftands in { E / A / D }

When { F is / F and C are / F G & C are } *Sharp, mi* ftands in { F / C / G }

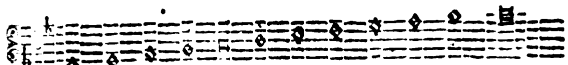
The Place of *mi* being known, you afcend above *mi* by *fa, fol, la, fa, fol, la*; and defcend below *mi* by *la, fol, fa, la, fol, fa*, calling all Eights by the fame Name.

Mi in B.



Sol la fa fol la mi *fa fol la fa fol la* mi.

Mi in A.



la fa fol la mi *fa fol la fa fol la* mi.

I'll

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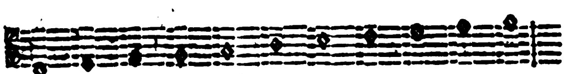
I'll now propose the other way of naming the Notes, that I mention'd before.

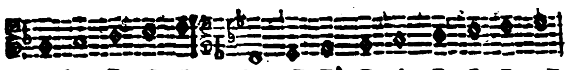
The seven musical Notes being express'd in the *Gamut* by the 7 first Letters of the Alphabet, *A. B, C, D, E, F, G*; let these Letters be their Names whereby to express them in Singing. Only, for better Sound's sake, and to accommodate them to the Variations by *Flats* and *Sharps*, let *A* and *E* be call'd *lA* and *lE*. Let *F* be called *Fâ* (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 *lA, B, Ce, D, lE, Fâ, 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.

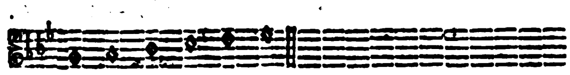
Examples of the Notes Names.



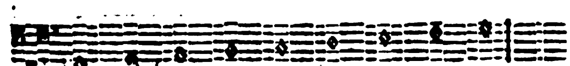
D, lE. Fâ, Ge, lA, B, Ce, D, lE, Fâ, Ge.



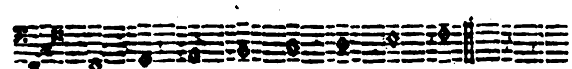
Ge, lA, Be, Ce, D. D, mE, Fâ, Ge, lA, Be, Ce, D, mE.



Ge, mA, Be, Ce, D, mE.



Fa, Ge, lA, B, Ce, D, lE, Fa, Ge.



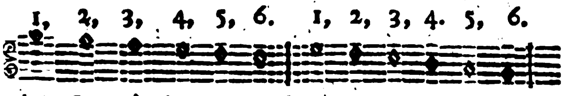
Fa, Ge, lA, B, Ce, D, lE, Fa.

To sing 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 I 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.

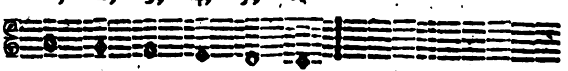
To apply the Tune of Six Bells to Notes prick'd in the Treble Cliff.

1, 2, 3, 4, 5, 6. 1, 2, 3, 4. 5, 6.



lA, Ge, Fâ, lE, D, Ce | *lE, D, Ce, B, lA, Ge.*
1st Bar. | *2d Bar.*

1, 2, 3, 4, 5, 6.



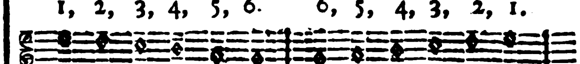
lA, Ge, Fâ, lE, D, Ce.
3d. Bar.

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 *Gamut*.) 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) *lA, Ge, Fa, lE, D, Ce*; singing them in the same Tune that you did the Numbers 1, 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 *lE* a little longer than the rest; then repeating only the three last Notes of the first Six, begin at *lE* in the second Bar, and sing *lE, D, Ce, B, lA, Ge*, in the Tune of Six Bells, keeping the three first 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 *Octave*. If you stop at the lower *lA*, (one Note short of the last 6, you will have a compleat *Octave* from *lA* above to *lA* below, which is the Order of Notes in a Flat Key.

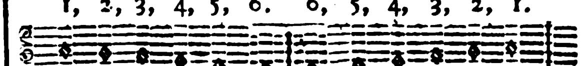
If your Voice will reach another six Notes, you may, in the Third Bar, repeat the two last Notes of the foregoing Six, and sing *lA, Ge, Fa, lE, D, Ce*, in the Tune of Six Bells.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.



lE, D, Ce, B, lA; Ge. Ge, lA, B, Ce, D, lE.
4th Bar. *5th Bar.*

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.



lA, Ge, Fa, lE, D, Ce. Ce, D, lE, Fa, Ge, lA.
6th Bar. *7th Bar.*

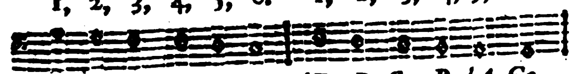
In the 4th Bar, having sung the 6 Notes *lE, D, Ce, B, lA, Ge*, in the Tune of 6 Bells several times, try to sing them backward, as in the 5th Bar, *Ge, lA, B, Ce, D, lE*; which with a little heed may easily be done, as may also the other Six, beginning at *lA* in the 6th Bar.

Here note, 1. That the Tune of Six Bells may begin either at *lA* or *lE*, 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 *lE* and *Fa*.

The

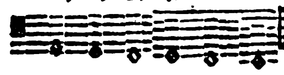
The same Directions will serve for the following Notes set in the *Bass Cliff*, and therefore I shall only set down the Notes.

1, 2, 3, 4, 5, 6. 1, 2, 3, 4, 5, 6.



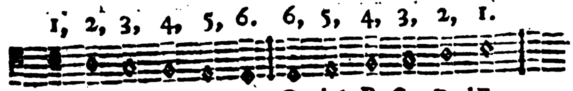
lA, *Ge*, *Fa*, *lE*, *D*, *Ce*. *lE*, *D*, *Ce*, *B*, *lA*, *Ge*.
1st. Bar. *2d. Bar.*

1, 2, 3, 4, 5, 6.



lA, *G*, *Fa*, *lE*, *D*, *Ce*.
3d. Bar.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.



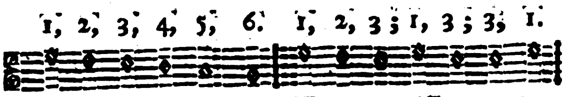
lE, *D*, *Ce*, *B*, *lA*, *Ge*. *Ge*, *lA*, *B*, *Ce*, *D*, *lE*.
4th. Bar. *5th. Bar.*

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

lA, *Ge*, *Fa*, *lE*, *D*, *Ce*. *Ce*, *D*, *lE*, *Fa*, *Ge*, *lA*.
6th. Bar. *7th. Bar.*

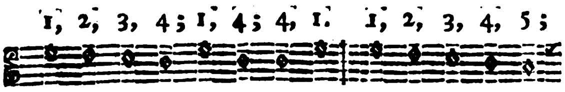
Examples of rising and falling the Voice by Leaps in the *Treble Cliff*.

1, 2, 3, 4, 5, 6. 1, 2, 3; 1, 3; 3, 1.



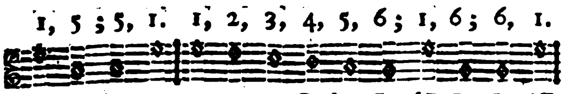
lE, *D*, *Ce*, *B*, *lA*, *Ge*. *lE*, *De*, *Ce*; *lE*, *Ce*; *Ce*, *lE*.
1st. Bar. 2.

1, 2, 3, 4; 1, 4; 4, 1. 1, 2, 3, 4, 5;



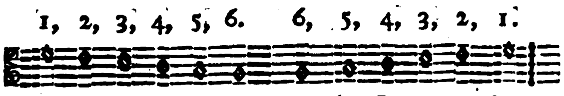
lE, *D*, *Ce*, *B*; *lE*, *B*; *B*, *lE*. *lE*, *D*, *Ce*, *B*, *lA*;
3. 4.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.



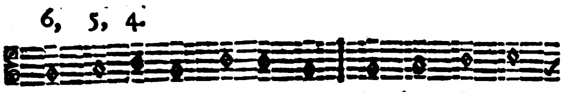
lE, *lA*; *lA*, *lE*. *lE*, *D*, *Ce*, *B*, *lA*, *Ge*; *lE*, *Ge*; *Ge*, *lE*.
5.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

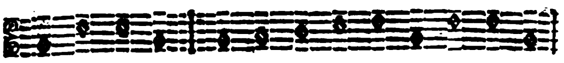


lE *D*, *Ce*, *B*, *lA*, *Ge*. *Ge*, *lA*, *B*, *Ce*, *D*, *lE*.
6.

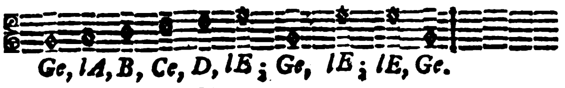
6, 5, 4.



Ge, *lA*, *B*; *Ge*, *B*; *B*, *Ge*. *Ge*, *lA*, *B*, *Ce*;
7. 8.



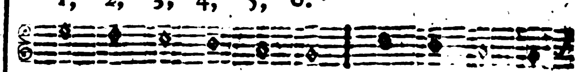
Ge, *Ce*; *Ce*, *Ge*. *Ge*, *lA*, *B*, *Ce*, *D*; *Ge*, *D*; *D*, *Ge*.
9.



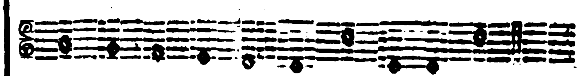
Ge, *lA*, *B*, *Ce*, *D*, *lE*; *Ge*, *lE*; *lE*, *Ge*.
10.

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 the second Note *D*, sing *lE*, *Ce* several times, and then upwards *Ce*. *lE*. In like manner proceed to the following Bars, singing the Notes in each Bar as they are prick'd, till you have learnt to raise and fall the Voice by the Leaps there set down.

1, 2, 3, 4, 5, 6.



lE *D*, *C*, *B*, *lA*, *Ge*. *Ce*, *Be*, *lA*, *Ge*,
11. 12.

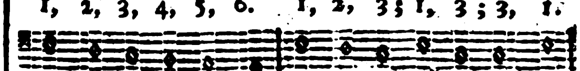


lA, *Ge*, *Fa*, *lE*, *D*, *Ce*; *Ce*, *Ce*; *Ce*, *Ce*,

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.

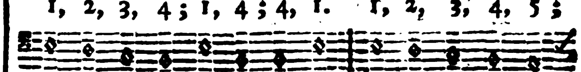
Examples of raising and falling the Notes by Leaps in the *Bass Cliff*.

1, 2, 3, 4, 5, 6. 1, 2, 3; 1, 3; 3, 1.



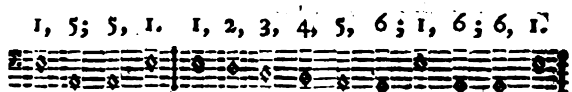
lE, *D*, *Ce*, *B*, *lA*, *Ge*. *lE*, *D*, *Ce*; *lE*, *Ce*; *Ce*, *lE*.
1. *Bar.* 2.

1, 2, 3, 4; 1, 4; 4, 1. 1, 2, 3, 4, 5;



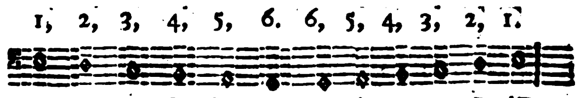
lE, *D*, *Ce*, *B*; *lE*, *B*; *B*, *lE*. *lE*, *D*, *Ce*, *B*, *lA*;
3. 4.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.

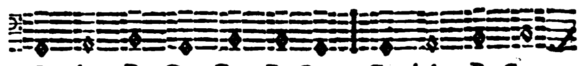


lE, *lA*; *lA*, *lE*. *lE*, *D*, *Ce*, *B*, *lA*, *Ge*; *lE*, *Ge*; *Ge*, *lE*.
5.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

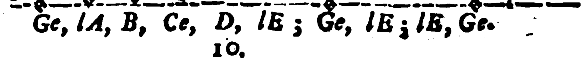


lE, *D*, *Ce*, *B*, *lA*, *Ge*. *Ge*, *lA*, *B*, *Ce*, *D*, *lE*.
6.



Ge, *lA*, *B*; *Ge*, *B*; *B*, *Ge*. *Ge*, *lA*, *B*, *Ce*;
7. 8.

Ge, *Ce*; *Ce*, *Ge*. *Ge*, *lA*, *B*, *Ce*, *D*; *Ge*, *D*; *D*, *Ge*.
9.



Ge, *lA*, *B*, *Ce*, *D*, *lE*; *Ge*, *lE*; *lE*, *Ge*.
10.

lA,

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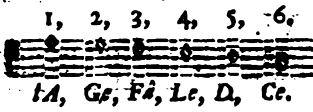
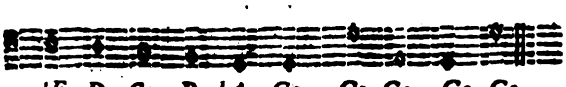
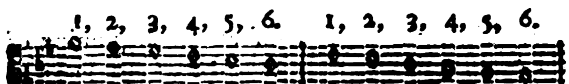


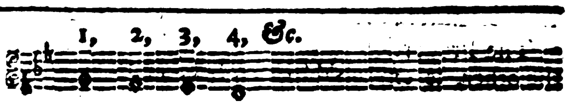


When Flats or Sharps (b, ♯) are set at the Beginning of the Staff by the Cliff, they alter the Places for beginning the 6 Notes, by removing the *Semitones* (one or both) from their original Places; the Flat [b] removing its Notes a *Semitone* lower; and the Sharp [♯] removing then a *Semitone* higher. When there are no Flats and Sharps, the Tune of Six Bells begins at *lE* and *lA* only; in other Cases as follows.

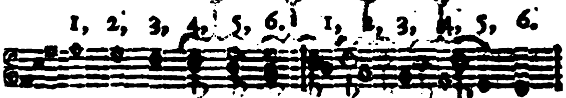
When	*Be* is flat *Be* and *mE* are flat *mA*, *Be* & *mE* are flat	begin the Tune of 6 Bells at	*lA* & *D*. *Ge* & *D*. *Ge* & *Ce*.
When	*Fa* is sharp *Fa* and *C* are sharp *Fa* G & *C* are sharp	begin the Tune of 6 Bells at	*B* & *lE*. *B* & *Fa*. *C* & *Fa*.

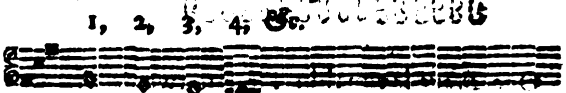
An Example when B *and* E *are flat.*





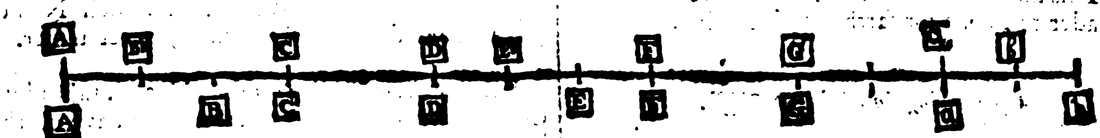
An Example when F *and* C *are sharp.*





By the Table above, and these two Examples, 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, lie between the 3d and 4th Notes of the Six.

See more, with Application to *Psalmody*, in a Treatise called, *A New and Easy Method to learn to Sing by* Book; Printed for *W. Rogers* in *Fleetstreet*.



It may be a good Way to give Learners a Notion of the Alterations made by Flats and Sharps; in the Distances 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, F, 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 *Semitones* between B and C, and between E and F. Suppose I should now see the Order of the *Tones* and *Semitones* 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 a *Semitone*) 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*.

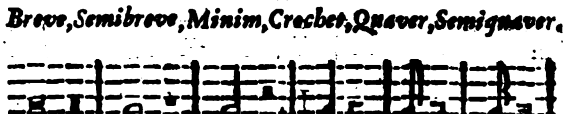
Thus may all the Varieties be represented to the Eye, and the Reason of beginning the Six Notes as is directed, be also understood.

Of the Quantity of Notes as to Time.

Besides the giving to Notes their right Tune (according to their Places in the Staff of 5 Lines) Regard is also to be had to the *Length* or *Shortness* of *Time* they are express'd in, which is known by the Figure or Shape of the Character by which they are pricked on the Lines.

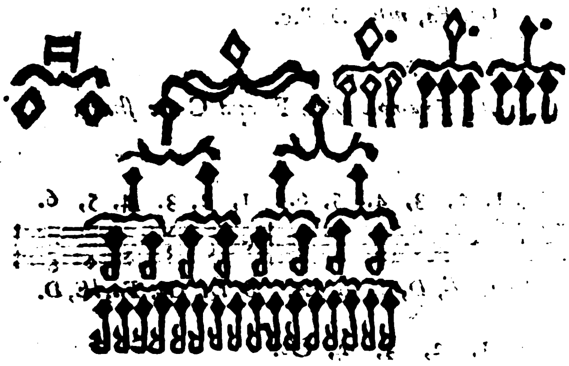
The Names and Figures of the usual Notes in Respect of *Time*, and their correspondent Rests are as follow;

Breve, Semibreve, Minim, Crochet, Quaver, Semiquaver.



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.

The Proportion of the foregoing Notes, one to the other, is express'd in this Scheme.



One *Breve* is equal in Time to two *Semibreves*; one *Semibreve* to two *Minims*; one *Minim* to two *Crotchets*, &c.

When a Prick (.) is set after any Note, it increases its Quantity half as much more. So (𝅗.) is equal in Time to (𝅗𝅗) a *Semibreve* and *Minim*. A prick'd *Minim* (𝅗𝅥.) is equal in Time to (𝅗𝅥𝅘𝅥) a *Minim* and *Crotchet*.

If the Words *one*, *two*, *three*, *four* be pronounc'd in a reading Tenor, the Time of pronouncing each Syllable may be accounted the Measure or Time of one *Crotchet*; and consequently, *one*, *two*, gives the Time 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.

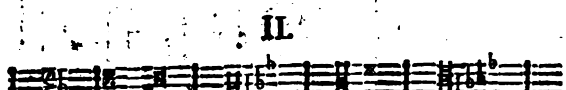
Of Singing in different Cliffs.

The Difference of Cliffs is what doth perplex Learners. They who can sing in the *Treble Cliff*, are at a Loss when they come to the *Tenor* or *Base Cliffs*: I will therefore here give a Table, wherein 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 sing in any other in the Table.

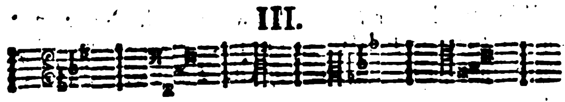
A Table whereby all the usual Cliffs *may be reduced to any one* Cliff *desired.*

I.

II.

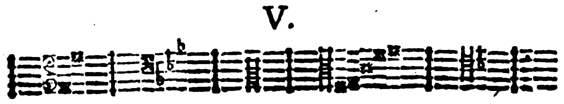


III.

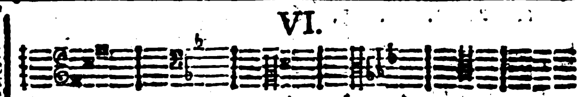


IV.

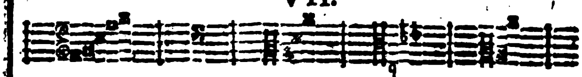
V.



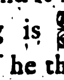
VI.



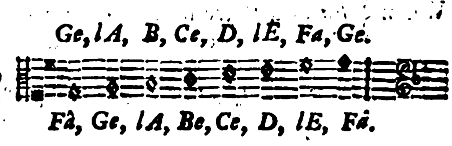
VII.



This Table, consisting 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 consequently 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 sing 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 sing the Notes as if they were in the *Treble Cliff* with *B flat*, he'll sing them as true as if he had understood the *Tenor Cliff*.

Examp



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 set above them. At the End is set the *Treble Cliff*, in which the Notes may be sung, and their Names (as accounted in the *Treble Cliff*) as set under.

Dr. *Wallis*, in *Phil. Transact.* N. 243. takes into Consideration the strange Reports we have of the Power of the ancient Musick; and tho' he judges they are in a great Degree Hyperbolical, if not Fabulous; yet he thinks too that some Account may be given of the great Effects it's said 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 ever heard before; and on *such*, 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 Musick was much more Simple and Plain than ours now: They had no Consorts of 2, 3, 4, or more Voices or Parts; but one single Voice or Instrument a-part; which to a *rude* Ear is much more taking than compounded Musick: *That* not exceeding their Capacity, whereas *This* confounds them quite, and is by no means distinguishable 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 Musick 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 set to a Musical Tune, sung by a decent agreeable Voice, accompanied with soft Instrumental Musick only, if with any; *i. e.* such as doth not drown or obscure the emphatical Expressions (like what we call *Recitative Musick*, tho' I doubt not more justly managed; for I hope the

the same Tone did not serve with them for making Love, Fighting, and delivering Letters) will work strangely upon the Ear, and move all the Affections suitable to the Tune and Ditty, especially if attended with a *Gesture* and *Action* suitable; for we see that *suitable Action* alone doth on the *Stage*, give great Life and Force to Words; and therefore all this together might easily operate very strongly 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, Pity, 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 Affectation.

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 so, was but with them the *Harmonick*, *i. e.* but one Part of their whole Musick, which consisted 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 adapted 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 such Compositions and Performances can distinguish,

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 Dispositions, is such as is more Simple and Uncompounded; such as a Nurse's languid Tone lulling her Babe to Sleep, or a continued Tale (as in *Ireland*) or reading in an even Tone; or the soft Murmur of a little Rivulet running upon Gravel or Pibbles inducing a quiet Repose to the Spirits: and on the other Hand, the Brisknefs of a Jig, *&c.* on a Violin exciting to Dance; for these are more operative for such Ends than elaborate Compositions of full Musick.

The same excellent Author in N. 249. hath a judicious Discourse about the Imperfection 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 *Flatness* or *Sharpness*; and the Relative or Comparative Consideration of the two or more such Sounds or Degrees of Flatness or Sharpness is the Ground of what we call *Concord* and *Discord*; that is, a soft or harsh Coincidence. Concerning which there was among the ancient *Greeks* two Sects of Musicians; the *Aristoxenian* and *Pythagorean*: But both agreed thus far, that *Diatessaron* and *Diapente* do together make up *Diapason*; *i. e.* a *Fourth* and a *Fifth* make up an *Eighth*. And the Difference of these two, of a 4th and a 5th they agreed to call a *Tone*; which we now call a *whole 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, sol, la*, is a perfect *Fifth*. The Difference of which is *la, mi*; and this the *Greeks* called the *Diazeutick 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 *Octave*, 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 $\frac{1}{2}$, a *Fifth* three Tones and $\frac{1}{2}$, and consequently an *Eighth* six Tones, or five Tones and two half Tones; and at this Rate our practical Musicians talk of *Notes* and *half Notes* at this Day; supposing an *Octave* 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*, *Cartes*, and other Writers on *Speculative Musick*, in this and the last Age. Accordingly they accounted an *Octave* 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 *Sesquialteral*, 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 *Octave*, 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 $\frac{4}{3}\times\frac{3}{2}=\frac{4}{2}=\frac{2}{1}=2$: 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 $\frac{4}{3})\frac{3}{2}(=\frac{9}{8}$: Or if out of the Proportion of 3 to 2 you take that of 4 to 3, the Result is that of 9 to 8. Now according to this Computation 'tis plain, that an *Octave* is something less than 6 *full Notes*; for as hath been demonstrated by *Euclid*, and some others since, the Proportion of 9 to 8 being 6 times compounded is something more than that of 2 to 1, for $\frac{9}{8}\times\frac{9}{8}\times\frac{9}{8}\times\frac{9}{8}\times\frac{9}{8}\times\frac{9}{8}=\frac{531441}{262144}$ which is more than $\frac{524288}{262144}=\frac{2}{1}$. And this being the Case they allowed to the *Diazeutick 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, sol, 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*.

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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*, *sol*, and to *sol*, *la*, the full Proportion of 9 to 8; and therefore to *fa*, *sol*, *la*, which we now call the *greater Third*, that of 81 to 64; for $\frac{9}{8} \times \frac{9}{8} = \frac{81}{64}$, and consequently to that of *mi*, *fa* (which is the Remainder to a *Fourth*) that of 256 to 243; for $\frac{81}{64})\frac{4}{3}(\frac{256}{243}$, *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 λεῖμμα, 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 $\frac{5}{4}$, $\frac{6}{5}$, $\frac{7}{6}$, $\frac{8}{7}$) 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 *Diatonick* 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 *Ditone* or *greater Third*, that of 5 to 4; for $\frac{10}{9} \times \frac{9}{8} = \frac{10}{8} = \frac{5}{4}$, and consequently to *mi*, *fa*, which is remaining of the *Fourth*, that of 16 to 15. for $\frac{5}{4})\frac{4}{3}(=\frac{16}{15}$; that is, if out of that of 4 to 3 you take that of 5 to 4, there remains that of 16 to 15.

Omitting to speak of the other Ways of Division, this $\frac{16}{15}$ is what we now call an *Hemitone* or *half Note* in *mi*, *fa*: $\frac{9}{8}$ is that of the *greater Tone* in *fa*, *sol*; and $\frac{10}{9}$ that of the *lesser Tone* in *sol*, *la*.

Only with this Addition, That each of these *Tones* is now, on Occasion, by *Flats* and *Sharps* divided into *Hemitones* 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.* $\frac{9}{8} = \frac{18}{16} = \frac{18}{17} \times \frac{17}{16}$: and $\frac{10}{9} = \frac{20}{18} = \frac{20}{19} \times \frac{19}{20}$.

This by the Help of Flats and Sharps, as they are now called, (dividing each whole Note by its *greater* or *lesser* into two *half Notes*, or such as we call so.) The whole *Octave* is divided into 12 Parts or *Intervals*, contained in an Organ between 13 Pipes; and these are commonly called *Hemitones* or *half 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 *B fa B mi* (which is accounted its natural Place) the Sound of each Pipe is to bear these Proportions one to another, *viz.*

B.	C	♯	D	♯	E.	F	♯	G	♯	A	♯	B.
mi,	*fa*	♯	*sol*	♯	*la*	*fa*	♯	*sol*	♯	*la*	♯	*mi*.
$\frac{16}{15}$		$\frac{18}{17}$	$\frac{17}{16}$	$\frac{20}{19}$	$\frac{19}{18}$	$\frac{16}{15}$	$\frac{18}{17}$	$\frac{17}{16}$	$\frac{20}{19}$	$\frac{19}{18}$	$\frac{18}{17}$	$\frac{17}{16}$

$$\underbrace{\underbrace{\tfrac{16}{15}\;\underbrace{\tfrac{18}{17}\;\tfrac{17}{16}}_{\frac{9}{8}}\;\underbrace{\tfrac{20}{19}\;\tfrac{19}{18}}_{\frac{10}{9}}\;\tfrac{16}{15}}_{\frac{4}{3}}\;\underbrace{\underbrace{\underbrace{\tfrac{18}{17}\;\tfrac{17}{16}}_{\frac{9}{8}}\;\underbrace{\tfrac{20}{19}\;\tfrac{19}{18}}_{\frac{10}{9}}}_{\frac{4}{3}}\;\underbrace{\tfrac{18}{17}\;\tfrac{17}{16}}_{\frac{9}{8}}}_{\frac{3}{2}}}_{\frac{2}{1}}$$

And so in each *Octave* successively following: And if the Pipes in each *Octave* 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 *Hemitone*, it hath been found necessary (if I do not mistake the Practice) so to order the 13 Pipes containing the 12 Intervals or *Hemitones*, as that their Sounds, as to Gravity and Acuteness, shall be in continual Proportion (that is, each to its next following in one and the same Proportion) which altogether shall compleat that of the *Octave* 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 Imperfection 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 Musick 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 such Proportions as I have now design'd. But Musical 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 *E 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 Instanee. 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.

B	♯.	C	♯.	D	♯.	E.	F	♯.	G	♯.	A.	B.
fa	♯	*sol*	♯	*la*	♯	*mi*	*fa*	♯	*sol*	♯	*la*	*fa*.
	$\frac{18}{17}$	$\frac{17}{16}$	$\frac{20}{19}$	$\frac{19}{18}$	$\frac{18}{17}$	$\frac{17}{16}$	$\frac{16}{15}$	$\frac{18}{17}$	$\frac{17}{16}$	$\frac{20}{19}$	$\frac{19}{18}$	$\frac{16}{15}$

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 Interposition of *quarter* or *half quarter Notes*, &c. for it hath been long since 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 $\frac{9}{8}$ or as 9 to 8; that of the half Note must be, as $\sqrt{.}\ 9$. to the $\sqrt{.}\ 8$. that is, as 3 to the $\sqrt{.}\ 8$. or 3 to $2\sqrt{.}\ 2$. which are incommensurable Quantities: and that of a Quarter Note will be as $^4\sqrt{.}\ 9$. to $^4\sqrt{.}\ 8$. 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 vast Number of Pipes for every *Octave*, would greatly encrease the Charge, and after all, make the whole impracticable.

Authors of Note who have treated on this Subject of Musick.

Claudii Ptolemæi Harmonicorum Lib. III. By Dr. *Wallis. Oxon.* 1682. *4to.*

Porphyrii Comment. in Lib. 4. *Harm. C. Ptolemæi atque Manuelis Bryennii Comment. in* 3 *Libros Harmonicos ejusdem Ptolemæi. (Qui soli restant ex Græcis Musicæ Scriptoribus nondum Editi.)* G. L. *Cura J. Wallisii in Folio.*

Syntagma Musicæ; Treating of Musick Philosophically, Mathematically, and Practically, by *J. Birchensha*, Esq;

Musica Speculativa des Mengoli. Bologna. 1670. *4to.*

Philosophical Essay of Musick. Lond. 1677. *4to.*

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 Antiquæ Musices Scriptores. G. L. *Amst.* 1652.

Morley's Introduction to Musick.

Des Cartes's Musick.

Jo. Cochæi Tetrachordon Musices.

Cleonidis Musica. Fol.

Fabii Stapulensis Elementa Musices.

Salmon's Theory of Musick in *Philos. Trans.* N. 302.

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 consists 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 Contract without Reward, and admits, properly speaking, of no Recompence. And therefore where Use and Interest is agreed on, they arise from some distinct particular Argument, or by Custom of the Country.

NAMATION, is the same as Distreyning or taking a Distress; and in *Scotland* 'tis used for Impounding.

NASALIS or *Rhinæus*, 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 *Alæ*; 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 *Phænomena* as at any time appear in the Material World; such as Meteors, &c.

Some Writers on this Subject are these:

Plinii Historia Naturalis Dalechampii. Gen. 1631.

Joan. Eusebii Nierembergii Historia Naturæ. Antw. 1635.

Mart. Lister Historia Conchyliorum, Lond. 1685.

Fr. Willoughbei Historia Piscium.

Ornithologia (ejusdem Authoris) sive de Avibus.

Moufettus de Insectis. Lond. 1634.

Garneri Historia Animalium.

Gurnerus Rolfincius de Vegetabilibus. Jenæ. 1670. *4to.*

Martyn Lister's Historia Animalium Angliæ.

Fred. Lackmund. Admirand. Fossilium Descriptiones.

Swammerdam's Hist. Generalis Insectorum.

G. Pisonis de Re Naturali, &c. *Indiæ Utriusque.*

J. Johnston's Historia Naturalis.

History of Animals by the Academy of Sciences.

Plot's Natural History of { *Oxfordshire.* *Staffordshire.* }

Historia Naturalis de Terrante.

Merret's Pinax Rerum Naturalium Angliæ.

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 *lesser Machines*, every one of which is adjusted by the same Wisdom in Number, Weight and Measure.

Laws of Nature, signify 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

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 *Attracting 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 reciprocal amongst them.

The *Vis inertiæ*, is a Principle *purely passive*, by which Bodies persist in their State of Rest or Motion, whereby they receive Motion from others equal or proportionable to the *moving Force*; and whereby they *resist* as much as they are *resisted*. 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, 'tis plain that there cannot be always the same Quantity of Motion in the World, for if two Globes, connected together by a slender 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 *Attrition* 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 *hard*, or throughly *soft*, as to have no *Elasticity*, cannot be reverberated back from one another, 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 preserved 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 aud 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 considering and undestanding these Things, our admirable Author, (whose Piety 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 *solid, firm, impenetrable*, perfectly passive and moveable; 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 *Meatuses*, 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 *one*. As long therefore as these original Particles remain entire, there may for ever be Bodies made or composed of them; which shall have the same *Nature* and *Texture*: But if these can be broken, worn away, or diminished, then the Nature of Corporeal Things which is dependent on these must be changed. Earth and Water composed of either such Particles as have been worn or broken, or of their Fragments, could not have at this Day, 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 solid 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 Inertiæ* 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 *Cause of Fermentation* and of the *Cohesion* of the Parts of *Matter*. And these *Principles* are not to be considered as *occult Qualities* which are feigned to arise from the *Specifick Forms* of Things, but as the *Universal Laws of Nature* by which Things themselves 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 assert that the *several Species* of Things are endued with *Specifick Occult 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*.

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NAVE, in Architecture, signifies the main Body of a Church,

NAVEL-STING. See *Umbelical Vessels*.

NAVIGATION. Books on this Subject are;
Sir *Jonas 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 of Navigation. *His Seaman's Practice.* — *Companion.*
Phillips's Geometrical Seaman.
Colson's Calendar.
Martin's Art of Navigation.
Perkin's Seaman'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. 4to. 1707.

NEALING *of Steel*, is heating of it in the Fire to a *Blood-red-heat*, and then taking it out and letting it cool gently of it self. This is done to make it softer, in order to engrave or punch upon it.

NEAR, at Sea, when the Conner commands, the Man at the Helm to set the Ship full to Leeward, his Word is *No-near*.

NEBULOUS-*Stars*, seen thro' good Telescopes appear to be Clusters of small Stars: as appears by the Observations of *Cassini* and *Flamstead*. See *Philos. Trans.* N. 123.

NECYDALUS, the same with *Nympha*, a Term used in the Natural History of *Insects*. See *Nympha*.

NEIFE, *Nativa*; is a Bond-woman. *An.* 1 *E.* 3. and 9 *R.* 2. *cap.* 2. But if she married a Freeman she was thereby made free; and when once made free and discharged of all Bondage cannot be *Neife* after, without some special Act done by her; as Divorce or Confession in a Court of Record. Nor shall a Free-woman be bound by taking a Villain to her Husband; but their Issue shall be Villains after their Father. There was also anciently a *Writ of Neifty*, whereby the Lord claim'd his *Neife*; but all this is now out of Doors.

NEWEL, in Architecture, is the upright Post that the Case of winding Stairs turns round about.

NITRE. See *Clark's Natural History of Nitre. Lond.* 1670. in 8vo. Mr. *Boyle's Tract about the Redintegration of Salt Petre.*

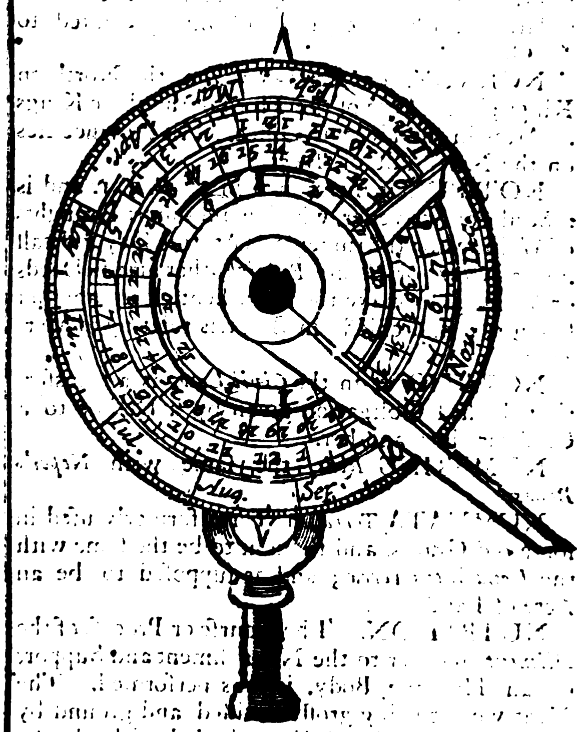
NOBLE; there hath not been any Piece of Gold (or Silver) of this Name coined with us since 9 *H.* 5. They were first coined by *E.* 3. 1344. The Noble contained 80 Pence; its half, which was then called *Obolus* 40 *d*, its 4th Part the *Quadrans* or *Farthing* in these Days 20 *d*.

NOCTURNAL. There are several Sorts of *Nocturnals*, of which some may be Projections of the Sphere; such as the Hemispheres or Planispheres on the Plane of the Equinoctial; but the Seamen use 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 consists 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 Piece there 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 backside 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 ½ 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 set 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 Uses of this Instrument are;

1. *To find the Hour of the Night.*

To do which, set the Tooth to the middle Part 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

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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 Guards are.*

This will appear on the backside 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 Compass as the *Guards* really are.

3. *To find at what Hour the Moon 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 *If. 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 Canonists 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. e.* 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-side 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 call him a *Notary* or *Notary Publick*, that attests Deeds or Writings to make them authentick in another Country; and chiefly in Business relating to Merchants.

NOVATION, in the *Civil Law*, is a transferring the first Obligation given by a Debtor to a Creditor, into another.

NUMBRING *Rods*, the same with *Neper's Bones*.

NUMMATA *Terræ*, a Term formerly used in some old Grants, and thought to be the same with the *Denariatus Terræ*; 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 grosly divided and ground by the Teeth, is in that Action mingled with the *Saliva*, 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 Juices contained in the Glands of the Stomach, its Parts are farther broken and the intimate Cohesion of them destroyed, and they divided one from another, 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, (arising from the Alternate Action of their Spiral and Longitudinal Fibres) and by the Pressure of the *Dyaphragm*, and the Muscles of the *Abdomen*, the grosser 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 *Lacteal Veins*, 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 Ducts*, which further dilates it and scours its containing Vessels; which Vessels going from those Mesenterick 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 *Lacteal* 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 Nourishment.

But if you take *Nutrition* in the Sense which some do, of the Blood nourishing the several Parts of the Body: Then will that kind of Nutrition be performed by a *Secretory Duct* arising from the Termination of an Artery, and carrying a suitable Portion of the Blood to every Part to be nourished; so that every Point of the Body must be the Termination of a *Secretory Duct* thro' which a proper Part of the Blood is brought in order to supply 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 *Hist. Insect. general.*) rather the Growth and Increase of the *Eruca*, 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 *Eruca* (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 *Aristotle* in his *Hist. 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 signify the same Thing.

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O. The Seven *Antiphones* 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 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 *Sacrosanctis Tactis 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 Constitutions for those that have the Execution of any Office under their Superiors.

OBIT, signifies an Office for the Dead or a Funeral Solemnity: The Anniversary of any Person's Death was also called an *Obit*. 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*.

OBLATÆ; were the Consecrated Wafers or Hosts 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 Altar*, 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 Feasts. The customary Dues also for *Sacramentalia* or Christian Offices, were comprehended under this Title; and also all little Summs for saying Masses for the Souls of Persons deceased.

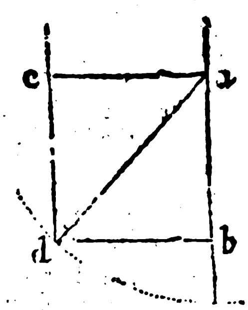
OBLATIONES *Funerales*, were the *Soul Scent* or Offerings to expiate the Omissions or Defaults of the Party deceased in paying Tythes or other Ecclesiastical Dues: At first this was an Oblation at the Funeral, and was often the best Horse of the Defunct, led before the Corps, and delivered at the Church-Gate or Grave, for the Use of the Parish-Priest.

To this Custom we owe the Original of Mortuaries. If the Corps were buried any where else, the Offerings were due to the Parish-Priest where the Party died.

At the Burial of the Dead, it was a Custom for the surviving 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 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. *Kennet's Glossary*.

OBLIGATION, by the Civilians, is defined to be a *Cause of Action*, 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 distinguish into *Effectual* and *Ineffectual*: The former of which, tho' there is not Ground enough for Action by the *Roman* Law, yet may bar by *Plea* and *Exception*; but the latter hath no Assistance 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 *d a*; draw *d e* at Right Angles to *d b*, 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 *d a*, by the Laws of Composition and Resolution of Motions will be resolved into the two Forces *d e* and *d b*; of which *d e* being parallel to *a b*, hath no Energy or Force to move that Body; and consequently *d b* expresses all the Power of the Stroke or Impulse upon the Body to be moved. But *d b* is the Right Sine of the Angle of Incidence *d a b*; wherefore the Oblique Force *d a*, to one falling perpendicularly is as the Sine of the Angle of Incidence to Radius. *Q. E. 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 $23^{\circ}.29'$ And this Angle (allowing for a very small Nutation of the Earth's Axis, which tho' necessarily 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 Solstitial Days observe the Sun's Meridian Altitudes, and then freeing them from Refractions, Parallax, *&c.*

subtract 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, tho' now taken to signify our Half-penny, anciently signified the *Half Noble.* The Noble or *Florin* being called a *Penny,* and its quarter part a *Farthing*: And indeed in the old Histories and Accounts of Coin, you are to understand by the Word *Denarius*, the whole Coin, be it *Angel, Rial,* &c. and by *Obolus* its half; and by *Quadrans* its fourth part.

OBSERVATION. The Seamen call an *Observation* the taking 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 *Working 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 *Mastoideus*, and part of the Beginning of the *Trapezius* next it, and then tendinous from the rest of the Line backwards, arising after the same Manner on the other side; from thence it goes strait up, and soon becoming all tendinous, it covers the two *Parietal Bones*, and the *Ossa squammosa* above the *Temporal Muscles*, 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 Eye-brows having sent down between them a narrow fleshy Slip or Elongation which is continued over the *Ossa Nasi*, as far as its Cartilaginous Parts, where its Fibres run off on each Side, and terminate in the Skin above the *Musculus Nasi 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 Possession 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 Beasts for Game, &c. or by finding things before undiscovered, or truly lost, or lost by their proper Owners.

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, &c. See *Salt*.

OCEAN, is the vast Collection or Union of all the Seas which compass round the whole Earth, and in which the two great Continents of *Europe, Asia*, and *Africa* on one side 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 Ocean*. Also the great Sea on the East of *Africa*, 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. *cap.* 9.

OECONOMICUS, was formerly used for the Executor of a last Will and Testament, as the Person who had the Oeconomy or Fiduciary Disposal 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 Church.

OGEE, *Ogive*, and as it is often written O— G— is a sort of Moulding in Architecture, consisting 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— G— with the Hollow downwards, as some define it.

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 *If. Newton, Opticks, Book* 2. shews that the *Opacity* of all Bodies ariseth from the Multitude of Reflections caused in their Internal Parts: And he shews also, that between the Parts of the opake 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 Bodies become transparent by filling their Pores, with any Substance of equal or almost equal Density with their Parts. Thus Paper dipp'd in 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 intimately 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,

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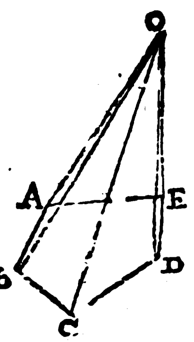
Bubbles either alone in the Form of Froth, or by shaking it together with Oil of Turpentine, or some other convenient Liquor with which it will not perfectly incorporate.

But 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 Reflections in their common Surfaces: Wherefore white Metals become opake not from their Density alone, but from their Parts being of such a Bigness as fits 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, may by reason of their great Density reflect all the Light incident upon them, and so be as opake and splendent as 'tis possible for any Body to be. 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 Trench: 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 favour 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 second 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 any Object, and united in a Point in the Eye of the Spectator. Thus if A B C D E be the Base of the Eye in O, the Optick Pyramid O A B C D E O. And when the Base is a Right-Line, as suppose A E or C D, then the Triangle O A E or O C D is called the



OPTICK *Triangle*, as the Angle A O E or C O D, 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 Colours, and all the Phænomena of visible Objects. In this large Sense our incomparable Sir *If. Newton* calls his Book of Light and Colours, *Opticks*; and from thence the following Brief Introduction to this Science is taken.

DEFINITIONS.

DEFIN. I.

By the Rays of Light I understand its least Parts, and those as well successive in the same Lines as 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 it 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. II.

Refrangibility of the Rays of Light, is their Disposition to be refracted or turned out of their Way in passing out of one transparent Body or Medium into another. And a greater or less Refrangibility of Rays, is their Disposition to be turned more or less out of their Way in like Incidences on the same Medium. 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 Instant. But by an Argument taken from the Æquations of the times of the Eclipses of *Jupiter's Satellites* 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.

DEFIN. III.

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; 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 Ray contains with the Perpendicular to the reflecting or refracting Surface at the Point of Incidence.

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DEFIN. V.

The Angle of Reflexion or Refraction, is the Angle which the Line described by the reflected or refracted Ray contained with the Perpendicular to the reflecting or refracting Surface at the Point of Incidence.

DEFIN. VI.

The Sines of Incidence, Reflexion, and Refraction, are the Sines of the Angles of Incidence, Reflexion, and Refraction.

DEFIN. VII.

The Light whose Rays are all alike Refrangible, I call Simple, Homogeneal and Similar; and that whose Rays are some more Refrangible than others, I call Compound, Heterogeneal, and Dissimilar. The former Light I call Homogeneal, not because I would affirm it so in all respects; but because the Rays which agree in Refrangibility, agree at least in all those their other Properties, which I consider in the following Discourse.

DEFIN. VIII.

The Colours of Homogeneal Lights, I call Primary, 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 Discourse.

AXIOMS.

AX. I.

The Angles of Incidence, Reflexion, and Refraction, lie in one and the same Plane.

AX. II.

The Angle 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.

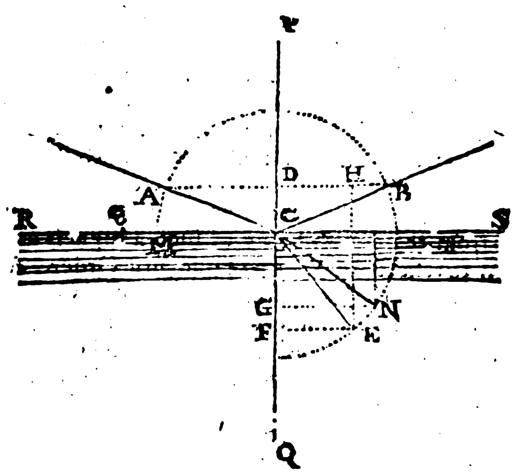
AX. IV.

Refraction out of the rarer Medium into the denser, is made towards the Perpendicular; that is, so that the Angle of Refraction be less than the Angle of Incidence.

AX. 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 so little, that it need seldom be considered.



Suppose therefore, that R S represents the Surface of stagnating Water, and C is the point of Incidence in which any Ray coming in the Air from A in the Line A C is reflected or refracted, and I 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 Reflexion and Refraction, shall be found somewhere in the Plane of the Angle of Incidence A C P produced. I let fall therefore upon the Perpendicular C P the Sine of Incidence A D; and if the reflected Ray be desired, I produce A D to B, so that D B be equal to A D, and draw C B. For this Line C B 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, so that D H may be to A D 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 A B E I draw parallel to the Perpendicular C P Q, the Line H E cutting the Circumference in E, and joyning C E, this Line C E shall be the Line of the refracted Ray. For if E F be let fall perpendicularly on the Line P Q, this Line E F shall be the Sine of Refraction of the Ray C E, the Angle of Refraction being E C Q; and this Sine E F is equal to D H, 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.

Let

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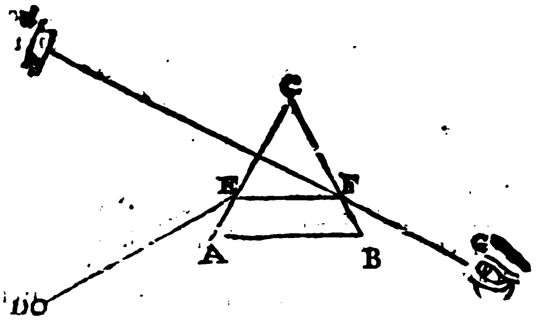
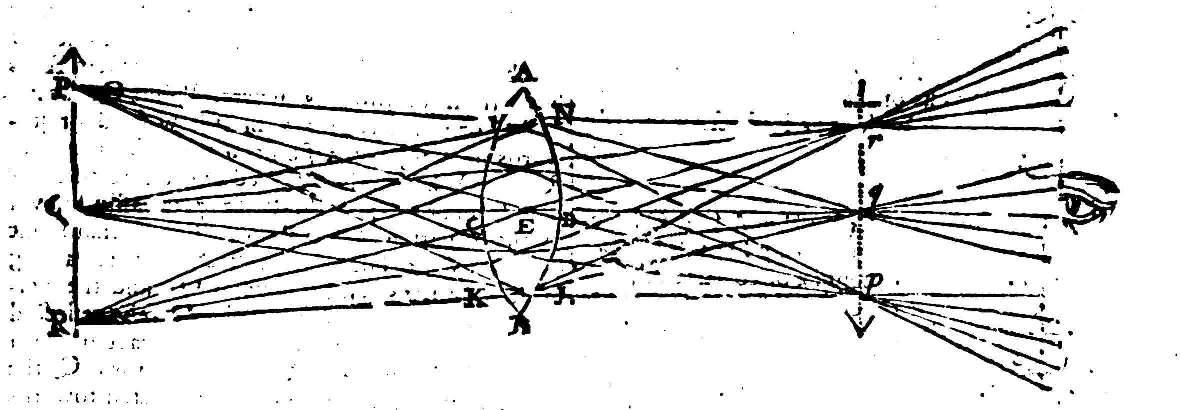


Let A B C represent a Plane cutting this Prism transversly to its three Parallel Lines or Edges there where the Light passeth through it, and let D E be the Ray incident upon the first side of the Prism A C where the Light goes into the Glass; And by putting the Proportion of the Sine of Incidence to 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 second side 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 Incidence out of Air into Glass be to the Sine of Refraction as 17 to 11, the Sine of Incidence out of Glass into Air must on the contrary be to the Sine of Refraction as 11 to 17, by the third Axiom.



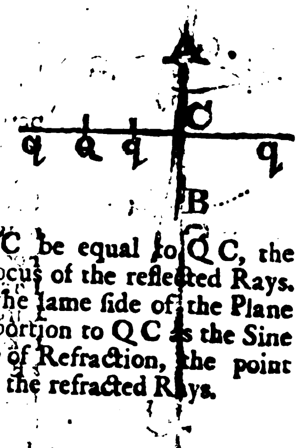
Much after the same Manner, if A C B D represent a Glass spherically convex on both Sides (usually called *Lens*, such as is a Burning-glass, or Spectacle-glass, or an Object-glass of a Telescope) and it be required to know how Light falling upon it from any lucid Point Q shall be refracted, let Q M represent a Ray falling upon any point M of its first spherical Surface A C B, and by erecting 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 q 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.

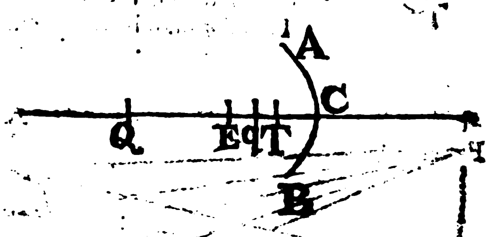
A X. VI.

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 parallel 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 reflected or refracted successively by two or three or more Plane or Spherical Surfaces.

The Point from which Rays diverge, or to which they converge, may be called their *Focus*. 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 above; or more readily thus.

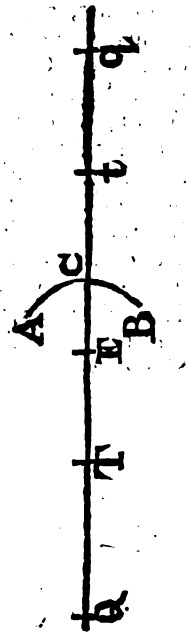
Cas. 1. Let A C B be a reflecting or refracting Plane, and Q the Focus of the incident Rays, and Q q C a Perpendicular to that Plane. And if this Perpendicular be produced to q, so that q C be equal to Q C, the Point q shall be the Focus of the reflected Rays. Or if q C be taken on the same side of the Plane with Q C and in proportion to Q C as the Sine of Incidence to the Sine of Refraction, the point q shall be the Focus of the refracted Rays.





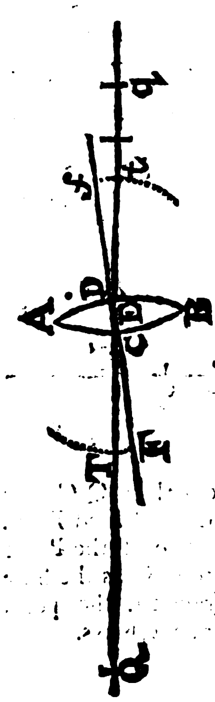
Cas. 2. Let A C B be the reflecting Surface of any Sphere whose Center is E. Bisect any Radius thereof (suppose E C) in T, and if in that Radius on the same Side the point T you take the Points Q and q, so that T Q, T E, and T q be continual proportionals, and the point Q be the Focus of the incident Rays, the point Q shall be the Focus of the reflected ones.

Cas. 3.



Case 3. Let B C B be the refracting Surface of any Sphere whose Center is E. In any Radius thereof E C produced both ways take E T and C *t* severally in such Proportion to that Radius as the lesser 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 T Q be to E T as E *t* to *t q*, taking *t q* the contrary way from *t* 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.



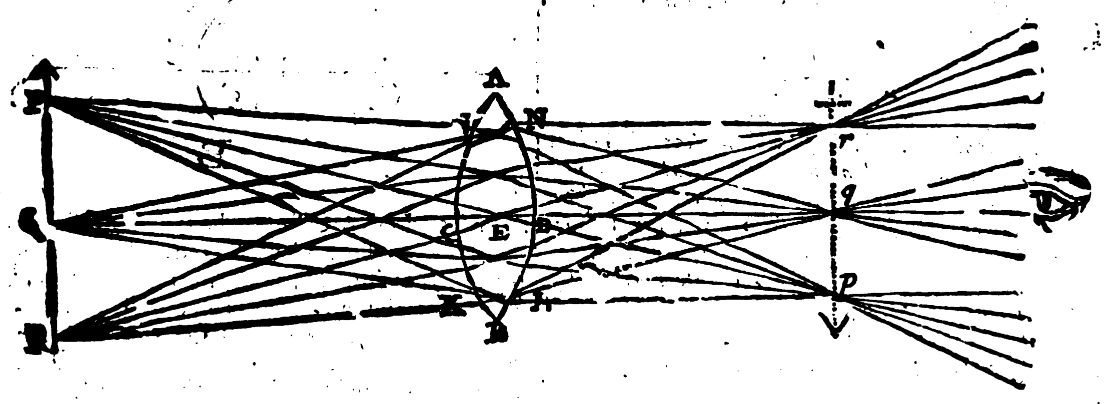
Case 4. Let A C B D be any refracting Lens, spherically convex or concave or plane on either side, and let C D be its Axis (that is, the Line which cuts both its Surfaces perpendicularly, and passes through the Centers of the Spheres,) and in this Axis let F and *f* be the Foci of the refracted Rays found as above, when the incident Rays on both sides the *Lens* are parallel to the same Axis; and upon the Diameter F *f* bisected in E, describe a Circle. Suppose now that any Point Q be the Focus of any incident Rays. Draw Q E cutting the said Circle in T and *t*, and therein take *t q* in such proportion to *t* E as *t* E or T E hath to T Q. Let *t q* lie the contrary way from *t* which T Q doth from T, and *q* shall be the Focus of 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 Surfaces.

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* found by the same Rules. Whether the reflected and refracted Rays flow from or towards the Point *q*, is easily known by the Situation of that Point. For if that Point be on the same side of the reflecting or refracting Surface or Lens with the Point Q, and the incident Rays flow from 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 it. And the contrary happens when *q* is on the other Side of that Surface.

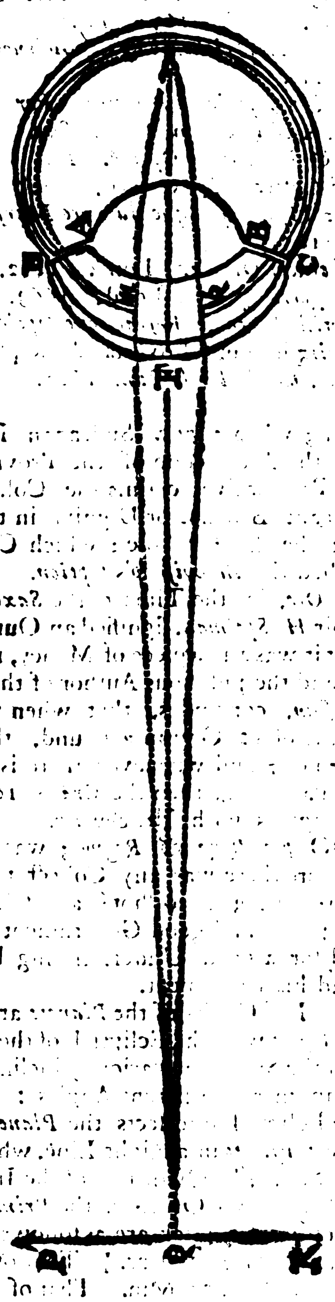
AX. VII.

Where-ever the Rays which come from all the Points of any Object meet again in so many Points after they have been made to converge by Reflexion 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, and A B be a Lens placed at a Hole in the Window-shut of a dark Chamber, whereby the Rays 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 Light there to fall upon it: The Picture of that Object P R will appear upon the Paper in its proper Shape and Colours. For as the Light which comes from the Point Q goes to the Point *q*, so the Light which comes from other points P and R of the Object, will go to so many other correspondent

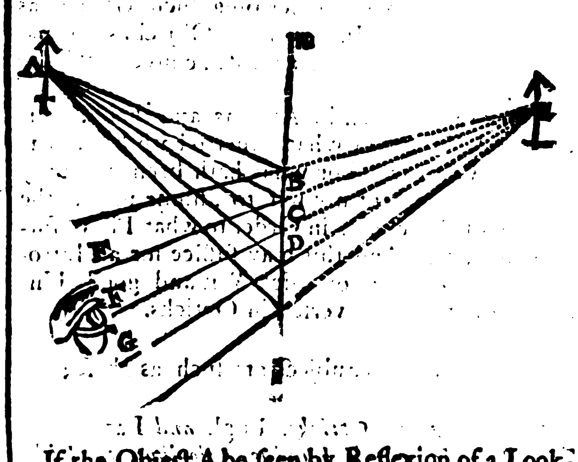
spondent Points *p* and *r* (as is manifest by the sixth Axiom;) so that every Point of the Object shall illuminate a correspondent Point of the Picture, and thereby make a Picture like the Object in Shape and Colour, this only excepted that the Picture shall be inverted. And this is the Reason of that 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 P Q R, the Light which comes from the several Points of the Object is so refracted by the transparent Skins and Humours of the Eye, (that is, by the outward Coat E F G called the *Tunica Cornea*, and by the crystalline Humour A B which is beyond the Pupil *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 Anatomists, when they have taken off from the Bottom of the Eye that outward and most thick Coat called the *Dura Mater*, can then see through the thinner 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 *Coat* of the *Crystalline 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 Indistinctness of this Picture the Object will appear confused. 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 Refraction 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-sighted Men see remote Objects best in Old Age, and therefore they are accounted to have the most lasting Eyes.

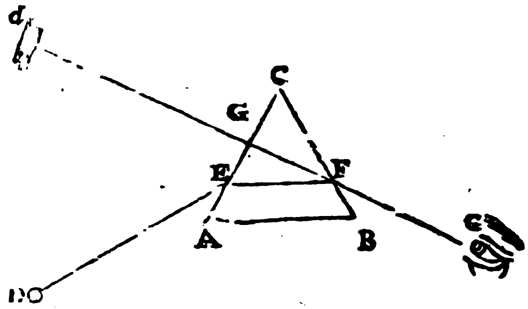
AX. VIII.

An Object seen by Reflection, or Refraction, appears in that Place from whence the Rays after their last Reflection or Refraction diverge in falling on the Spectator's Eye.

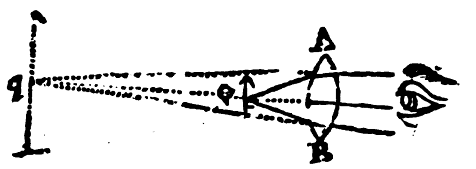


If the Object A be seen by Reflexion of a Looking-glass *m n*, it shall appear, not in its proper Place A, but behind the Glass at *a*, from whence any Rays A B, A C, A D, which flow from one and the same Point of the Object, do after their Reflexion

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 Interposition 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 *q* 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 Consideration 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 made.

I have now given in Axioms and their Explications the Summ of what hitherto hath been treated of in Opticks. 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 Introduction to Readers of quick Wit and good Understanding not yet versed in Opticks.

Authors on this Subject are such as these;

Sir *Is. Newton's Opticks*, Engl. and Lat.
Physico-Mathesis de Lumine, Coloribus, & Iride. per Fr. Mar. Grimaldi. Bononiæ. 1665. 4to.
Cogitationes Physico-Mechanicæ de Natura Visionis. Per J. Ott. Schaphusam. Heidelburgh. 1670. 4to.
Synopsis Optica per Honorat. Fabrum, Lugduni. 1667.
L' Occhiale all' Occhio overo Dioptrica Practica. del Carlo Ant. Mancini. Bolognæ. 1660. 4to.
Lectiones 18 Cantabr. in Scholis Habitæ in quibus Opticorum Phenomenωn genuinæ Rationes investigantur & exponuntur. Per D. Is. Barrow. Lond. 1669. 4to.
La Dioptrique Oculaire, par le Pere Cherubin D'Orleans. Paris. 1671. Fol.
A Treatise of Dioptricks, by Will. Molineux, Esq; *F. R. S.* 4to.
Catoptricæ & Dioptricæ Elementa. Per D. Gregorium, M. D. Oxon. 1695. 8vo.
Albazeni & Vitellionis Optica. Fol.
Aguillonii Optica. Antv. 1613. *Fol.*
L' Optique & Catoptrique du Pere Mersennes, a Paris. 1651.
Christ. Scheineri Optica. Lond. 1652.
Jacobi Gregorii Optica. Lond. 1663.
Joan. Baptist. Porta de Refractione Optices. 15.
Mr. *Leibnitz* his one Universal Principle of *Opticks* in *Act. Erud. Lips. Jun.* 1682.

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 therefore called the *Archbishop's Option*.

ORA or *Ore*, in the Time of the *Saxons*, according to Sir *H. Spelman*, signified an Ounce, and he saith, that it was also a piece of Money, in value 16 pence; and the judicious Author of the *Chronicon Pretiosum*, concludes, that when we find Mention made of 12 Oræ in 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 & 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 Parliament.

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 intersects the *Plane* of the Orbit of every *Planet* in a Right Line, which passes 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. That of *Saturn* is an Angle of 2 Degr. ½. 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 Guilt, or attesting the Innocence of parties accused; chiefly by *Water* or *Hot Iron*. This *Ordeal* was simply call'd *Judicium*, in Opposition to *Bellum*, which was Duel or Combat Fight, the other customary purgation. Neither of these Trials were taken away by *William the Conquerour*, as Sir *W. Temple* asserts. *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*

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Kennet's Glossary at the End of his Parochial Antiquities.

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 same with Regular ones; that is, they are *Equilateral* and *Equiangular*.

ORDONANCE, in Painting or Sculpture, is the just and elegant Composition of the whole Piece by a proper, natural, and agreeable Disposition of the Figures, so as to answer the Design 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 *Is. Newton*, 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 *Recordæ*, which signify 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 Lips.

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 *Peritonæum*, which covers also the Spermatick Vessels. The Substance of the *Ovaria* is composed of Fibres and Membranes, which leave little Spaces, 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 Nerves. 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 for 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.

PACK *of Wool*, is a determinate Quantity of 17 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. 8*vo*.

A General Idea of the Art of Painting, and a Relation of 7 Conferences held at Paris *in the Academy Royal for the Improvements of the Arts of Painting and Sculpture.*

Optique de Portraiture & Peinture, contenant la Perspective Speculaire & Pratique Accomplic. &c. *per Gregoire Huret de l' Academ. Royale de Peinture & Sculpture, a* Paris. 1670. *Fol.*

Entretiens sur les Vies & sur les Ouvrages des plus Excellens Peintres Anciens & Modern, per M. Felibien.

PALATO-*Salpingæus*, a Muscle of the *Tuba Eustachyana*. See *Musculus Tubæ Novus*.

PALATO-*Staphilinus*, is a Muscle of the *Uvula*, 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. *Dowglas*, *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 and

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 Archbishops 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.*

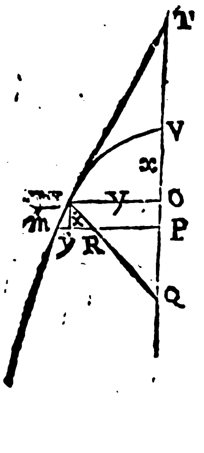
PANEL; some say is a little Part of any Thing; others, as *Spelman*, say it signifies a Schedule or little Page; which seems truest, for hence comes our Law Word to Empennel a Jury, *i. e.* to write the Names in a Pannel or Schedule of such Jurors as the Sheriff returns to pass upon any Trial.

PANNAGE, *Pannagium*; signified 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 Pannage*, 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 Pannage were not duely paid, there was a *Process* from the *Exchequer* and a *Destraint* by the *Sheriff.* The Title of *Pannage* was sometimes alienated from the Parish Priest to the Appropriators. 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 *Papillæ Pyramidales* lie the *Glandulæ 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 according to Par.*

PARABOLA. To draw a Tangent to the *Parabola* in a Point assign'd.



Let the Point assigned be *M*, and the Parameter $=p$.

Then the Equation expressing the Nature of the Curve is $\boxed{px=yy}$

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 MOT being similar, let the former be noted with its proper Fluxionary Letters, and then this Proportion will arise;

$\dot{y} : \dot{x} :: y . \frac{\dot{x}y}{\dot{y}} (= OT)$. and the Equation of the Curve being $\boxed{px=yy}$ the Fluxion ($p\dot{x}=2y\dot{y}$ and dividing all by p; $\frac{2y\dot{y}}{p}=\dot{x}$. and substituting $\frac{2y\dot{y}}{p}$ instead of $\dot{x}$, in the Quantity $\frac{\dot{x}y}{\dot{y}}=OT$, you will find that $\frac{2yy}{p}=$ is also equal to *OT.* Then substituting px instead of yy, you will have $\frac{2xp}{p}$ or $2x=OT$: That is, in the common *Parabola, The Subtangent is always = to twice the Abscissa.*

N. B. In any *Parabola* if the Parameter be supposed $=1$. and m be the Index of the Power of y, and a positive Number, whole or broken, then will $\boxed{y^m=x}$ 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 $(=2x) . y :: y . \frac{yy}{2x} = OQ$, and then putting for yy its equal px it will be $\frac{px}{2x}=OQ$ $\boxed{\text{or } \frac{p}{2}=OQ}$ which gives you a very remarkable 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 standing Quantity.

Wherefore 'tis a very ready Way to draw a Tangent to the Parabola, to set 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 Parabola.*

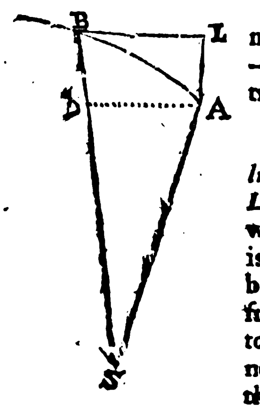
PARABOLOIDS, are Paraboliform Curves in Geometry; whose Ordinates are supposed to be in a Subtriplicate, Subquadruplicate, &c. Ratio of their respective *Abscissæ*; and putting x for the Abscissa, y for the Ordinate, and p for the Parameter, the Equation for the *Cubical Paraboloid* will be $\boxed{ppx=y^3}$ In the Biquadrical Paraboloid, the Cube of the Parameter into the Abscissa is equal to the Biquadrate of the Ordinate; that is, $p^3x=y^4$: and so of other Paraboloids *ad infinitum.*

But there is also another Species of the *Paraboloids*; *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, $pxx=y^3$. Then the Curve is called a *Semicubical Paraboloid.* And,

2. When $px^3=y^4$. 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 S B——S A *bB*, the Paracentrick Motion of that Planet. *Hayes. p.* 293.

PARACENTRICK *Sollicitation of Gravity,* or *Levity* (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 S B (infinitely near S A) until it interſect the Tangent B L.

PARADIGRAMMATICE, is the Art of making all ſorts of Figures in *Plaiſter*. The Artiſts in this are called *Gypſochi*.

PARALLAX, in the *Leipſick* Acts for *October*, 1685, there is an Account of the *Caſſinian Method* of finding the *Parallaxes* and *Diſtances* of the *Planets* from the Earth; practiſed 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 ſailing under a Parallel of Latitude: of this there are but 3 Caſes. 1. Given Departure and Diſtance. Required Latitude.

The Canon is, As Diff. of Longitude to Rad. :: ſo is Diſtance, to Coſine of the Latitude.

2. Given Diff. of Longitude between two places under the ſame Parallel; required their Diſtance.

The Canon is, As Rad. to Diff. Longitude :: ſo 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. See the *Practice of the Exchequer, p.* 99.

PARCELLING of the Seam of a Ship, is after it is caulked, to lay over it a narrow piece of Canvas, and then pouring on it hot *Pitch* and *Tar*.

PARGETING or *Parging*, is the Workmens Word for plaiſtering of Walls.

PARHELII and *Parhelia*, or ſuch *Phænomena* 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 ſummons our *Parliaments* runs, *ad conſulendum*, &c. *de arduis Regni Negotiis*. And therefore ſignifies a ſolemn Conference of all the Eſtates of the Kingdom, ſummoned together by the King or Queen's Authority to treat of the weighty Affairs of the Realm. The ancient *Britains* ſeem to have had 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 *Suit* and *Service* in their Courts. The chief of theſe were called *Barons*, who thrice every Year aſſembled at the King's Court, *viz.* at *Chriſtmas, Eaſter,* and *Whitſontide*: 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.* 1. who in the 16th Year of his Reign, ſummoned the Commons to the great Council at *Salisbury*. *Cowell's Interpreter*.

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 $z \times {}^3z^2m + zr \leftrightarrows S$ 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 *conſtituent* 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 Newton*, 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 ſhewn 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 ſince their Parts ſeem for the moſt part to have the ſame Denſity with Water or Glaſs, as by many Circumſtances 'tis 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 diſtinguiſhes it) by looking into the Table, you will find that the Number $16\frac{1}{4}$ ſhews it to be $\frac{16,}{1000000}$ parts of an Inch. In the general he proves alſo, *That the Parts of Bodies on which their Colours depend are denſer than the Medium, which pervades their Interſtices.* Prop. 6. B. 2. part 3.

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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 'tis certain that *Water, Oyl, Vinegar*, and Spirit or Oyl of *Vitriol* will do by *Cold*; Quicksilver 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 so. 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 Vacuities must needs be much harder.

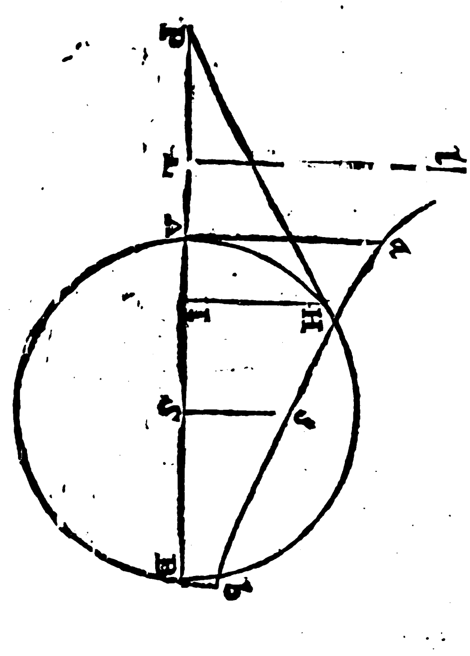
'Tis probable that the most small Particles of Matter do attract one another, and adhere together with the greatest Force; and that these may combine into larger Particles, whose attracting Force is weaker; and many of these latter cohering together may form yet greater Particles of Bodies, whose attracting 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 *Colours* 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. *J. 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 evaporating part of the Water, they are brought within a due Distance; and then they presently run towards one another, unite, and form Chrystals, whose Parts have a strong Cohesion. (See *Attraction* in this Vol.)

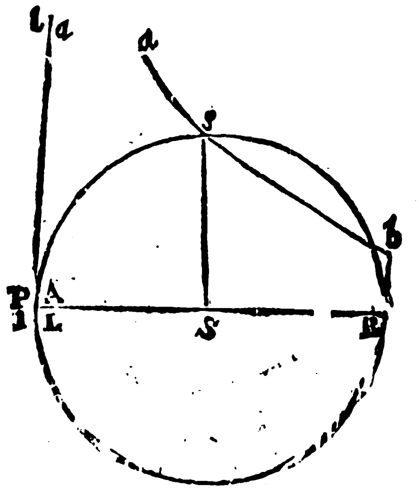
'Tis plain also, that the *attractive Force in these Particles is* (cæteris paribus) *proportionable to their Solidity*; for it must be compounded of the *Summs of all the Parts* of each Particle, and those parts will be most numerous in such Particles as are most solid; *i. e.* in such as have fewest 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 few 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 attract 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 attractive Particles, is infinitely greater at the Contact, or extreamly nearer it, than at any determined Distance from it.*

Suppose the Sphere *A H B* composed of Particles that attract any Particle, as *P*, with a Force reci-



procally proportionable to the Cubes of their Distances. Draw the Tangent *P H*, and from *H* let fall the *Perpendicular H I*: Bissect *P I* in *L*, and raise the *Perpendiculars l L, A a, S s, B b*; and make $Ss = SI$. Then with the Asymptotes *L B*, *L l* thro' *s* describe the Hyperbola *b s a*; and then the Area $aABb - \sqcap 2AS \times SI$; 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 *A a* becomes the Asymptote of the Hyperbola, and the *Area a A B b* becomes infinite; and the Rectangle $2AS \times SI$ being finite, the *Area* $aABb - 2AS \times SI$, 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 $=0$, snd consequently whatever is divided by it becomes infinite, and therefore the attractive Force at the Point of Contact being proportional to $\frac{1}{PS^2 \times PI}$, will be infinite.

Prop. IV. *If a Body consists 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, or extremely near it; but 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 asunder, tho' that Body may be prodigiously greater and heavier than the Particles united. Sir *Isaac Newton* calculates from the Inflection 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 Distance 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 strongly than a small one at the same Solidity, but a Diversity of Figures causes different Degrees of Attraction 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, *cæteris 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 pressed 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 Attraction, 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 polished 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 increas'd 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. XI.

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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 mightily 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 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 heat, is quieted.

Mr. *J. 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 *Lecture De Divisibilitate Materiæ*, in his *Lectiones Physicæ*.

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; so 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. e.* 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 Vacuities.*

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.* And such *Moles* as are compounded of these second *Moleculæ* by several of them coalescing together 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 made*, and into which they are primarily dissolved.

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 Contact, for such Particles as lie remote from the Place of Contact add Nothing to the Cohesion.*

And therefore according to the several Degrees or Quantities of the *Contact* 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 Corpuscle adheres to another, will (*cæteris 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 such Bodies as are *soft*, and herein the Reason of their *Softness* consists.

8. *As Particles which are perfectly solid 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 perfectly 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 long and slender Cylinder.

9. Salts

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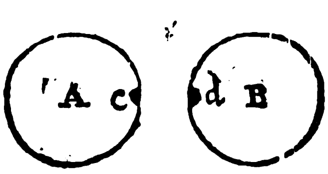
9. *Salts are Bodies, whose Particles of the last Composition are endowed with a very great attractive Force: But yet between those Particles, there are very many Pores or Meatus, which are pervious to the Particles of the last Composition of Water; which aqueous Particles being strongly attracted by the Saline ones, do rush towards them with an Impetuosity, do disjoyn their mutual Contact, and dissolve their Cohesion.*

10. *A Body specifically heavier 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 Pores; 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 that 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 *Phænomena* 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 *Vitriol* with a little Water; for the Particles of the Steel have a very great Degree of Elasticity, and from thence a strong Reflection 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.

16. *If the Particles which do mutually attract each other have no Elasticity, then they are not reflected 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.*

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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 have 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 lift them up to the Bodies from whence they flow: 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 *Phænomena* of *Electricity* may be solved.

PARTING, is one of the Refiners Ways to separate Gold and Silver; 'tis done by *Aqua fortis*, which how to make, and the whole Manner of the Operation, see under *Refining*.

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. *Kennet*.

PASS, a Frame of Boards consisting of 2 or 3 Bottom Boards, and two Side ones, set 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 *Tessellata*. See *Tessellata*.

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 'tis the Course and Custom of our Nation, that every one shall be tried 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 passing Tryals on Noblemen.

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 four 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.

PENNY-*Weight*, formerly every Pound contained 12 Ounces, and each Ounce was divided into 20 parts, called *Twenty-penny-weight*; for then Twenty-penny-weight weighed an Ounce: and tho' the *Penny-weight* be altered, the Denomination 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 *Whitsontide*. They were also made by the *Parishioners* to their *Parish Priest*, and sometimes by inferior *Churches* or *Parishes* to their Mother-Church. These *Parish Pentecostals* were called *Whitson-Farthings*, and their Sum was divided into four parts, of which one went to the *Priest*, one to the *Poor*, one towards the Repair of the *Parish Church*, and one to the *Bishop*. See *Stephens of Procurations and Pentecostals*, and Dr. *Kennet's Parochial Antiquities in Glossary*.

PERCH, *Pertica*, 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 $16\frac{1}{2}$ 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 significatione sub. verb. Perticata Terræ*, saith, *Perticata Terræ* is a Rood of Land. There are also some other Measures mentioned which are now out of use. He saith three Feet and one Inch make an *Elne*; six *Elnes* make a *Fall*; which he saith is the common lineal Measure. Six *Elnes* long and six broad make a *Square*, and *Superficial Fall* of Land measured; and 'tis to be understood, he saith, that a *Raip*, a *Rod* and a *Lineal Fall* of Measure, are all one; only a Rod is a *Staff* or *Pole* 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*.

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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 Nictitans*.

PERISTERNA, in Anatomy, are the lateral parts of the *Thorax*.

PERITONÆUM: The external Surface of this soft 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 *Peritonæum* grows thick, as in several Dropsies. The *Peritonæum* 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 *Peritonæum* hath Veins and Arteries from the *Phrenicæ*, 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 likewise a few 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 *Variation* and *Combination*.

PERNANCY: Taking or receiving Tythes in Pernancy, is taking such as are or may be paid in kind.

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 understood 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 since 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 *Machine* greater than that of the first Force impressed; and therefore since on our Earth, all *Motions* are performed in a Fluid which resists 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* whatsoever, can all *Friction* be avoided, there being in Nature no such thing as exact Smoothness or perfect Congruity: 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 *Friction* will also sensibly in time diminish the impressed or communicated Force, so 'tis not possible the *Motion* 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 first Mover. But *nil dat quod non habet*, the generating Force cannot communicate a greater Degree of *Motion*, that it hath it self, 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 single Impulse; since that Degree of *Motion* and *Velocity* arising from such a single 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 *Quæ 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.

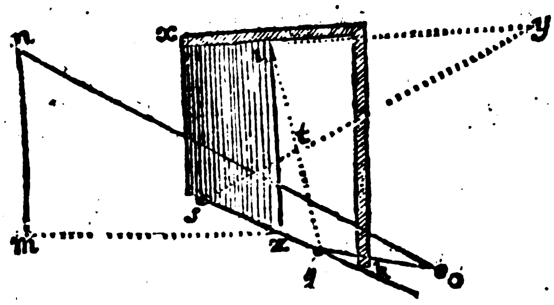
PERQUISITE, in the Law-sense, is any thing gotten by a Person's own Industry, or purchased with his own Money, different from that which descends to him from his Father or Ancestors.

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 Copyholds, Herriots, Amerciaments, Waifes, Strayes*, &c.

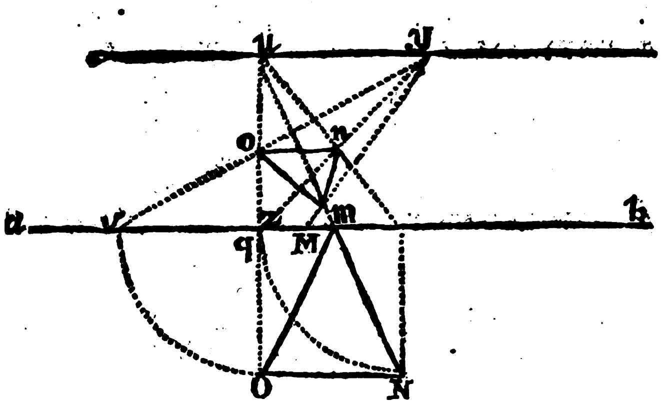
PERSONAL *Services*. See *Services*.

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 z 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 z*; at *z* in the Table erect the *Perpendicular* *z u* equal to *n m*, and at Right Angles to it, from the Point *u*, draw also *u y* equal to *m z* the Distance of the Eye from the Table. From *o* let fall a Perpendicular to the Base of the Table, as *o q*. and

and draw the Line $q u$. Take $q s =$ to $q o$, draw $s y$ cutting $u q$ in the point t, so is t the point required.



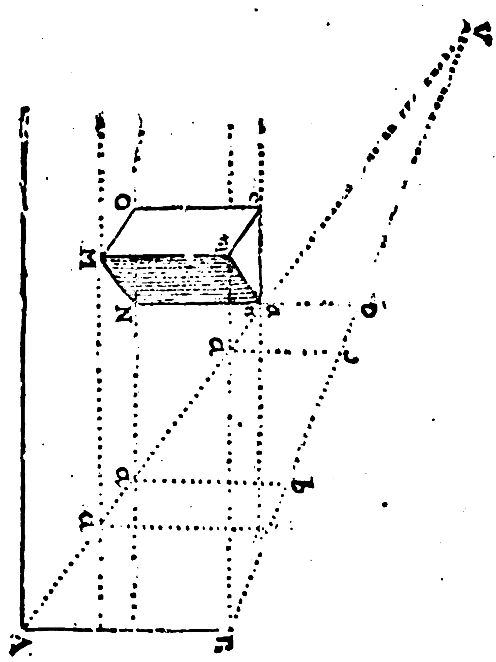
On this Foundation is the primary Rule of all *Perspective* built, and all its Practices established, *v. gr.* Suppose an Equilateral Triangle (as *m n o*) or any other Geometrical Plane Figure were to be represented in *Perspective*. Between the Eye and the Triangle draw somewhere the Right-line *a 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' *v* draw, at Right Angles to *z u*, or parallel to *a b*, the *Horizontal Line v y*; then will the Plane lying between those Parallels represent the *Table* or *Transparent Plane*. Then in order to find the perspective Point for *o*, one of the Angles of the Triangle *o m n*, draw *o q* perpendicular to the *Fundamental Line a b*, and make *q s* equal to *q o*. Take *u y* equal to *u z*, and then from *y* draw *s y*; draw also *v q*, whose intersection with *q s* will find the point *o*, which will be the true Representation of *o* in *Perspective*; proceed after the same manner with the Points M and N, and drawing the Lines *o n*, *n m*, *m o*, the Triangle *o n m* will be the true Representation of the Triangle M N O. And thus proceeding with the Angular Points of any Figure, whether regular or irregular, you may draw any thing truly in *Perspective*; only in Practice, several 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 Base, or *Ichnographick Plane m n o*;



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 *A B* be erected perpendicularly equal to the true Altitude (or if the Figure hath different Altitudes, let them all be transferred into the Perpendicular *A B*) and from the points *A* and *B* (and from all the points of intermediate Altitudes, (if there be any such) draw Right Lines to the Eye point in *V*, or to any point in the Horizontal Line: Those Lines *A V* and *V B* will constitute 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 *A V* and *B V*; 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 purpose, and others of this Nature.

Authors on this Subject of *Perspective*, are;

Alberti Dureri Perspectiva, cum Fig.
Hansen Leucours Perspectiva, in *High-Dutch. Ulm.* 1617. *Fol.*

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Henrick Loutensack Perspectiva, ditto. *Franck*, 1618.
La Perspective curieuse de Niceron. à Paris. 1663.
La Perspective avec la Raison des Umbres, &c. *par Salomon de Causa.*
Roger Bacon's Perspective. Lat.
Joan. Cantuariensis Archiepiscopi Perspectiva communis.
Leingenno de Glocchi, Perspettiva practica.
Lecda Regele delle Perspettiva.
Verdmanni Frisii Perspectiva.
The Jesuits Perspective; or, *La Perspective practique par un Religieux*, &c.
Moxon's Practical Perspective.
G. Ubaldi Perspectiva, Lib. 6.
La Perspective speculative & practique, par Mignon.
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 *Pesarius.*

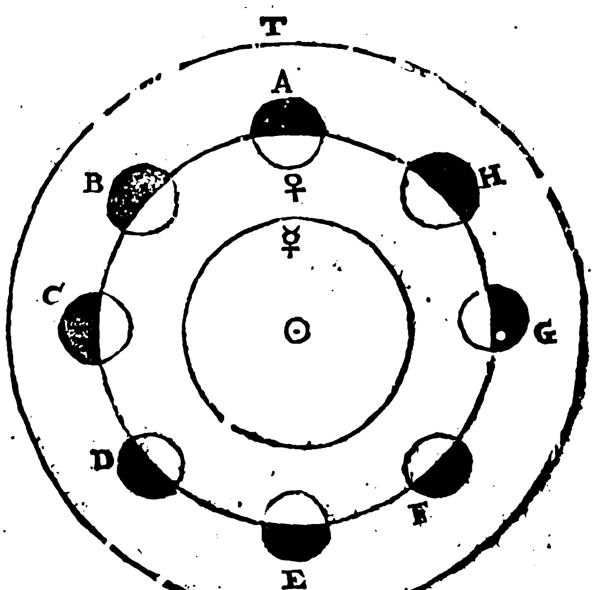
PETER-*Pence*, called also *Hearth-pence*, *Rome Scot*, and in the North *Ream Pence*; was a Levy of a Penny on every House wherein there were 30 Pence *viva pecuniæ*, to be collected and sent to *Rome*: This at first tho' only a Contribution, at last pass'd into a standing Tax; one half of it went for 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 *Canute*, *Edward the Confessor*, *William the Conqueror*, 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 soon 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 Feoffer; 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. c. 24.

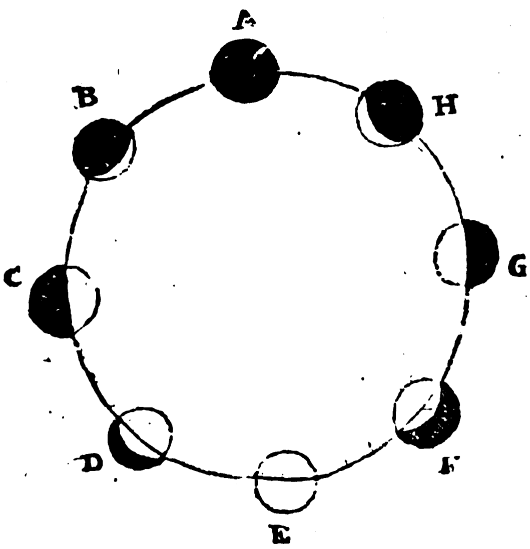
PHALANX, among the *Macedonians*, was an oblong square close Battle of Pikemen, consisting of 16 File, and 500 in Front, as *Polybius* saith; and the Soldiers stood so close together, that the Pikes of the 5th Rank extended 3 Foot beyond the Front of the Battle.

PHASES *of the Planets*: Since all the Planets as well as the Earth are spherical, opake, 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 'tis that Hemisphere of any Planet, which is obverted to the Earth, which is considered by any Observator:



The eight little Circles represent the different Phases of *Venus*, as they will appear to an Eye placed in T on the Earth, while she moves round in her Orbit A C E G about the Sun. It will be plain 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 further 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, or 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 full. And the same Phases she will put on as she moves in the other Semicircle from E to A again, 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 round 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 vacuo*; 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 tho' *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 Degree 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 six Ounces of well purified clean Quicksilver; 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 Spectators.

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. Newton's Principia Philosoph. Naturalis Mathematica.*
Ejusdem Optice: sive de Lumine & Coloribus.
Borellus de Motionibus à Gravitate pendentibus.
— De vi percussionis.
Wallis Mechanicks, sive Liber de Motu Tractatus 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 Religion.
All Dr. *Hook's* Tracts printed while he was living, and his *Opera Posthuma.*
Philosoph. Transactions.
And *Collections.*
Acta Eruditorum Lipsiæ.
Collegium Experimentale sive Curiosum, in quo primaria hujus seculi Inventa & Experimenta Physico-Mathematica inveniuntur 2 Vol. *4to.*
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.
Bohun, of Winds.
De Resistentia Solidorum, by *Alex. Marchettus,* Florentiæ. 1665. *4to.*
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 a Paris 1673. *12mo.*
Traite de Mouvements des Eaux & des autres Corps Fluides par Feu. par M. Mariotte. Paris 1686. *8vo.*
Pardies Local Motion, Engl.
Exegesis Physico-Math. de momentis Gravium.
Whiston's Theory of the Earth.
Gallilæi Dialogi de Mechanica & Motu Locali.
— de Systemate Mundi.
Sinclari Ars nova & magna Gravitatis & Levitatis.
Dee de Præstantioribus quibusdam Naturæ Virtutibus. *4to* Lond. 1558.
Miscellanea Curiosa Germanica, in 8 Vol. *4to.*
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 Pillar which is partly within the Wall. *Bulid. Dict.*

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 she 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 *Squard 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-

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PISCIVOROUS *Animals*, are such as feed on Fish. 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 $\frac{3}{4}$ of the Breadth of the Building, then they say that Roof is of a *True-Pitch*: But if the Rafters are longer, they say 'tis a *high* or *sharp pitch'd Roof*; if shorter, they call it a *low* or *flat pitch'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 apparent 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, ἀναλυόμενος, i. e. *Resolutus*, and the Order of their Writings about it, according to *Pappus*, is this, (1.) *Euclidis Datorum, Lib.* 1. (2.) *Apollonii* λόγου ἀποτομῆς, or *de Rationis Sectione, Libri* 2. (3.) The same Author's χωρίου ἀποτομῆς, of the *Section of a Space*, 2 Books. (4.) His two Books of *Tactiones* (ἐπαφῶν.) (5.) *Euclide* his 3 Books of *Porismata*. (6.) *Apollonius* his νεύσεων, or of *Inclinations*, Book 2. (7.) The same Writer's two Books of *Loca plana*, τόπων ἐπιπέδων. (8.) His eight Books of *Conicks*. (9.) *Aristæus* his five Books τόπων στερεῶν, 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 *J. Craig's Tractatus Mathematicus de Fig. Curvilinearum Quadraturis*; *& de Locis Geometricis*. Lond. 1693. 4*to*.

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 *Fore-plane*, which is a long Plane, and used first of all before either *Smooth-plane* 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 Stuff as soon as may be, in order to prepare it for the *Smoothing-plane*, or *Jointer*. If the *Stuff* be *free* and *frowy*, that is, even tempered all over, you may then set 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 *Fore-plane*, 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 design'd to shoot an Edge of a Board perfectly streight 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 Jointer*. 'Tis used also for framing and fitting the Joints of *Mitres* 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 lapping over is called *Rabbeting*. The *Rabbet-plane* is sometimes used also to strike a *Fascia*, 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. *Moulding-planes*, 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, Ebony, Lignum Vitæ, *&c.* it is set to 80 Deg. and sometimes quite upright. There is also some 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 Stereographically: 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 *Projection* in Vol. I.

PLANETS. The Motions of the six Primary Planets round the Sun is so adjusted, that the Square of the Times of their periodical Revolutions are as the Cubes of their Distances from the Sun: And the same thing is found by all Astronomers to be true, with Regard to the Motions of the *Secondary Planets* or *Satellites* round their primary ones. *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 *Apsides* of all the Planetary Orbits 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 System. *p.* 57.

If a Primary Planet revolving round the Sun as its Centre carry round with him a Satellite 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 also be more *Curvilineal* in the Quadratures than in the Syzygies, and consequently the Satellite will be or recede farther from the Primary Planet, in the Quadratures than in the Syzygies, so as that the Orbit will be an Ellipsis, whose Centre is the Primary Planet, 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 Planet, instead 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 Planet. *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, Planets, *&c.* in Clay, *&c.* The Workmen are called *Plastæ*. It differs from Carving, because here the Figures are made by *Addition* usually, but in Carving always by *Subtraction* of what is superfluous. 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 Proportion of Hazard in Play or Gaming is a Thing Mathematically computable, *&c.* For tho' 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 considered, they would not, perhaps, venture their Money with Sharpers, and such Wretches as make it their whole Business 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 improbable 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 Expectation 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 Expectation in a just or equal Game.

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 Proposition.

Proposition I.

Where there is an equal Chance for $a=3$ *s.* and $b=7$ *s.* the Value of my Expectation is $\frac{a+b}{2}$; or half the Summ of a and b.

To investigate the truth of which Proposition; suppose I would seek what the value of my Expectation 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 shall Stake down x, 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, subducting a) if I win. Now to make it an equal Game, this $2x-a$ must be $=b$, wherefore transposing a and dividing by 2, you will have this Equation $x=\frac{a+b}{2}$, which gives x sought.

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 'tis 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 equal 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.*

Prop-

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Proposition II.

Where there is 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 $x=\frac{a+b+c}{3}$. And so on; if there had been an equal Chance for four Things as $a+b+c+d$, the Value of my Expectation will be $x=\frac{a+b+c+d}{4}$, &c.

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 $p+q$; of which every one must stake x, Therefore the whole Stake will be $px+qx$, and every one plays with equal hopes of winning.

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 exprest by q, and my self) I bargain, that whoever of them gains the Stakes 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 1 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 $bb+pa-a$; 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 first Expectation; wherefore putting $px+qx-bq-ap+a=a$. By Reduction $x=\frac{ap+bq}{p+q}$. *Q. E. J.*

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 $13\times3=39$. and $8\times2=16$. and $39+16=55$, and $55\div5=11$.

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 Losers of us 13 a-piece. Then 'tis 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 *two* 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 1 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 $\frac{a}{2}$ or $\frac{1}{2}a$.

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 $\frac{a}{2}$; for if I win the Game I have a, and if he win, my just share of the Stake is $\frac{1}{2}a$.

Since therefore, before I begin this Game, I have an equal Chance to gain a or $\frac{1}{2}a$, the Value of my Expectation (by *Prop.* I.) is half the Sum of both those Chances (*i. e.*) $\frac{a+\frac{1}{2}a}{2}=\frac{3}{4}a=6$. Now if I have $\frac{3}{4}a$ due to me as my Share, he can have but $\frac{1}{4}a$ 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 Deficiencies 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 *Unciæ* be collected for A, and all where there's two b's (or bb and above) for B.

For

For A.	For B.
1 aa	1 bb
2 ab	
3	1

Wherefore A's odds to B is 3 to 1.

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 sure of, tho' he should win the next Game; and since 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 *two 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 so 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 $\frac{3}{4}a$; wherefore before I threw I had an equal Chance for a or $\frac{3}{4}a$, and therefore (by *Proposition* I.) my Expectation is worth $\frac{a+\frac{3}{4}a=\frac{7}{4}a}{2}$: But if my Proportion of Expectation be $\frac{7}{8}a$, his can be but $\frac{1}{8}a$; 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,
$1a^3$	$1b^3$
$3aab$	
$3abb$	
7	1

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 wins 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 being up.

Then if I win the next, I shall want but one and he three. This State of the Sett is worth $\frac{7}{8}a$ by the last *Case*; but if he win, then each of us will want 2, and so our Chance is equal, and there is $\frac{1}{2}a$ due to each of us; wherefore I have an equal Chance to gain $\frac{7}{8}a$ or $\frac{1}{2}a$: But $\frac{\frac{7}{8}a+\frac{1}{2}a}{2}=\frac{11}{16}a$. 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 must 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.

I take therefore the 4th Power of the Binomial $A+B$, *viz.* $a^4+4a^3b+6a^2b^2+4b^3a+b^4$, 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.	B.
$1a^4$.	$4b^3a$
$4a^3b$	$1b^4$
$6a^2b^2$	
11	5

Then adding all the *Unciæ* in each Collection together they will give the Chances and shew the Odds of A's winning or being up before B, to be as 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 *Unciæ* of the 5th Power of $a+b$ you will have

for A.	for B only
$1a^5$	$1b^5$
$5a^4b$	$5ab_4$
$10a^3b$	
$10a^2b$	
in all 26.	in all 6.

Wherefore the Odds is 26 to 6, or 13 to 3.

This Method by the *Unciæ* of a *Binomial* was communicated to me by the Honourable *Francis Roberts*, Esq;

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 next Game, I shall want 2 and he 3; wherefore by *Case* 3, 4. I have an equal hazard of gaining $\frac{15}{16}$ or $\frac{11}{16}$, and this by *Prop.* I. is worth $\frac{13}{16}a$; wherefore his Share is but $\frac{3}{16}a$, 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 $\frac{3}{4}$ or $\frac{12}{16}a$, whereas now 'tis $\frac{13}{16}a$.

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 $\frac{1}{3}a$ is each Man's Share: Where-

Wherefore the first Man hath one Expectation to gain a, one to get nothing, and one for $\frac{1}{3}a$; which by *Prop.* II. is $\frac{a+0+\frac{1}{3}a}{3}=\frac{4}{9}a$. 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 $\frac{4}{9}$ of a: But $\frac{4}{9}a+\frac{4}{9}a=\frac{8}{9}a$, and consequently the Third's Share can be but $\frac{1}{9}a$; 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 consider 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 undertake to throw 6 with one Dye?

Case 1. If I undertake to throw six 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 Nothing; wherefore by *Prop.* II. $\frac{a+5 \text{ nothing,}}{6}$ (for 5 times Nothing is Nothing) $=\frac{1}{6}a$, is the Value of that Expectation, and consequently my Antagonist must have $\frac{5}{6}a$; 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 $\frac{1}{6}a$, and but one for a; which (by *Prop.* II.) $=\frac{a+\frac{5}{6}a}{6}=\frac{11}{36}a$, the Chances against me then give my Fellow Gamester $\frac{25}{36}a$, 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*, Esq; Thus,

In how many times, with a single 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.*

Now I say, that the Number of Throws requir'd must be the Index of that Power of $\frac{6}{5}$, which makes the Numerator at least double to the Denominator; for by that Means the Chances against me being subducted, a *Majority* will remain for me.

Throws			$\frac{6}{5}\times\frac{6}{5}\times\frac{6}{5}\times\frac{6}{5}$	
1	makes it	5 agst. me.	1 for me	that is 36—25
2		25	11	216—125
3		125	91	1296—625
4		625	671	

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 expeditiously solved by the *Logarithms*, as in this Example.

In how many times, with six 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.

x2 | 1 | $\frac{46556^x}{46655} > 2$. that is, this Fraction when raised up to the Power of x must have its Numerator above double of the Denominator; or by the *Logarithms*.

2 | $0.00000931x > 0.30103000$.

3 | Wherefore dividing one by the other, it will follow, that $x > 32334$.

4 | And consequently $x=32335$.

Now without the Logarithms, (which solve 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 $\frac{1}{36}a$.

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 $\frac{1}{36}a$, 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 1 Chance for a and 35 for $\frac{1}{36}a$, which by *Prop.* II. is worth $\frac{71}{1296}a$, and there will be against him $\frac{1225}{1296}a$. 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 him;

him; which by the former Case are worth $\frac{71}{1296}a$.

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 $\frac{71}{1296}a$; 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, so 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 $\frac{1}{2}a$; 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 $\frac{2}{3}a$ in Value. So I have 27 Chances for half *a* and 9 Chances for $\frac{2}{3}a$, which (by *Prop.* II.) $= \frac{13}{24}a$ for me, and $\frac{11}{24}a$ 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 $\frac{31}{36}y$. But at first I supposed my Hazzard to be x, wherefore $\frac{31}{36}y=x$, wherefore $\frac{36}{31}x=y$. 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 $\frac{6a+30x}{36}$, but by the Supposition, that is $=y=\frac{36}{31}x$, and therefore $\frac{6a+30x}{36}=\frac{36}{31}x$; and by Reduction $x=\frac{31}{61}a$, which is the Value of my Hazard; wherefore his must be $\frac{30}{61}a$, 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 Disadvantages 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*, $\frac{15}{48}$, or $\frac{5}{16}$ 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.*

$$\frac{6\times5\times4\times3\times2\times1\times0, \&c.}{6\times6\times6\times6\times6\times6\times6, \&c.}$$

The Under *Series* is the Summ of all the Chances; and the Upper, the Number of Changes against him who undertakes 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 $\frac{13}{18}$: 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 $\frac{ap+bq+cr}{p+q+r}$, that is, in Numbers, supposing $p=2 . a=3 . q=4 . 5=b . 1=r . c=9$; the Value of my Hazard is $\frac{2\times3+4\times5+1\times9}{7}=5$. For call my Expectation x, then x must be such, as 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 so many others, as with my self, make up the Number $p+q+r$; 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 self; 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 self, to get $px+qx+rx-ap-bq-rc+c$. which if it be supposed 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 $px+qx-rx-ap-bq-rc+c=c$: Then is $x=\frac{ap+bq+cr}{p+q+r}$ as it ought 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 1 *H.* 3. *Ranulph* the 3d. Earl of *Chester* granted to his Barons of *Cheshire* 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 *Lupus*) Ancestor to this Earl *Ranulph, Tenere ita Libere per Gladium, sicut ipse Rex Willhelmus tenuit Angliam per Coronam.* And consonant hereunto, in all Indictments for Felony, Murder, &c. in that County Palatine, the Form was anciently, *Contra Pacem Domini Comitis, Gladium & Dignitates suas.*

PLEBANIA, *Ecclesia plebanianis,* is a Mother-Church which hath one or more subordinate Chapels.

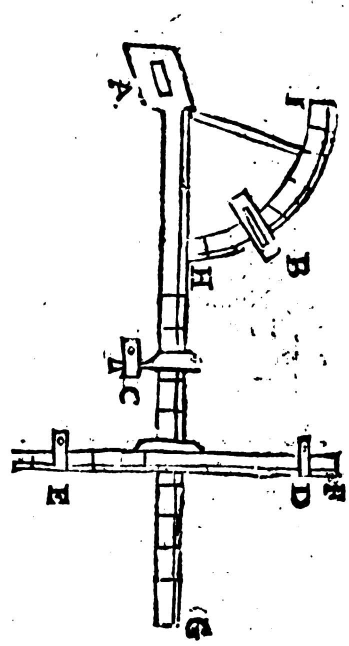
PLEBANUS, was sometimes the Title of a Rural Dean, because the Deanaries were formerly affixed to the *Plebaniæ*, or chief *Mother Churches* within such a District, which at first was usually Ten Parishes. Sometimes it seems to have been used for a Parish-Priest of such a large Mother-Church as was exempt 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 subject.

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 *Vertebræ* of the Back, and ascends on each side 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 *Jonas 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 deficient. 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 fall 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

Year. 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 according 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 *Rhumbs*.

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 disused 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 *Silesia*; Dr. *Davenant*'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 *France*, are about 7 or 8 to 1. That the People of *Amsterdam* are $\frac{2}{3}$ of those of *Paris*, or *London*, which don't differ, he saith, above 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* 900000, the *French* 100000, the *Hamburghers*, *Danes*, *Swedes*, and *Dantzickers*, have 250000, and *Spain*, *Portugal*, and *Italy*, &c. about as much. The Value of the Goods exported from *France* into all the Parts is supposed Quadruple to what is sent into *England* alone, and consequently 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 raised by the *French* King (in Peace) is about 6$\frac{1}{2}$ 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 7 *l.* *per Annum* a Head, 42000000. The Rent of the Lands about 8 Millions, and the Profits of the Personal Estate as much. The Profits of all the 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, not above 45000000. The Manufactures of *England* in the whole, exported from *England*, amount to about 5000000 *per Ann.* Lead, Tin, and Coals, 500000 *l. per Ann.* The Value of the *French* Commodities (then) brought into *England*, did not exceed 1200000 *l. per Ann.* The whole Cash of *England* in current Money was then about 6000000 *l.* and at 6000000 of Souls, allowing each to spend 7 *l. per Ann.* the whole Expence will be 42000000, 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 above-mentioned 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. *Gregory 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* about 5545000 Souls, they increasing about 9000, every Year, Allowances being made for Plagues, &c. Wars, Shipping, and the Plantations. The People of *London* he reckons at 530000. Those 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, in Butter, Cheese, and Milk, he thinks, is about 2,500000. The Value of the Wooll yearly shorn, about 2,000000: Of Horses yearly bred, about 250000. Of the Flesh yearly spent as Food, about

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bout 3,350000. Of the Tallow and Hides about 600000. Of the Hay yearly consumed by Horses, about 1,300000; of Hay consumed 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 7¼ 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 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 since the War about 43,000000 *l.* That of *France* 81,000000, and that of *Holland* 18,250000 *l.* *&c,*

The Ingenious Capt. *Halley*, Geometry Professor 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 Curiosa*, 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 ¼ 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 doth not die in a Year's Time, or before he attain such an Age. 3. To shew at what Number of Years, 'tis 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 Insurance upon Lives: And, 5. The Valuation of Annuities on Lives. 6. How to value two or three Lives after the same Manner. And 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 wise 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 square Miles of Land in *England*.

That in *England* and *Wales* there are 4600000 Souls.

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 10 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 1 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, *&c.*

That the Odds is 5 to 4, that one of 25 dies before 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 5½ 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 Purchase.
1	10 . 28
5	13 . 40
10	13 . 44
15	13 . 33
20	12 . 78
25	12 . 27
30	11 . 72
35	11 . 12
40	10 . 57
45	9 . 91
50	9 . 21
55	8 . 51
60	7 . 60
65	6 . 54
70	5 . 32

POLLARDS

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POLLARDS, were formerly a kind of Spurious Coin used in *England*, but these, as also Crocards, Staldings, Eagles, Leaonies, and Steepings have been long since disused. See *Matt. West. in Anno.* 1299. *p.* 413. 2 *Inst. 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 *Chests* belonging to it, The *Baulks* are seven Yards long and about five or six Inches square: The *Chests* are Boards joined together by Wooden Bars about a Yard broad and four Yards long. 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 Artillery may pass.

PORES. Sir *Is. 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 outside 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 hath more Pores than solid Parts*, 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 sensible 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 Effects is hard to conceive, but yet not impossible. For Sir *Is. Newton* hath shewn, That the Colours of all Bodies arise from their Particles being of such a determinate Size or Magnitude: (See *Colours.*) 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 *solid* 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 so 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 possible there may be yet far greater Quantities of Vacuity Interspersed in Bodies.

PORTA or *Vena Portæ*: Dr. *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 Portæ*) which is, that the Bile being to be mixed with the Chyle as it comes out of the Stomach into the *Duodenum*, could no where be so conveniently secerned from the Blood, as where the Liver is placed: But if all the Branches of the *Cæliack 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 consequently 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 *Aorta* does to its Branches; so the Branches of the Mesenterick Artery are likewise less in Proportion to their *Conjugate Veins* than the *Aorta* is to the *Vena Cava.* The descending Trunk of the *Aorta* below the Emulgents is to the *Vena Cava* at the same Place,

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as 324 is 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 10 Inches long, and is used to fire Guns and Mortars instead of Match.

PORTREVE, is the Title for the Chief Magistrate in some Sea-Coast Towns: And *Cambden* in his *Brit.* saith, 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 Bailiffs appointed by the King; but presently after King *John* granted them a Mayor for their yearly Magistrate.

PORTIFORIUM, was formerly an Ensign 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 used 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 *Yards 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 a Body of Men can make a Stand, 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, *&c.* 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 Army, *&c.* they call the *Post of Honour*.

POSTNATI, are such as were born in *Scotland* after the Descent of that Crown to K. *James* I. 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 signify 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 Pound Troy 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 20*s.* sometimes the Pound was composed of 12 Ounces or *Oræ*, and then the *Ora* was 20 *d.* and sometimes of 15 Ounces or *Oræ*, and then the *Ora* was 16*d.* 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*, *Screew* 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 such a Periphery, which the Power moves, is to the Periphery of the Axis of the Cylinder 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 *Sanction*, 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, *Proœmium*, 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 Mischiefs design'd to be prevented or remedied by the same.

PRÆBEND. See *Prebend*, in Vol. 1.

PRÆMUNIENTES, are Writs sent to every particular Bishop to come to Parliament, *Præmunientes, 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. *Apeldarham*. 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 *Præceptor* or *Commander*: And thence the Place was called a *Præceptorie* 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. Creſſing Temple*, *Balſhall*, *Shengay*, *Newland*, *Tevely*, *Witham*, *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 'tis 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 another Contract, and conſequently as far as 'tis contrary to and inconſiſtent 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.

PRE-FINE, (in Law) is that Fine which is paid on Suing out the *Writ of Covenant*.

PREMUNIRE. See PRÆMUNIRE.

PREPOSITUS *Villæ*, ſome will have to be the Conſtable of a Town, or Petit Conſtable. Tis alſo ſometimes uſed for a *Reeve*: For others ſay in our Old Records, it ſignifies the *Reeve* or *Bailiff* of the Lord of the Mannor who is ſometimes called *Serviens Villæ*. 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 *Præpoſitus & quatuor de unaquq; 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 Interpreter*.

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 Carteſian Hypotheſis, 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 *Iſ. 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 conſiſted 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 conſiſt, 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 inflect it ſelf *in Umbram*. For the fixed Stars do immediately diſappear on the Interpoſition 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 Command at all Times appointed by their Officers.

PREST *Sail*: A Ship at Sea is ſaid 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 Prætenſum*; 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-

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PREVARICATION, In the Civil Law, is where an Informer colludes with the Defendant, and so makes only a feigned 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 Carcase of the House.

PRIDIAL *Services*. See Services.

PRIMAGE, is a Duty due to the Mariners and Sailors for the loading of any Ship at the setting 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 single 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 left 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 *John Guttenburgh* stole 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 seen 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 *Art* was first invented about the Year 1460, and was practised 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*, disagrees a Year with that in the Library of C. C. College there. In that Book in 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*, *Joh. Arnoldus in Libello de Chalcographiæ Inventione*, makes the Inventer 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 Book, which refers the first Invention of *Printing* to the Year 1453; but most to the Year above-mentioned by Dr. *Wallis*, *viz.* 1460.

Next to these two Places of *Mentz* and *Harlem*, it seems to have been practised first at our University of *Oxon* in *England*: For K. *H.* 6. and *Thomas Bouchier*, then *A. B.* of *Canterbury*, sent *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 Corseles*, (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. *Jerom*, (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 *Mentz*; 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 it, 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 it was received in *Italy*, *Germany*, *&c.*

In *Philos. Transactions*, N. 288, and 310, there is this further Account of the Rise and Progress of the Art of Printing.

Boxhornius Schrevelius, and other Authors say, 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 *Bennet 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* tells us, but *Fust* ran away with *Koster's* Tools and Materials, and in some time set up a *Printing-Press* at *Mentz*, where he was assisted by his Servant *John Scheffer*, a young Man of a good Genius, and who afterwards married his Daughter, and became his Partner. They tell a Story also of *Fust's* going to *Paris*, but whether before or after he settled at *Mentz*, 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-writers could not be thus exact, forc'd the Secret out of

 him,

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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. *Faustus*.

And 'tis probable about this Time many printed Books were sold up and down for *Manuscripts*.

'Tis not certain in what Year *Fust* and *Scheffer* began first to work at *Mentz*. But *Schrevelius* saith, *Faustus* (as he calls him) printed *Alexandri Doctrinale cum Petri Hispani Tractatibus, A. D.* 1442. And *Lambetius in Comment. de Biblioth. Cæs. Lib.* 2. *p.* 988. saith, that he brought from *Inspruck* to the Imperial Library at *Vienna*, a *Psalter* 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* above-mentioned; which was not printed till 1465 or 1466. The first Book printed here in *England*, was the *Ruffinus*, printed at *Oxford* 1468, as was said before. But they practised 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 fled 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 Paper, 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 Bodleian Library, (placed *Laud. p.* 138.) being a *Missale secundum usum Eccles. Herbipolensis*, (i. e. *Wurtzburgh*) in *Germany*. At the Beginning of this Book is an Instrument of *Rodulfus* the *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-Press*. 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 Chineses, of whom we had no Knowledge hardly, when this Art was invented: But rather from *Old Medals, Seals*, &c. and the Letters on them. But if it be certain, as it seems to be, that Cards are as old as *H.* 6. nothing seems 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 moist Paper on the Form or Block, being first lightly brushed over with Ink made 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 *Stanesiles*, as they call them; being Card-Paper cut thro' with a Penknife 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 Picture, 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 *single 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 Letters 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 *Antwerp* by our industrious *John Speed*.

As to the Art or Practice of *Printing* it self, 'tis so useful to the Common-wealth of Learning, to have it better understood by Authors and Editors of Books than it usually is, that I shall here give a full a full but succinct Account of the whole Matter from Mr. *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 *Presses* and *Cases* 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 $\frac{1}{2}$ in Length and $4\frac{1}{2}$ 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 enough.

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* set on them; that both the *Cases* and the *Forms*, may be the better secured from running to *Pye*.

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.

Of *Letter*.

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 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	contain'd in a Foot.
Nompareil	150	
Brevier	112	
Long Primer	92	
Pica	75	
English	66	
Great Primer	50	
Double Pica	38	
Two Lined English	33	
Great Cannon	$17\frac{1}{2}$	

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 high*; for if they are much to high they cut thro' the Paper, Tympans, and Blankets: 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 a *Lower one*: They are usually both of equal Length, Breadth and Depth: *viz.* 2 Foot 9 Inches long, one Foot 4 Inches $\frac{1}{2}$ broad, and about one Inch $\frac{1}{4}$ deep besides the bottom Board. These *Cases* are encompassed about with a *Frame* about $\frac{3}{4}$ 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 $\frac{1}{2}$ 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 $\frac{3}{4}$ of 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 $\frac{1}{4}$ or $\frac{1}{3}$ of an Inch in Thickness: The uppermost to slide in Grooves of 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 $\frac{3}{4}$ 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

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but they must not be *glewed*; because the Compositor may have sometimes Occasion to wet the *Page* in the *Galley*.

Of the *Correcting Stone.*

This Stone is made of *Marble*, *Purbeck*, 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*, tho' 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.*

Letter Boards, are to lay the Letters on, and are oblong Squares; about 2 Foot long, 18 Inch. broad and 1 an ½ Inch thick: These should be made strong, and clampt on the under side within about 4 Inches of either End 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-sticks, &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-sticks* are called *Riglet*, if they are not above an Inch in Thickness.

Side-sticks, and *Foot-sticks*, are of the same height with the *Head-sticks*; the latter serving to determine the Breadth, at Bottom and Top; as the *Side-sticks* do the length of each *Page*.

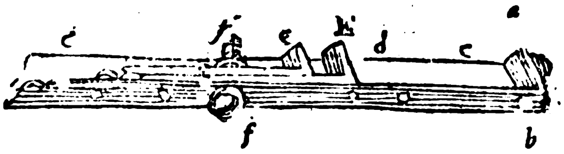
Gutter-sticks, are used to set *between Pages*, on either Side the Crosses, as in 8*vos.* 12*mos.* 16*mos.* and Forms upwards.

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 10 Inches long and doubled up square so as that the bottom may be ½ Inch and ¼ 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 asunder to receive the Shank of the *Male Screw*, that Screws the *sliding 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 ¼ of 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 Shank 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 ½ Inch and ¼ thick, and the breadth of the Iron on every Side is ¾ of an Inch usually, but it should be an entire Inch: All the Sides must be truly square to one another; that when 'tis laid on the *Correcting 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 upperside 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 Inside 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 *Short Cross* is moveable also in the *Chase* about 3 Inches ½ from the Middle. The Middle of these 2 *Crosses*, 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 *Cross*, beginning at about 2 Inches from each End: They are ½ an Inch deep all the Way, and about ¼ of an Inch broad, that the Points may fall into them. The *Short Cross* is about ¾ of an Inch thick; and the *Long* about half as much.

See their Figure as they lie on the *Correcting-stone.*

Of

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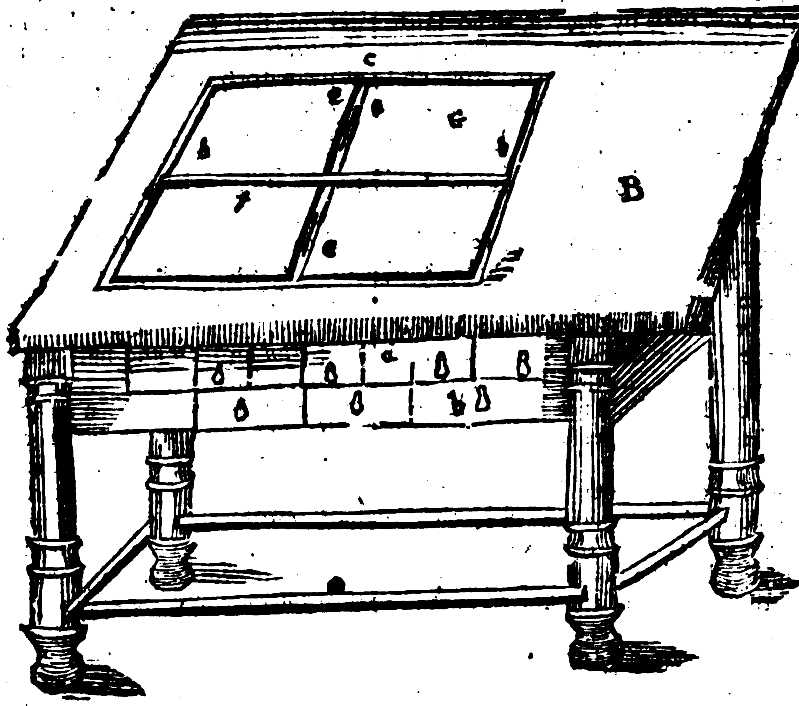
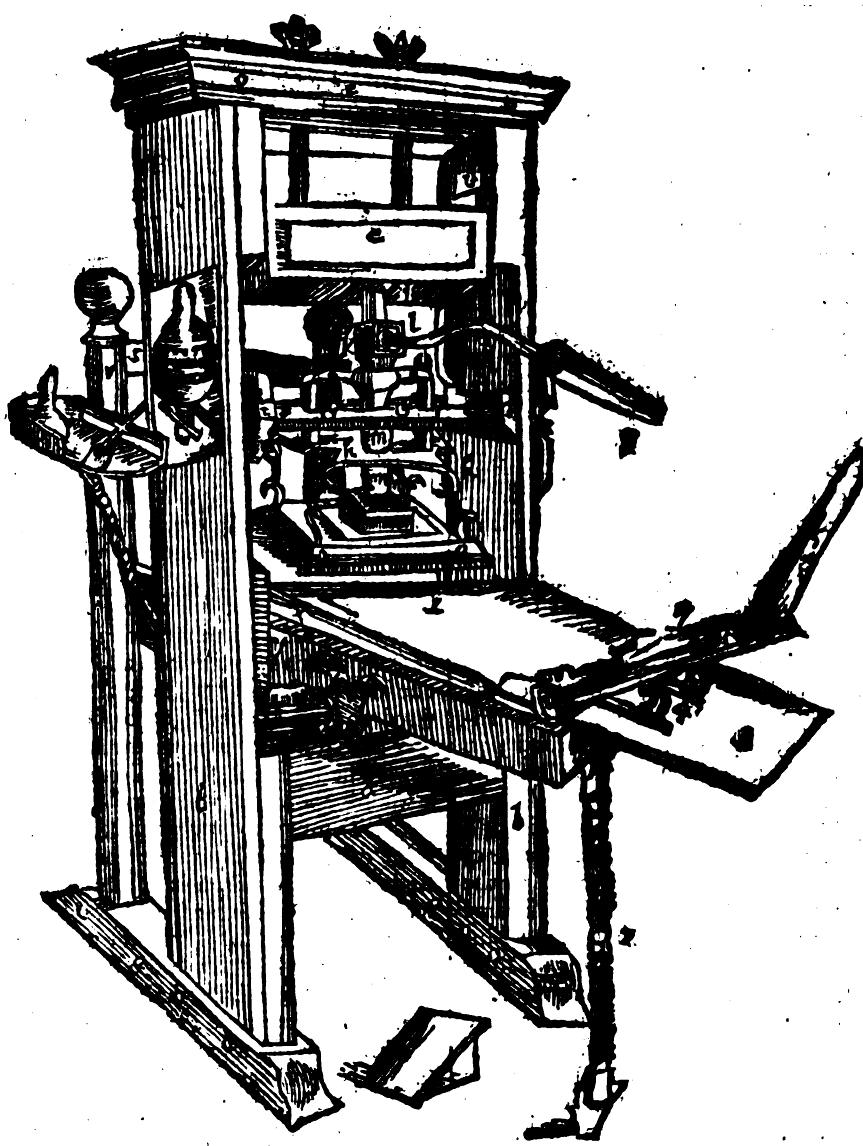


Of the *Press*.

The Printing Press, whose Figure is here annexed, was invented by the famous *Willem Jansen Blaeu*, of *Amsterdam*; who was eminent not only for his good and great Printing, but also for his Globes and Geographical Maps and Charts.



'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*.

aa, Represent its *Feet*, which are 2 Feet 9 Inches ½ long, 5 deep, and 6 broad, having their Outsides truly square.

bb, Are the *Cheeks*, which are 5 Foot 10 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 ½, 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, 4½ Inches deep, and 9½ Inches broad.

e, Is the *Head* of the Press; whose length, besides the Tenons, is 1 Foot 9½ Inches, Breadth 8½ Inches, and Depth 8 Inches. Its Top, Bottom, and hind Sides are all square; but the Foreside projects half 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 Tenons are 3 Inches broad, and are cut down at either End, from the Top to the Bottom of the Head, and made fit to *Mortices* in the *Cheeks*, that may slide right, and yet play in them.

In the Under-side of the *Head* is cut a Hole about 4 Inches square, and 3½ 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.

i, k, l, m, n, Is the whole *Spindle*.

f, Is the *Till*, a Board about an Inch thick, one Foot 9¼ long besides the Tenons, its Breadth 8 Inches; in its middle is a round Hole for the Shank of the *Spindle*, and at 7¼ Inches from each End is a square Hole for the Hose to pass thro'

gg, Are the *Hose*, being upright Irons of ¾ of an Inch square, and at each End have *male Screws* on them. Their lower Ends are fastened into the *Hose-hooks*, and their upper Ends into the *Garters* or *Curts*, which is a round Hoop placed over the flat Neck of the Shank of the *Spindle*.

hhhh, are the *Hose-hooks*, 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 16½ Inches, the Length of the Cylinder the Worm is cut on is 3¼ Inches, and its Diameter 2¼.

oooo, Is the *Platten*, tied on to the *Hooks* of the *Hose*; this is usually made of beaten 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*, ¼ of an Inch thick, 6 Inches long, and 4 broad; in the middle of this Plate is made a square Iron Frame of about half an 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.

p Is the *Bar*, in length about 2 foot 8 Inches, 'tis fastned strongly with a Nut and Screw into the Eye 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.

r r, Are the *Hind-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 six Rails fitted to them, and marked *ss*, and called the *Hind-Rails*.

t t, Are the Wedges of the *Till f*.

u u, The Mortices of the *Cheeks bb*.

xxxx, yy, Express the *Carriage*; whose Plank is of *Elm* an Inch and half thick, 4 Foot long, and 1 Foot 8 Inches ½ broad. On this Plank at its fore end is firmly nailed down a square Frame 2 Foot 4 Inches long, 1 Foot 10 Inches broad, and the Thickness of its sides 2½ Inches square. This is called the *Coffin*, and is marked with the Figure (1) in the Plate, and in it the *Stone* 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 over. This *Gutter* is so nail'd on, that its hither End standing about an inch higher than its further End, the Water that descends from the *Tympan* (5) falling into it, is carried on the further side of the Coffin by the Declivity of the further End of the *Gutter* (2,) and so keeps the Plank of the Carriage neat 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 Dove-tails 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 side 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 half 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

I hope this Description may serve to make the Figure a little Intelligible, and to give a general Idea of the *Printing Press*; but no words can possibly explain it so well, as once seeing of it work will do.

I shall omit describing the manner of making the *Types* or several sorts of *Letters*, used in Printing; but whosoever hath a mind to satisfy 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 *Rinsing Trough*, and rears it a little aslope 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 Backside of it; by which he raises it up, and then sets *Letter Board*, and *Form* both a little aslope in the *Rinsing Trough*. Next with his *Mallet* and *Shooting-stick* he *opens* or *Unlocks* (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 asunder: after it hath stood a while to dry; he carries *Letter Board*, *Form* and all to the *Distributing 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 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 besides the Lye makes their fingers sore.

The *Compositor* next sets himself to the *Composing work*: and here he must first Determine his *Measure*; to which he fits his *Composing stick* (above described) by loosening the screw, and Sliding the Cheeks nearer to or further from its head.

Having *fitted his Measure*, he Places the *Galley* on his upper Case on the Right-hand, and placing his Copy before him, he reads 5 or *six words* or such a part of it as he can keep in his mind, and then spells it over Letter by Letter, taking up the proper Letters out of their respective *Boxes* in 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 it secure, tight and close together, as with his right-hand he puts them into the Stick successively. And 'tis a very surprizing thing to see how very quick this work is performed; and how in an instant he spells, resolves upon, and takes out the several letters which compose his work, and supply his stick.

Having composed one Line; if it ends with a *word*, or a *Syllable* and a *Division*, and just fill the *Measure*, 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 *Riglet* of just the length of the Line, he claps it down into the *Galley*, placing the first line close and upright against the lower Ledge of the *Galley*.

As he *Sets* or composes 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 Latin Alphabet hath no such Letter.

When our *Compositor* hath got a full Page in his *Galley*, he next ties it up fast together with a Pack-thread, or Cord, 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 sheet, 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 be folded into an orderly Succession. And the 4 different volumes of *Folios*, *Quartos*, *Octavos*, and *Twelves*, are all diversly *Imposed*.

Correction.

In *Correcting* Faults, if there be but a *few* of them, and these *Easy* ones, the Compositor gathers the Corrections in his *Stick*, beginning at the bottom of every Page and so Ascending: 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. Then he *unlocks* the *Form*, but keeps the *Quoins* pretty tight up, least his Letter should *hang* or *squabble*: and there folding the Proof, so that the *Head-line* in it may lie in the same Range with the *Head-line* of the Metal, &c. so that all the lines in the *Proof* coincide or range right with the respective ones in the Metal; by running his eye along easily the several Places, or Lines in the Proof, where the *Corrector* had mark'd a Fault; he as easily mends it in the Corresponding Line in the *Letter* of *Metal*.

If there be a *Long* word or more than one left out, the Compositor is usually forced to *over-run*, 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 out.

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 he take, if he happen instead of *Leaving out*, to set any thing *twice 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 the next Page, or more, and sometimes the whole 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-Corrected*, 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 *Compositor* 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, out of a due regard to his own Reputation, which else may much suffer, or at least as much as he can, will correct 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 *Tho* for *The*; he dashes out the wrong *Letter* thus *tho*, and Writes the *Letter* 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 *Margin*. e|

If two or three, or more Words in the same *Line* have *Faults* in them as in these Words, Potienpe per foerce; where first an o is *Set* 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*. a| c| r| o|

But if one word be set instead of another, as *Scoff* instead of *Smile*, here he marks Scoff out thus ~~Scoff~~, and writes Smile, as in the *Margin*. Smile,

If a *Word* or *Words*, or *Letter* or *Point* be *Left out*, he makes this mark ‸, where it is *Left out*, for a mark of Insertion, and Writes in the *Margin* what must come in.

If a *Space* be *Left out*, he makes the former mark of Insertion 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 Sentence *Left out* be not very long, he Writes it under the *Page*, or on the Left Hand *Margin* of the *Page*: But if it be too large to be Writ in the *Margin*, or under the *Page*, he Writes in the *Margin*, See the Copy. (Out) (See the Copy)

If a Word or Sentence be *Set* twice, as Him Him, he marks out one Him thus ~~Him~~, and makes this mark ꝺ in the *Margin*, for *Dele*, to take out. ꝺ|

If a *Letter* be turned thus ʁ, he dashes it out as you see, and makes this mark in the *Margin*. ɹ|

If Words are *Transposed*, that is, if one Word stand in another Words place, as, no I love Swearing, and it should be, I love no Swearing; he marks this *Fault* thus, no I love Swearing, and makes this mark ꞩ in the *Margin*. The like mark he makes in *Matter* and *Margin* if two *Letters* are *Transpos'd*.

If a *Space* or an m or n *Quadrate*, &c. stick up and *Print 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 the *Margin*. Ital | Eng |

In like manner, if a single *Letter* or more *Letters* be *Set* in *Roman Letter*, and it should be *Italick* or *English Letter*; or if in *English* or *Italick*, and it should be *Roman Letter*, he dashes the *Letter* or *Letters* thus underneath, and writes *Ital. Rom.* or *Eng.* in the *Margin*: Or if *Lower Case Letters* be *Set* instead of *Capitals*, he dashes them underneath, and Writes *Capt.* in the *Margin*. Ital | Rom | Eng Capt |

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

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.

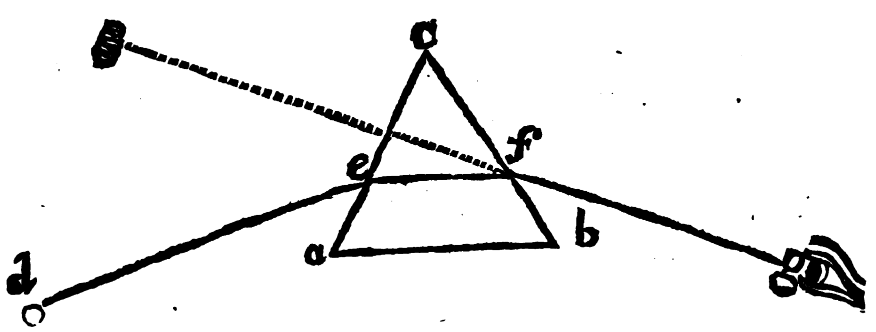
After the Second or Third *Proof* he has a *Revise* which is also a *Proof-sheet*: He examines in this *Revise Fault* by *Fault*, if all the *Faults* he markt in the last *Proof* were carefully mended by the *Compositor*; if not, he marks them in the *Revise*.

PRINTS. The Original of *Prints* or *Cutts*, as we sometimes call them, was this; in the Year 1460, one *Maso Finiguerra*, a Goldsmith of *Florence*, graved his Plate; and then casting some of it in melted Brimstone, he perceived, that what came out of the Mold was markt with the same Prints as his Plate, by the Black which the Sulphur had taken from the Graving: after this he tried to do as much on Silver Plates with wet paper, by rolling it smoothly with a Roller, and this succeeded. This Novelty tempted *Baccio Baldini*, a Goldsmith of the same City, to attempt the same thing, which he did with Success; ingraving several Plates of *Sandro Boticello's* Invention and Design; and upon this *Andrew Mantegna*, who was then at *Rome*, set about engraving some of his own Pieces. This knowledge getting into *Flanders*, *Martin* of *Antwerp*, a famous Painter, graved abundance of Plates of his own Invention, and sent several Prints into *Italy*, which were markt thus *M. C.* After him the Famous *Albert Durer* appear'd and gave the world a vast number of Prints, both in wood, and copper. About this time one *Hugo de Carpi*, an *Italian* Painter of no great Capacity, but of a ready Invention, found out a way, by means of several Plates of wood, 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*.

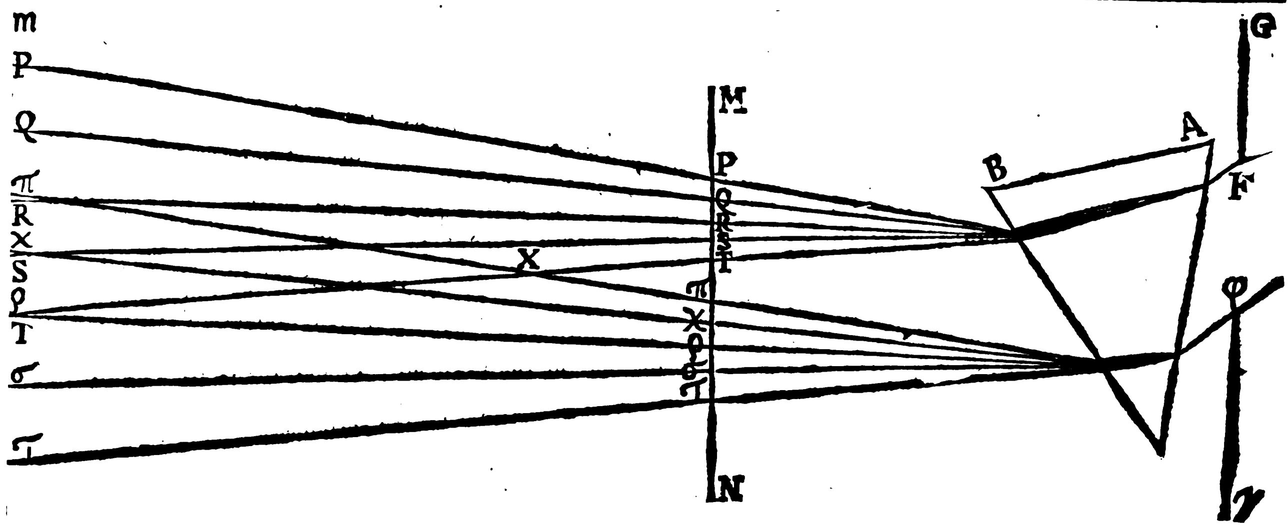
PRISAGE, is the Custom or Share that belongs to the Queen, out of such Merchandice as is taken at Sea by way of lawful Prize.

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 *Colours* you have a great variety of Experiments made with such Glasses, by the Incomparable Sir *If. Newton*; and from whence, in a good measure, he hath established his Demonstrative Theory of Light and Colours; a large account of which you may find in his *Opticks*.

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 made by a Plane passing transversely to three parallel Lines or Edges, then when the Light passeth thro' it; and let *d e* be the Ray incident on the first side of the Prism *a c*, where the Light goes into the Glass: Then by putting the Line of Incidence to the Line of Refraction as 17 to 11: Find (by the Direction given under the word *Incidence* in this Volume) *e f* the first refracted Ray; then taking this Ray for the *Incident Ray* on the second side of the Glass *b c*, where the Light goes out, find the next refracted Ray *f g*; by putting the *Ratio* of the Line of Incidence to the Line of Refraction as 11 to 17; for if the Line of Incidence out of Air into Glass be to that of Refraction as 17 to 11, the Line of Incidence back again, out of Glass into Air, must be as 11 to 17.



The same admirable Author, *Opticks*, *p.* 121, shews, how by the Properties of Light discovered by his most accurate Experiments, to explain the *Phænomena* of Colours made by Prisms; thus,



Let *a b c* be a Prism refracting the Sun's Light, brought into a darkned Room, by the Hole F φ, almost as broad as the Prism; and let *m n* be a White Paper on which the refracted Light is cast: And suppose the most refrangible or deepest Violet Rays to fall on the Space P π, the least refrangible or deepest Red Ray on the Space T τ; the middle sort, between the Indico and Blue Rays, on the Space Q χ; the middle sort of the Green Rays on the Space R ρ; the middle sort between the Yellow and Orange Rays on the Space S σ; and the other intermediate sorts 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 *m n* be so near the Prism that the Spaces *P t* and $\pi\tau$ do not interfere with one another, the distance between them T π will be illuminated by all the sorts of Rays in that Proportion to one another which they have at their very first coming out of the Prism, and consequently, will be White. But the Spaces *P T* and $\pi\tau$ 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 Rays are mix'd, their Colours must (by the Constitution of *Problem* 2. in *pag.* 114) compound a middle Colour between Indico and Blue. At *S*, where all the Rays are mix'd, the Red and Orange, thin 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 side 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 ρ, the Mixture of Red, Orange, Yellow, and one half of the Green, must compound a middle Colour between Yellow and Orange. At χ, 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 and dilute continually, in its progress from χ to π, where it will become White by a mixture of all sorts of Rays.

These Colours ought to appear were the Sun's Light perfectly 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 *T* ought 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 Prism 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 χ 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 consequence, 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 White one, spreading into the Regions of the Black; and therefore they will appear in a contrary order. And 'tis 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 excess of the Light of the more luminous, and to be of the same kind as if the darker parts were Black, but yet to be more faint and dilute.

And what is thus said 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 uncovered may be considered, as a kind of *Cuneus* with

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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.

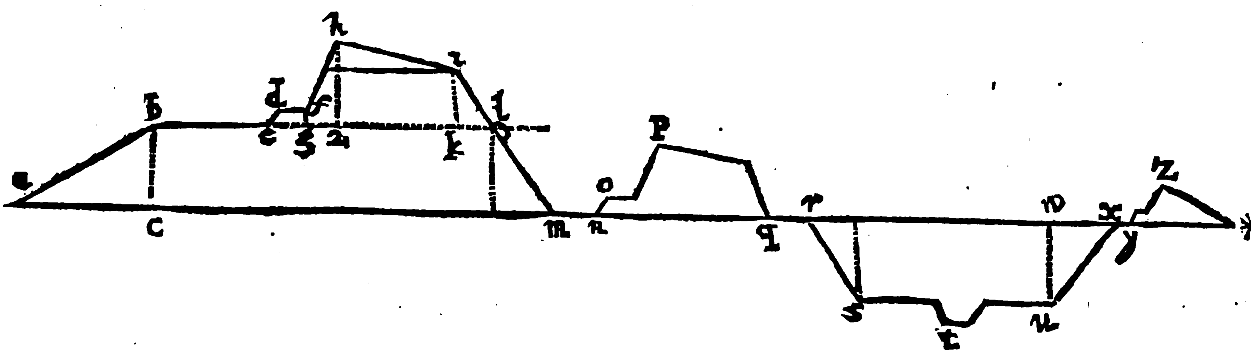
PROCURATIONS, are a Pecuniary Sum or Composition paid by the Parish Priest to an Ordinary or some other Ecclesiastical Judge, as an Archdeacon, &c. to commute for the Provision or Entertainment which was otherwise to have been procured for him; which Entertainment was called *a Procuration*.

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 Instrument impowering him to do it. In the West of *England*, such Persons are called *Proctors* to 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 Representation 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*, *Faussebray*, *Foss*, *Covert-way* and *Esplenade*.



a b l m is the Solidity of the Rampart, *a m* its Base; *b l* its Top; *b c* its perpendicular Height; *a b* its inward *Talus* or Slope; *l m* its outward *Talus* or Slope; *b e* is the *Terre-plain*; *e l* is the Base of the *Parapet*, *e d* its *Banquet*; *f b* is the inward *Talus* of the Parapet, *i l* the outward one, *h i* its upper one; *h* 2 is the inward Height of the Parapet, *i k* the outward Height; *l* the *Cordon*; *n o p q* represents a Faussebray with its Banquet, &c. *q r* is its *Liziere* or *Berm*; *r s t u x* is the Foss or Ditch; *r s* the *Scarp*; *u y* the Counterscarp; *t* the Lunette; *w u* the Depth of the Ditch; *x y* the Covert-way; *x z* * the Parapet and Glacis of the Covert-way; *y z* the Height of the Barnquet and Parapet of the Covert-way; *x* * the Basis of the Glacis; *z* * the Slope of the *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 constant 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 called by this Name *Profre Vicecomitis*. But altho' these *Profers* 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 indeed he could receive, he hath his *Profers* paid or allowed to him again.

PROJECTIVE *Dialling*, is the way of Drawing, by a method of Projection, the true Hour-Lines, Furniture of Dials, &c. on any *kind of Surface* whatsoever, 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 from the middle Point in the Arch, to the Diameter; 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 *Dialling*, *p*. 198. But there is no difficulty in understanding the use of it at all; and a Quadrant, divided on both sides, 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 Depression, 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 if you hold the Edge of the Ruler to the fix'd Point, and also apply the Point of the Edge of the 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 degr. of Altitude or Depression intended; for then the

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the Ruler lies at the Altitude or Depth, and so projects it from the fix'd Point into a Line, as was designed.

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 fastned in such wise, that it no way hinder either the draught of the Horizontal Line, or the Point of the Shadow from having free access 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 self, and also to the Point of the Gnomon, through the whole Superficies on which the Dial is to be described. 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 if 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 so that it will not at all, or not so well, receive an Horizontal Line upon it, you may *Either* set up some Board, or such like Object, upon which for a time 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 not 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 signed out by slipping 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 Azimuth 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 sight (as it hangeth down) the Points of the Gnomon and Shadow both together; and at the same view cutting 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; so, as that it may be staid, either upon the Horizontal Line (where it may so be conveniently) or at least so 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 Gnomon be signed, which may be called the Center; and from this Center to the Sign of the Azimuth before projected into the Horizontal Line, draw a right Line: this right Line so drawn, shall represent 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 before 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 Past-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 Past-board 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 first. 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 slipping Knots upon the Thred, where a Thred Horizontal Line is used) especially mark out the Hour of 12: For which (if it chance to run besides 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 conjecture 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 aslope 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 12 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 those Hours that were inserted before into the Horizontal

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rizontal Line, the Axis upon an Hour Point, or a 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 designed 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 assigned upon any Superficies Flat or Curved, one, or more, wherein the Hour-Lines and Axis shall concur, how to project the Hours to 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 assigned (upon any side of it) by direction of your Semicircle or other Level, stretch 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 assigned 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 represenred by the knot.

4. Apply a Past-board to the Assigned Point, and hold it flat that it may answer to the Horizontal Thred also, and upon this Past-board, protract your Azimuth by a Thred extended from the Point assigned for the Center, to the mark upon the Horizontal Thred. This done,

5. By help of that Azimuth upon your Past-board, protract the Meridian Line, observing the true Coast, and quantity of the Angle from the Azimuth: 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 Past-board, and set marks upon the same for the Points of each several Hour, which marks may be little 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 (as it shall be required) from the Point assigned for the Center, according to your Latitude project the Pole of the World.

9. Extend a Thred from the Point assigned for the Center to the Poles of the World, which shall represent the Axis.

10. 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 situation, you may easily fit an Axis to the same posture. If your Dial be described upon a plain Superficies, you may then (by one side of a Nominal Square, applied to a Thred or Axis, and the other side lying upon the Plain) find out the substyle, and measure from it the elevation of the Axis above the Plain: But if the Dial be described upon a curved Superficies, you must be content to set up your Axis by the direction of the Thred only.

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 a 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 case, set 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 pass, 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 noting 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 project to an Apex.

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 $\frac{1}{4}$ of an Inch in Diameter, being put in the room of a Pane of Glass) for the Sun shining thro' that Hole,

will

will cast a bright Spot of Light into the Room. Suppose then such a Hose to be the *Nodus*, or Point of the Top of the Perpendicular Style of any Dial, you may draw one or *more* Dials, (each side or part of the Room being a different Plane) after this manner.

(1.) Apply an Horizontal Dial in a true Horizontal Position, so that its Centre lie in that of the Hole in the Pane; and then by a Thred fixed at one end of the Centre of the Dial, and laid over successively, every Hour, Half Hour, Quarter, &c. find corresponding Points in the Sides of the Room where those Hour-Lines intersect them: Then (2.) The Twelve a Clock Line being an Azimuth also as well as an Hour Line, you may by a String and Plummet brought just to touch that Thred when strained over the 12 a Clock Hour Line, transfer that *Meridian Line* up to the Ceiling or down on the Floor, as you shall find occasion. (3.) Next in this *Meridian Line* find another Point, (by help of a Thred elevation to a proper Height (in degrees) by means of a Quadrant) from which, a Line or Thred extended to the Hole in the Window may represent either the *Direct* (or *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 side of the other Thred, as it is brought successively 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 say, 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 direct us into this excellent Mechanick way of *Dialling* or drawing *Hour Lines* on any Plane how irregular 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 horizontally, a Scaffold or Frame of Boards, greater or lesser, according to the designed Bigness of the Dial. Next, by some good Dial, Clock, Equinoctial 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 shining, 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 easily project them all into your Plane or Place designed 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 Revolution of a Semi-Ellipsis about its *shorter* Diameter; 'tis then called an *Oblate Spheroid:* And of this 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 Numbers or Logarithms placed on Lines, for the ease and advantage of Multiplying, Dividing, Extracting Roots, &c. by the means of *Compasses*, or by *Sliding Rules*; and they are only so many *Lines of Numbers*, as they are called by Mr. *Gunter*. (See *Gunter's Line*.) But make *Single*, *Double*, *Triple*, or *Quadruple*; beyond which they seldom go.

PROSTYLE, in the ancient Greek Architecture, was a Rank or Row of 4 Columns only, and whose Station was in the Front of a Temple, or other great Building.

PROVINCE, was used among the *Romans* for a Country without the Limits of *Italy*, and gained to their Subjection by the Sword. But with us the word is most commonly used for the Circuit of an Archbishop's Juridiction; and in some of our Statutes 'tis used for a County.

PROVISION, in the Canon Law, is used for the providing of a Bishop or any other Person, an Ecclesiastical Living. by the Pope, before the Incumbent be dead. 'Tis called also *Gratia Expectativa*, and *Mandatum de Providendo*.

PROVISIONS: The Acts to restrain the exorbitant abuse of Arbitrary Power, made in the Parliament 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 *Provision*; which see.

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 Sentence pass'd upon them. He likewise regulates the Weights and Measures, and the Price of all Provisions, &c. in the Army. There is also a

PROVOST *Marshal* in the Royal Navy, who hath charge of the Prisoners taken at Sea. 13 *Car.* 2. *c.* 9.

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 Advantage, so as to render himself happy here and hereafter.

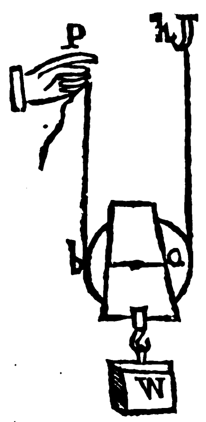
PRYAN *Tin*, is a sort of Tin that is found mix'd with a Gravelly Earth, sometimes White, but usually Red; 'tis not half so good as the other which is made out of Stone.

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*: above whom moves the Sun, then *Mars*; above him *Jupiter*, and last of all *Saturn*, all in the Zodiack from West to East. Above *Saturn* he places the Sphere of the fix'd Stars, which he supposes to move slowly 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 *Epicycles* and *Deferents*, &c. with which they endeavoured to solve the *Phænomena* which did almost moft all of them contradict this Scheme) was plainly overturned and refuted as foon as ever the ufe of the Telefcope acquainted us with the *Phases* 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 difufed, and confequently I fhall fay no more of it.

PULLET, in a Ship, is a little Room within her Hold, in which the Piggs of Lead, or fuch like weighty things are put, that the Ship may be well ballafted in a little Room.

PULLEY, is a compounded Mechanick Power, confifting of one or more *Shivers* or *Rundles* with proper Blocks, &c. to raife up any Weight, &c. and this Inftrument fo fitted is called *Trochlea* or the *Pulley*; and at Sea with Ropes, &c. fitted fo to it, it is called *a Tackle*.

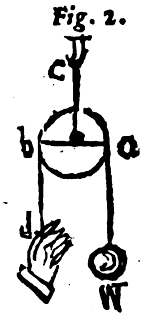
Fig. 1.



In every Pulley, from the Pofition and Number of the Shivers, you may know how much the Weight *W* is diminifhed, by making the *V.s 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 muft obferve, 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 fuftain it that fhall be fully equal to the Weight.

Fig. 2.



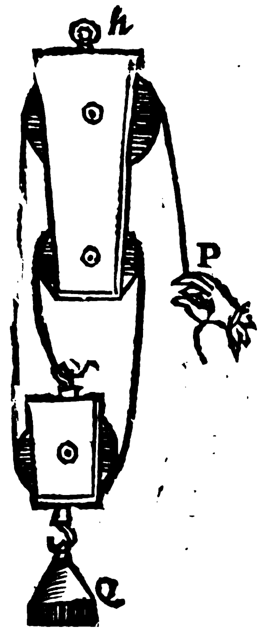
Thus if a Weight hang as in the Pofition *a W*, it would certainly fall, if a Force or Power equal to it did not hold the Rope *b d*.

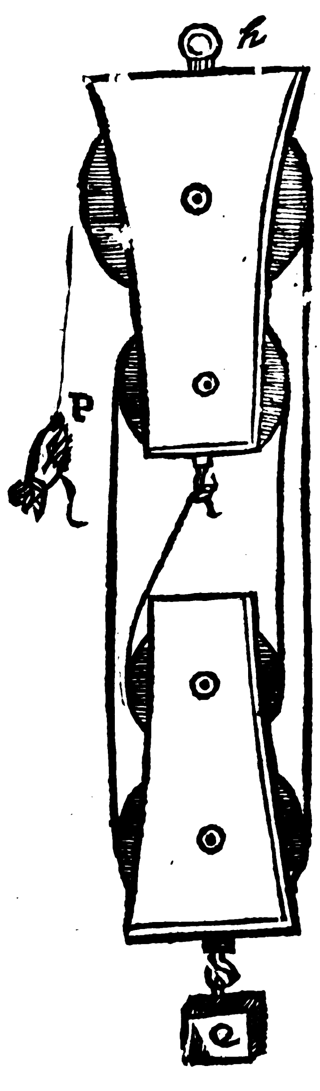
And all upper *Shivers* being every where of the fame Nature, none of them can conduce any thing towards eafing the Power or lightening the Weight; but they only ferve for the Convenience of the Motion.

But if you fuppofe the Weight *W* (as in *Fig.* 1.) to be fuftained by the Hook *h*, above the Block *a b*, then 'tis plain that the Hook *h* will fuftain juft 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*, whofe equal Arms were upheld by two feveral Strings, as *h a* and *P b*.

'Tis alfo apparent in *Fig.* 1. That in order to raife the Weight *W*, the Height of one Foot, each part of the Rope, *viz.* *h a* and *P p*; (accounting downwards from the Hook *b*) muft be made a Foot fhorter, *i. e.* the Power muft move two Feet, in order to raife the Weight but one: Wherefore in this Engine, the way of the Power is double to that of the Weight; and therefore their Celerities will alfo be in the fame Ratio; wherefore if the Power be to the Weight as 1 : to 2, its *Moment* will be equal to *that* of the Weight, and fo will fuftain the Weight.

If the Weight be fuftained by 3 turns of the Rope, and be made to afcend one Foot (as in *Fig.* 3.) then each Part, or Turn, or Fall of the Rope muft be fhortened 1 Foot (reckoning as before from the Hook at *h*) and this cannot be done unlefs the Power in *P* move three Feet: Here therefore the way of the Power is *triple* to that of the Weight, as is alfo its Celerity; wherefore if the Power be to the Weight as 1 to 3, or one third of it, it will fuftain the Weight.





And fo on in the 4th *Fig.* the Power *P* muft be one fourth of the Weight, &c.

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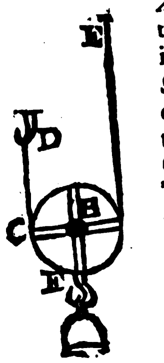
The *Pully* is a Wheel not only turning round its *Axis*, but made so, that at the same time 'tis *drawn up* by a Rope or Cord that goes round it: This may be considered as a perpetual *Homodromous* Lever or *Vectis*; for the Cord which is put over the Wheel *A F C* being fastned at one End at *D*, and the other End at *E* being drawn or held by some Power, so that the Weight suspended from the middle of the Wheel *A F C*, be kept *in Æquilibrio*; 'tis 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 *D C* 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 *B C*, 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 sustaining it in *E*; and consequently one under-Pulley takes off always half the Weight, or raises double the Weight with the same Power or Force.



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 equidistant 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 together, you need only *double the 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 50*lb.* in a Pulley with two lower Shivers will raise four times as much, *viz.* 200 *lb.*

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 Combinations.

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 these 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 Cask. *Bur-Pumps*, are used by the *Dutch*, who have them by their Ships sides. In these there is a long Staff with a Bur at the end like a Gunner's Spunge, to pump up the *Bildge-water*: These 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 Punchins*.

PUNCTATED *Hyperbola*, is an Hyperbola whose Oval Conjugate is infinitely small, that is, a *Point*. 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 Ellipsis, and under that and the Distance between the Vertex and Focus in the Hyperbola, are equal to $\frac{1}{4}$ 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 part 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 receiv'd 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 *Intestines*; 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 easily 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 fluid by the same active and stimulating Quality of the Purgative Medicine) renders it more fluid; by which, and by

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by the uncommon Contractions of the Inteftines, it paffes more eafily and plentifully into the *Rectum Inteftinum*, and is thence ejected by Stool. Thus gentle and eafie Purges act, and do only cleanfe the Inteftines, few of their Particles entring in by the Lacteal Veins and fo affecting the Blood: But in violent Purgatives, the ftimulating Particles are mixed with the Blood, and produce there many times very great effects by occafioning unnatural Fermentations, by feparating the natural Cohe fions of the Liquors of the Body; and alfo by vellicating the Spiral Fibres of the Veins and Arteries, bring thofe into more forcible Contractions, and thereby accelerate the Motion of the Blood; all which may fometimes have a good and fometimes a bad effect.

PURLINS, in Architecture, are thofe Pieces of Timber which lie acrofs the Rafters on the Infide, to keep them from finking in the middle of their Length.

PURPARS, *a Purparty*, is that part or fhare of an Eftate, which being held in Common by Copartners, is by Partition allotted to any one of them.

PUTLOGS, are fhort pieces of Timber (about 7 Foot long) ufed in Building Scaffolds; they lie at Right-Angles to the Wall with one of their Ends refting upon the *Ledgers* or Poles which lie parallel to the fide of the Wall of the Building.

PYRAMIDALES *Papillæ*. See *Papillæ Pyramidales*.

PYRAMIDOID, is what is fometimes called a *Parabolick Spindle*; and is a folid Figure formed by the Revolution of a *Parabola* round its *Bafe* or *greateft Ordinate*; and if you confider it according to the method of Indivifibles, you may conceive its Solidity to confift of an infinite feries of Circles whofe Diameters are all parallel to the *Axis* of the *Revolving Parabola*.

PYTHAGORICK *Tetractys*, was a Point, a Line, a Surface, and a Solid.

QUADRAGATA *Terræ*; a *Team* of Land: or which may be tilled with 4 Horfes.

QUADRAGESIMA, is the firft *Sunday* in *Lent*, and fo called, becaufe 'tis about the fortieth Day before *Eafter*; and on the fame account the three preceding *Sundays* are called *Quinquagefima*, *Sexagefima*, and *Septuagefima*.

QUADRAGESIMALS: In Popifh Times 'twas the Cuftom for People to vifit their *Mother Church* on *Midlent Sunday*, and to make their Offerings at the High Altar. And the like kind of Superftitious Devotion was alfo ufed in *Whitfon week*: But as the Proceffions and Oblations at *Whitfontide* were fometimes commuted for a rated Payment of *Pentecoftals* or *Whitfon Farthings*; fo thefe were changed into a Cuftomary Payment, and were called *Quadragefimals*; *Denarii Quadragefimales*; and fometimes *Lætare Jerufalem*, becaufe that Hymn was fung on *Midlent Sunday*. The Cuftom of *Mothering*, as 'tis called in many places in *England*, is ftill retained, being that of vifiting Parents on *Midlent Sunday*; and it feems to be called *Mothering* from the Refpect thus in old Time paid to the *Mother Church*. And the Epiftle of *Gal.* 4. 21. is ftill retained on *Midlent Sunday*, which began *Jerufalem mater omnium*, &c. tho' the occafion of it is forgotten.

QUADRANS, the fourth part of a Penny, or a Farthing; for before the Reign of *Edw.* I. our fmalleft Coin was a Penny, called then *Sterling*; and it was ftamp'd with a Crofs or Traverfe Stroke, fo that it might on occafion be cut eafily or broken into Halves or Quarters: But to avoid the Fraud of unequal divifion of the Penny, this King *Edw.* I. coined Half-pence and Farthings in round diftinct Pieces. *Matt. Weft. in Anno* 1279.

QUADRANT *of Davis*. See *Backftaff*.

QUADRANTATA *Terræ*, the fourth part of an Acre.

QUADRAT: To Quadrat a Piece of Ordnance, is to fee whether it is duly placed in its Carriage, and that the Wheels be of an equal Height.

QUADRATRIX of the *Hyperbola*: There is a new Curve lately invented by Mr. *J. Perks* of *Great Swinford* in *Worcefter fhire*, for the Quadrature of the Hyperbola; of which fee an Account in *Phil. Tranf. N.* 306.

QUADRATURE *Lines*, or *Lines of Quadrature*; are two Lines placed ufually, or at leaft fometimes, 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 ftands for the Semi-diameter of a Circle, and 90 for a Line equal to 90 Degr. in the Circumference.

Their Ufes are readily (tho' not exactly) Thefe:

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 Diftance~~ 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*, fo will the Parallel Diftance 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 Diftances between the Points of any of the other Polygons, fhall be the Sides of thofe Regular Figures.

QUADRATURE *of Curves*, by Sir *If. Newton*.

I don't here confider Mathematical Quantities as compofed of Parts *extreamly fmall*, but as *generated* by

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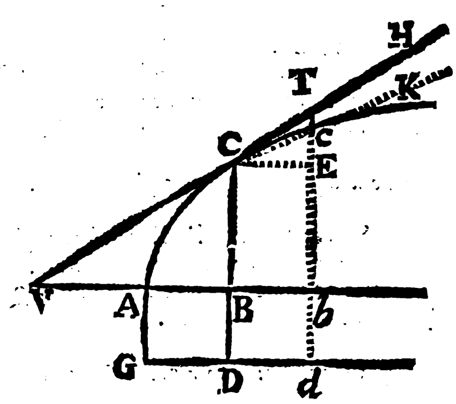
by a continual motion. Lines are described, and by describing are generated, not by any apposition of Parts, but by a continual motion of Points. Surfaces are generated by the motion of Lines, Solids by the motion of Surfaces, Angles by the Rotation of their Legs, Time by a continual flux, and so in the rest. These *Geneses* are founded upon Nature, and are every Day seen in the motion of Bodies.

And after this manner the Ancients by carrying moveable right Lines along immoveable ones in a Normal Position or Situation, have taught us the Geneses of Rectangles.

Therefore considering that Quantities, encreasing, in equal times, and generated by this encreasing, are greater or less, according as their Velocity by which they encreafe, 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 *Fluxions*, and the generated Quantities *Fluents*, I (in the Year 1665 and 1666) did, by degrees, light upon the Method of *Fluxions*, 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 nascent 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.



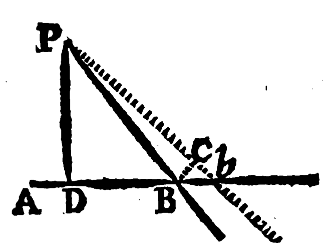
Let the Ordinate BC move out of its place BC into any new one bc: Compleat the Parallelogram $BCEb$, and let the right Line VTH be drawn which may touch the Curve C and meet bc and BA produced in T and V; and then the just now generated Augments of the Absciffa AB, the Ordinate BC, and the Curve Line 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 the Right Line Cc, and produce the same to K. Let the Ordinate bc return into its former place BC, and the Points C and c coming together, the Right Line CK co-incides with the Tangent CH, and the Evanescent Triangle CEc in its ultimate form becomes similar to the Triangle CET, and its Evanescent Sides CE, Ec and Cc will be ultimately to one another as are CE, ET and CT 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. As 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 Absciffa AB, and at Right Angles to it, the Fluxion of the generated Solid ABC will be as the generating 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 Absciffa AB, in the same time its Surface is generated by drawing the Perimeter of that Circle along the Curve AC.

Of this Method take the following Examples.

Let the Right Line P B *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.*

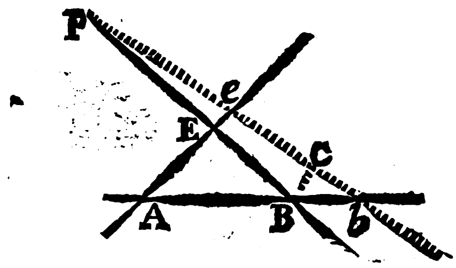


Let the Right Line PB go out of its place PB into a new one Pb: In the Line Pb take PC equal to PB, and draw PD to AB so that the Angle bPD may be equal to the Angle bPC; and then from the Similarity of the Triangles bBC, bPD, the Augment Bb, will be to the Augment Cb as Pb is to Db.

Now let Pb return into its former place PB, 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 P B *revolving about the given* P *Pole cut* A B *and* A E *two other Right Lines given in Position in* B *and* E; *'tis required to find the Proportion of the Fluxions of those Right Lines* A B *and* A E.

Let



Let the revolving Line PB 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 into its former place PB, and the Evanescent Augment Bb will be to the Evanescent Augment Ee 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 AE.

Hence if the revolving Right Line PB cut any Curve Lines given in position 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 AE touches, as $AB \times PB$ is to $AE \times PE$. The same thing will happen if the Right Line PB always touch any Curve given in Position in the moveable Point P.

Let the Quantity x flow 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 will become $\overline{x+o}|^n$, that is, by the Method of Infinite Series's $x^n + nox^{n-1} + \frac{nn-n}{2}oox^{n-2} +$, &c. and the Augments o and $nox^{n-1} + \frac{nn-n}{2}oox^{n-2} +$, &c. are to one another as 1 and $nx^{n-1} + \frac{nn-n}{2}oox^{n-2} +$, &c. Now let those Augments vanish, and their ultimate Ratio will be the Ratio of 1 to nx^{n-1}; and therefore the Fluxion of the Quantity x is to the Fluxion of the Quantity x^n as 1 to nx^{n-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 Solution 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 represent 'em by the Letters z, y, x, v, and I mark their Fluxions or their Celerities by which they encrease by the same Letters with Points over 'em thus, $\dot{z}, \dot{y}, \dot{x}, \dot{v}$. 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, $\ddot{z}, \ddot{y}, \ddot{x}, \ddot{v}$; and the *First Fluxions* of these, or the *Third Fluxions* of z, y, x, v, thus, $\dddot{z}, \dddot{y}, \dddot{x}, \dddot{v}$; the *Fourth* thus $\ddddot{z}, \ddddot{y}, \ddddot{x}, \ddddot{v}$, &c. And as $\dddot{z}, \dddot{y}, \dddot{x}, \dddot{v}$, are Fluxions of the Quantities $\ddot{z}, \ddot{y}, \ddot{x}, \ddot{v}$, and these are Fluxions of the Quantities $\dot{z}, \dot{y}, \dot{x}, \dot{v}$, and these Fluxions of the Quantities, z, y, x, v: 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'', y'', x'', v'', and these as Fluxions of others z''', y''', x''', v'''. Wherefore z''', z'', z', z, $\dot{z}$, $\ddot{z}$, $\dddot{z}$, $\ddddot{z}$, &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 Series $\overline{\sqrt{az-zz}}''$, $\overline{\sqrt{az-zz}}'$, $\sqrt{az-zz}$, $\dot{\overline{\sqrt{az-zz}}}$, $\ddot{\overline{\sqrt{az-zz}}}$, $\dddot{\overline{\sqrt{az-zz}}}$; as also this Series,

$$\frac{az+z^2}{a-z}'', \quad \frac{az+z^2}{a-z}', \quad \frac{az+zz}{a-z}, \quad \dot{\frac{az+z^2}{a-z}}, \quad \ddot{\frac{az+z^2}{a-z}}, \quad \dddot{\frac{az+zz}{a-z}}.$$

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 $\overline{\sqrt{az-zz}}'$ is the Area of a Curve whose Ordinate Applicate is $\sqrt{az-zz}$ and the Abscissa z.

The design 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 propofed containing the fluid or flowing Quantities z, y, x, &c. as $x^3 - xyy + aaz - b^3 = 0$. Firft let the Terms be multiply'd by the Indexes of the Powers of x, and in each Multiplication, inftead of the Root or Side of the Power, or inftead of x of one dimenfion only, write $\dot{x}$, and the Summ of the Products will be $3\dot{x}x^2 - \dot{x}yy$. Let the fame be done by y, and you will have $-2xy\dot{y}$: Do the fame by z, and there will be produced $aa\dot{z}$. Let the Summ of the Products be put equal to 0 and you will have the Equation $3\dot{x}x^2 - \dot{x}yy - 2xy\dot{y} + aa\dot{z} = 0$; I fay that in this Equation the Relation of the Fluxions is determined.

Demonftration.

For let 0 be a Quantity extreamly fmall, and let $0\dot{z}$, $0\dot{y}$, $0\dot{x}$, be the Moments of the Quantities z, y, x; that is, the momentaneous fynchronal Increments. And if the flowing Quantities are now z, y, and x, thefe after a moment of time being augmented by their Increments $0\dot{z}$, $0\dot{y}$, $0\dot{x}$, will become $z + 0\dot{z}$, $y + 0\dot{y}$, $x + 0\dot{x}$, which being fubftituted in the firft Equation inftead of z, y, and x, give this Equation, $x^3 + 3xx0\dot{x} + 3x00\dot{x}\dot{x} + 0^3\dot{x}^3 - xyy - 0\dot{x}yy - 2x0\dot{y}y - 2\dot{x}00\dot{y}y - x00\dot{y}\dot{y} - \dot{x}0^3\dot{y}\dot{y} + aaz + aa0\dot{z} - b^3 = 0$. Subduct the former Equation from it and the Refidual divided by 0 will be $3\dot{x}x^2 + 3\dot{x}\dot{x}0x + \dot{x}^3 00 - \dot{x}yy - 2x\dot{y}y - 2\dot{x}0\dot{y}y - x0\dot{y}\dot{y} - \dot{x}00\dot{y}\dot{y} + aa\dot{z} = 0$. Let the Quantity 0 be leffened infinitely, and neglecting the Evanefcent Terms, there will remain $3\dot{x}x^2 - \dot{x}yy - 2\dot{x}yy + aa\dot{z} = 0$. Q. E. D.

A more full Explication of the fame thing.

After the fame manner, if the Equation were $x^3 - xyy + aa\sqrt{ax - yy} - b^3 = 0$, there would be produced $3x^2\dot{x} - \dot{x}yy - 2xy\dot{y} + aa\,\dot{\sqrt{ax - yy}} = 0$; where, if you wou'd take away the Fluxion $\dot{\sqrt{ax - yy}}$, put $\sqrt{ax - yy} = z$, and then will $ax - yy = z^2$, and (by this Propofition) $a\dot{x} - 2\dot{y}y = 2z\dot{z}$ or $\frac{a\dot{x} - 2\dot{y}y}{2z} = \dot{z}$, that is, $\frac{a\dot{x} - 2\dot{y}y}{2\sqrt{ax - yy}} = \dot{\sqrt{ax - yy}}$:

And thence $3x^2\dot{x} - \dot{x}yy - 2x\dot{y}y + \frac{a^3\dot{x} - 2aa\dot{y}y}{2\sqrt{ax - yy}} = 0$.

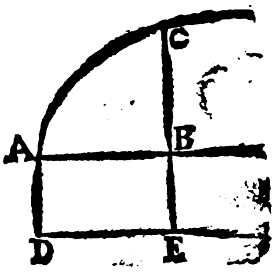
And by the fame Operation, you may proceed to Second Fluxions, Third Fluxions, and fo on: Let the Equation $zy^3 - z^4 + a^4$ be $= 0$, then it will be made by the firft Operation, $\dot{z}y^3 + 3z\dot{y}y^2 - 4\dot{z}z^3 = 0$, by the Second Operatation $\ddot{z}y^3 + 6\dot{z}\dot{y}y^2 + 3z\ddot{y}y^2 + 6z\dot{y}^2y - 4\ddot{z}z^3 - 12\dot{z}^2z^2 = 0$; and by the Third, $\dddot{z}y^3 + 9\ddot{z}\dot{y}y^2 + 9\dot{z}\ddot{y}y^2 + 18\dot{z}\dot{y}^2y + 3z\dddot{y}y^2 + 18z\dot{y}\ddot{y}y + 6z\dot{y}^3 - 4\dddot{z}z^3 - 36\ddot{z}\dot{z}z^2 - 24\dot{z}^3z = 0$.

But when we thus proceed to Second and Third Fluxions, &c. it is convenient to confider fome Quantity as flowing uniformly; and for its firft Fluxion to write 1; but for the fecond and following ones 0. Let the Equation be $zy^3 - z^4 + a^4 = 0$, as above; and let z flow uniformly, and let its Fluxion be Unity; and then by the firft Operation it will become $y^3 + 3z\dot{y}y^2 - 4z^3 = 0$, by the Second $6\dot{y}y^2 + 3z\ddot{y}y^2 + 6z\dot{y}^2y - 12z^2 = 0$, by the Third $9\ddot{y}y^2 + 18\dot{y}^2y + 3z\dddot{y}y^2 + 18z\ddot{y}\dot{y}y + 6z\dot{y}^3 - 24z = 0$.

But in Equations of this kind we muft conceive, that the Fluxions in each of the Terms are of the fame Order, that is, that they are all either of the firft Order $\dot{y}$, $\dot{z}$, or all of the Second $\ddot{y}$, $\dot{y}^2$, $\dot{y}\dot{z}$, $\dot{z}^2$, or all of the Third, $\dddot{y}$, $\ddot{y}\dot{y}$, $\ddot{y}\dot{z}$, $\dot{y}^3$, $\dot{y}^2\dot{z}$, $\dot{y}\dot{z}^2$, $\dot{z}^3$, &c. And when the thing happens otherwife, the Order is to be compleated by the fuppofed Fluxions of a Quantity flowing uniformly; and then the laft Equation, by compleating the third Order, becomes $9\dot{z}\ddot{y}y^2 + 18\dot{z}\dot{y}^2y + 3z\dddot{y}y^2 + 18z\ddot{y}\dot{y}y + 6\dot{z}\dot{y}^3 - 24z\dot{z}^3 = 0$.

Prop. 2. Prob. 2.

To find the Curves that are Quadrable.



Let ABC be the Figure, whofe Area is to be found; BC an Ordinate apply'd at Right Angles, and AB the Abfciffa. Produce CB to E that BE may be $= 1$, 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 *Propofition* 1.) Q. E. D.

We fhall give Examples of this thing in the two following *Propofitions.*

Prop. 3. Theor. 1.

If z be ufed promifcuoufly for the Abfciffa AB and the Area AE or $AB \times 1$; and R be put for $E + fz^n + gz^{2n} + hz^{3n} +$, &c. Let the Area of the Curve be $z^\theta R^\lambda$, and the Ordinate Applicate BC will be $= \theta E \begin{smallmatrix}+\theta \\ +\lambda n\end{smallmatrix} fz^n \begin{smallmatrix}+\theta \\ +2\lambda n\end{smallmatrix} gz^{2n} \begin{smallmatrix}+\theta \\ +3\lambda n\end{smallmatrix} hz^{3n} +$ &c. into $z^{\theta - 1} R^{\lambda - 1}$.

Demonftration.

For if $z^\theta R^\lambda = v$, then by the firft *Prop.* will $\theta\dot{z}z^{\theta - 1} R^\lambda + \lambda z^\theta \dot{R} R^{\lambda - 1} = \dot{v}$. Inftead of R^λ in the firft term of the Equation, and z^θ in the fecond, write $RR^{\lambda - 1}$ and $zz^{\theta - 1}$, and then the Equation will become $\theta\dot{z}R + \lambda z\dot{R}$ into $z^{\theta - 1} R^{\lambda - 1} = \dot{v}$. But R was taken equal to $E + fz^n + gz^{2n} + hz^{3n}$, &c. and confequently (by *Prop.* 1.) $\dot{R} = nf\dot{z}z^{n-1} + 2ng\dot{z}z^{2n-1} + 3nh\dot{z}z^{3n-1} +$, &c. which being fubftituted in their ftead, and BE or 1 placed in the room of $\dot{z}$;

Then

then will $\theta : \begin{smallmatrix}+\theta\\+\lambda n\end{smallmatrix} + fz^{n} \begin{smallmatrix}+\theta\\+2\lambda n\end{smallmatrix} gz^{2n} \begin{smallmatrix}+\theta\\+3\lambda n\end{smallmatrix} hz^{3n} +$ &c. into $z^{\theta-1} R^{\lambda-1}$ be $= v = BC$. 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 $z^{\theta} R^{\lambda} S^{\mu}$; then the Ordinate Applicate BC will be $=$

$$\left.\begin{matrix} \theta ek \begin{smallmatrix}+\theta\\+\lambda n\end{smallmatrix} fkz^{n} \begin{smallmatrix}+\theta\\+2\lambda n\end{smallmatrix} gkz^{2n} \cdot * \cdots\cdots * \cdots\cdots \\ \begin{smallmatrix}+\theta\\+\mu n\end{smallmatrix} elz^{n} \begin{smallmatrix}+\theta\\+\lambda n\\+\mu n\end{smallmatrix} flz^{2n} \begin{smallmatrix}+\theta\\+2\lambda n\\+\mu n\end{smallmatrix} glz^{3n} * \cdots\cdots \\ \begin{smallmatrix}+\theta\\+2\mu n\end{smallmatrix} emz^{2n} \begin{smallmatrix}+\theta\\+\lambda n\\+2\mu n\end{smallmatrix} fmz^{3n} \begin{smallmatrix}+\theta\\+2\lambda n\\+2\mu n\end{smallmatrix} gmz^{4n} \end{matrix}\right\} \begin{matrix}\text{into}\\ z^{\theta-1}\\ R^{\lambda-1}\\ S^{\mu-1}\end{matrix}$$

This is demonſtrated after the ſame manner as the former Propoſition.

Prop. 5. *Theor*. 3.

If z be put for the Abſciſſa of the Curve AB, and R be put for $e + fz^{n} + gz^{2n} + hz^{3n} +$ &c. And let the Ordinate Applicate be $z^{\theta-1} R^{\lambda-1}$ multiply'd into $a + bz^{n} + cz^{2n} + dz^{3n} +$ &c. and let $\frac{\theta}{n}$ be put $= r$. and $r + \lambda = S$. $S + \lambda = t$. $t + \lambda = v$, &c. Then the Area will be $z^{\theta} R^{\lambda}$ multiply'd into $\frac{\frac{1}{n}a}{re} + \frac{\frac{1}{n}b - SfA}{\overline{r+1},\, e} z^{n} + \frac{\frac{1}{n}c - \frac{s}{1}fB - tgA}{\overline{r+2},\, e} z^{2n} + \frac{\frac{1}{n}d - \frac{s}{1}fC - \frac{t}{2}gB - vhA}{\overline{r-3},\, e} z^{3n} + \frac{-\frac{s}{1}fD - \frac{t}{1}gC - \frac{v}{1}hB}{\overline{r+4},\, e} z^{4n} +$, &c. where A, B, C, D, &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 $\frac{\frac{1}{n}a}{re}$, B the Co-efficient of the ſecond Term $\frac{\frac{1}{n}b - SfA}{\overline{r+1},\, e}$, C the Co-efficient of the third Term $\frac{\frac{1}{n}c - \frac{s}{1}fB - tgA}{\overline{r+2},\, e}$, and ſo on.

Demonſtration.

According to *Prop*. Third.

Let the *Ordinates* of the *Curves* be, and their *Areas*

$$\left.\begin{matrix} 1, \; \theta : A \begin{smallmatrix}+\theta\\+\lambda n\end{smallmatrix} fAz^{n} \begin{smallmatrix}+\theta\\+2\lambda n\end{smallmatrix} gAz^{2n} \begin{smallmatrix}+\theta\\+3\lambda n\end{smallmatrix} hAz^{3n}, \text{ \&c.} \\ 2. \ldots \overline{\theta+n},\, eBz^{n} \begin{smallmatrix}+\overline{\theta+n}\\+\lambda n\end{smallmatrix} fBz^{2n} \begin{smallmatrix}+\overline{\theta+n}\\+2\lambda n\end{smallmatrix} gBz^{3n}, \text{ \&c.} \\ 3. \ldots\ldots + \overline{\theta+2n},\, eCz^{2n} \begin{smallmatrix}+\theta\\+\lambda n\end{smallmatrix} +2n fCz^{3n}, \text{ \&c.} \\ 4. \ldots\ldots\ldots + \overline{\theta+3n},\, eDz^{3n}, \text{ \&c.} \end{matrix}\right\} z^{\theta-1} R^{\lambda-1} \qquad \begin{matrix} Az^{\theta} R^{\lambda} \\ Bz^{\theta+n} R^{\lambda} \\ Cz^{\theta+2n} R^{\lambda} \\ Dz^{\theta+3n} R^{\lambda} \end{matrix}$$

And if the Sum of the Ordinates be put equal to the Ordinate $a + bz^{n} + cz^{2n} + dz^{3n} +$, &c. multiply'd into $z^{\theta-1} R^{\lambda-1}$, the Sum of the Areas $z^{\theta} R^{\lambda}$ into $A + Bz^{n} + Cz^{2n} + Dz^{3n} +$, &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 $= \theta : A$, $b = \begin{smallmatrix}\theta\\+\lambda n\end{smallmatrix} fA \begin{smallmatrix}+\theta\\+n\end{smallmatrix} eB$; $c = \begin{smallmatrix}\theta\\+2\lambda n\end{smallmatrix} gA \begin{smallmatrix}+\theta n+n\\+\lambda n\end{smallmatrix} fB + \overline{\theta + 2n},\, eC$, &c. and thence $\frac{a}{\theta e} = A$. $\frac{b - \overline{\theta + \lambda n},\, fA}{\overline{\theta+n},\, e} = B$. $\frac{c - \overline{\theta + 2\lambda n}\, gA - \overline{\theta + n + \lambda n}\, fB}{\overline{\theta+2n},\, e} = C$. And ſo on *ad Infinitum*.

Now put $\frac{\theta}{n} = r$. $r + \lambda = S$. $S + \lambda = t$, &c. and in the Area $z^{\theta} R^{\lambda} \times A + Bz^{n} + Cz^{2n} + Dz^{3n}$, &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 n may either be Affirmative or Negative. Let an Ordinate be propoſed $\frac{3k - lzz}{zz\sqrt{kz - lz^{3} + mz^{4}}}$ this may be either written $z^{-\frac{5}{2}} \times \overline{3k - lzz} \times \overline{k - lzz + mz^{3}}|^{-\frac{1}{2}}$ or thus, $z \times \overline{-l + 3kz^{-2}} | \times \overline{m - lz^{-1} + kz^{-3}}|^{-\frac{1}{2}}$. In the former Caſe $a = 3k$. $b = 0$. $c = -l$. $e = k$. $f = 0$. $g = -l$. $h = m$. $\lambda = -\frac{1}{2}$. $n = 1$. $\theta - 1 = -\frac{5}{2}$. $\theta = -\frac{3}{2}$ $= r$. $S = -1$. $t = -\frac{1}{2}$. $v = 0$. In the latter Caſe $a = -l$. $b = 0$. $c = 3k$. $e = m$. $f = -l$, $g = 0$. $h = 1$. $\lambda = -\frac{1}{2}$. $n = -1$. $\theta - 1 = l$. $\theta = 2$, $r = -2$. $S = -1\frac{1}{2}$. $t = -1$. $v = -\frac{1}{2}$. 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, h, λ, θ, r, s, t, v, all the Terms except the firſt vaniſh *ad infinitum*, and the Area of the Curve becomes $-2\sqrt{\frac{k - lzz + mz^{3}}{z^{3}}}$. 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 $\frac{z}{e}$ is equal to Unity. If $\frac{z}{e}$ be leſs than Unity, that Series will converge in which the Index n is affirmative; but if $\frac{z}{e}$ be 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 R^{π}, and the Side R of the Surd Factor does not divide the Rational Factor Q; then $\lambda - 1$ will be $= \pi$; and $R^{\lambda-1} = R^{\pi}$: but if the Side R of the Surd Factor divide the Rational Factor once, $\lambda - 1$ will be $= \pi + 1$ and $R^{\lambda-1} = R^{\pi+1}$: if it divide it twice, $\lambda - 1$ will be $= \pi + 2$ and

and $R^{\lambda-1}=R^{\pi+2}$: If thrice, $\lambda-1$ will be $=\pi+3$ and $R^{\lambda-1}=R^{\pi+3}$, and so on, &c.

If the Ordinate be a rational irreducible Fraction whose 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 still 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 left, or the Product under all the Divisors which are left, if there be more, must be put instead of R and R^{-2} the reciprocal of the Square of R for $R^{\lambda-1}$, 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, or 4, taken negatively instead of λ; and the Ordinate must be reduced to the Denominator R^1, R^3, R^4, or R^5, &c.

Let the Ordinate be $\frac{z^5+z^4-8z^3}{z^5+z^4-5z^3-z^2-8z-4}$; because this Fraction is irreducible, and the Divisors of the Denominator are equal, *viz.* $z-1$, $z-1$, $z-1$, $z+2$, & $z+2$, I reject one Divisor of either magnitude, and the product of the remaining $z-1$, $z-1$, $z-2$, which is z^3-3z+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 $R^{\lambda-1}$. Afterwards I reduce the Ordinate to the Denominator R^2 or $R^{1-\lambda}$, and it becomes $\frac{z^6-9z^4+8z^3}{\overline{z^3-3z+2}|^2}$, that is, $z^3\times\overline{8-9z+z^3}\times\overline{z^3-3z+2}|^{-2}$. And thence is $a=8$. $b=-9$. $C=0$. $d=-1$, &c. $E=2$. $f=-3$. $g=0$. $h=1$. $\lambda-1=-2$. $\lambda=-1$. $n=1$. $\theta-1=3$. $\theta=4=r$. $S=3$. $t=2$. $v=1$. and these being put in the Series, the Area comes out $\frac{z^4}{z^3-3z+2}$; 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^π, 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 $\lambda-1$ will be $=-\pi-m$ and $R^{\lambda-1}=R^{\pi-m}$, so that if the Ordinate be $\frac{3q^5-q^4x+9q^2xx-qqx^3-6qx^4}{qq-xx^3\sqrt{q^3+qqx-qxx-x^3}}$, because the Side R of the Surd Factor or $q^3+qqx-qxx-x^3$ 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 $qq-xx$ 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 $\frac{1}{3}$, $\lambda-1$ becomes $=-\frac{4}{3}$. Therefore I reduce the Ordinate to the Denominator $R^{-\frac{4}{3}}$, and 'tis made $\overline{z0\times 2q^6+2q^5x+8q^4xx+8q^3x^3-7qqx^4-6qx^5}\times\overline{q^3+qqx-x^3}|^{-\frac{4}{3}}$. from whence a is $=3q^6$. $b=2q^5$, &c. $e=q^3$. $f=qq$, &c. $\theta-1=0$. $\theta=1=n$. $\lambda=-\frac{1}{3}$. $r=1$. $S=\frac{2}{3}$. $t=\frac{1}{3}$. $v=0$. and these Values being put in the Series, the Area comes out $\frac{3qqx+3x^3}{\sqrt[3]{q^3+qqx-qxx-x^3}}$, all the Terms in the whole Series after the third, vanishing.

Prop. 6 *Theor* 4.

If the Abscissa AB of a Curve be z, and R be put in the room of $e+fz^n+gz^{2n}+hz^{3n}+$,&c. and S in the room of $k+lz^n+mz^{2n}+nz^{3n}$, &c. then let the Ordinate Applicate be $z^{\theta-1}R^{\lambda-1}S^{\mu-1}$ multiply'd into $a+bz^n+Cz^{2n}+dz^{3n}$, &c. if there be the Rectangles of the Terms e, f, g, h, &c. and k, l, m, n, &c.

$$\left.\begin{matrix} ek & fk & gk & hk \\ el & fl & gl & hl \\ em & fm & gm & hm \\ en & fn & gn & hn \end{matrix}\right\}\text{\&c}$$

And if the numeral Co-efficients of those Rectangles be respectively,

$\frac{1}{n\theta}=r$, $\quad r+\lambda=s$. $\quad s+\lambda=t$. $\quad t+\lambda=v$. &c.

$r+\mu=\dot s$. $\quad s+\ =\dot t$. $\quad t+\mu=\dot v$. $\quad v+\mu=\dot w$. &c.

$\dot s+\mu=\ddot t$. $\quad \dot t+\mu=\ddot v$. $\quad \dot v+\mu=\ddot w$. $\quad \dot w+\mu=\ddot x$ &c.

$\ddot t+\mu=\dddot v$. $\quad \ddot v+\mu=\dddot w$. $\quad \ddot w+\mu=\dddot x$. $\quad \ddot x+\mu=\dddot y$. &c.

The Area of the Curve will be

$$z^\theta R^\lambda S^\mu \text{ into } \frac{\frac{1}{n}a}{rek}+\frac{\frac{1}{n}b\begin{matrix}-sfk\\-\dot s el\end{matrix}A}{\overline{r+1},ek}z^n+\frac{\frac{1}{n}C\begin{matrix}-\overline{s+1},fk\\-\overline{\dot s+1},el\end{matrix}B\begin{matrix}-tgk\\-\dot t fl\\-\ddot t em\end{matrix}A}{\overline{r+2},ek}z^{2n}$$

$$+\frac{\frac{1}{n}d\begin{matrix}-\overline{s+2},fk\\-\overline{\dot s+2},el\end{matrix}C\begin{matrix}-\overline{t+1},g\\-\overline{\dot t+1},fl\\-\overline{\ddot t+1},em\end{matrix}B\begin{matrix}-vhk\\-\dot v gl\\-\ddot v fm\\-\dddot v en\end{matrix}A}{\overline{r+3},ek}z^{3n}+,\ \text{\&c.}$$

Where A denotes the given Co-efficient of the first Term, $\frac{\frac{1}{n}a}{rek}$ with its Sign + or —, B the given Co-efficient of the second Term, C the given Co-efficient of the Third, and so on. But of the Terms a, b, c, &c. e, f, g, &c. k, l, m, &c. one or more

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. *Theor.* 5.

If R be put instead of $e+fz^n+gz^{2n}$, &c. as above, and in the Ordinate of any Curve $z^{\theta \pm \sigma n} R^{\lambda \pm \tau}$ there remain the given Quantities $\theta, n, \lambda, e, f, g$, &c. and instead of σ and τ be put any Integer Numbers successively, and if the Area of 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 deficient as entire, the Indexes of whose Powers are in an Arithmetical Progression. So the Ordinate $\sqrt{a^4 - ax^3 + x^4}$ by reason of the two different Terms between a^4 and ax^3 ought to be reckoned a Quinquenomial. But $\sqrt{a^4+x^4}$ is a Binomial, and $\sqrt{a^4+x^4-\frac{x^8}{4}}$ a Trinomial, seeing the Progression now proceeds by greater differences. This Proposition is thus demonstrated.

Case 1.

Let the Ordinates of two Curves be $pz^{\theta-1}R^{\lambda-1}$ and $qz^{\theta+n-1}R^{\lambda-1}$, and their Areas pA and qB, R being the Trinomial Quantity $e+fz^n+gz^{2n}$. And by *Prop.* 3. since $z^\theta R^\lambda$ is the Area of a Curve whose Ordinate is $\theta e \begin{smallmatrix}+\theta\\+\lambda n\end{smallmatrix} fz^n \begin{smallmatrix}+\theta\\+2\lambda n\end{smallmatrix} gz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$, subduct the former Ordinates and Areas from this latter Ordinate and Area, and there will remain $\begin{smallmatrix}\theta e\\-p\end{smallmatrix} \begin{smallmatrix}+\theta\\+\lambda n\\-q\end{smallmatrix} fz^n \begin{smallmatrix}+\theta\\+2\lambda n\end{smallmatrix} gz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$ the new Ordinate of the Curve; and $z^\theta R^\lambda - pA - qB$ its Area. Put $\theta e = p$, and $\theta f + \lambda nf = q$ and the Ordinate will be found $\begin{smallmatrix}\theta\\+2\lambda n\end{smallmatrix} gz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$, and the Area $z^\theta R^\lambda - \theta eA - fB - \lambda nfB$. Divide both by $\theta g + 2\lambda ng$, and call the Area that will come out C, and taking r at pleasure, rC will be the Area of a Curve whose Ordinate is $rz^{\theta+2n-1}R^{\lambda-1}$. And after the same manner that from the Areas pA and qB we find the Area rC agreeing to the Ordinate $rz^{\theta} \times z^{2n-1} R^{\lambda-1}$, we may from the Areas qB and rC find a fourth Area, as SD, agreeing to the Ordinate $Sz^{\theta+3n-1}R^{\lambda-1}$, 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 Terms θ, $\theta+\lambda n$, and $\theta+2\lambda n$ be wanting, and break off the Series, assume the Area pA in the beginning of one Progression, and the Area qB in the beginning of the other, and from these two Areas will be given all the Areas in both Progressions. And on the contrary, from any two other Areas assumed, 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 θ 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 λ is encreased or diminished by Unites.

Case 2.

If the Ordinates $pz^{\theta-1}R^\lambda$ and $qz^{\theta+n-1}R^\lambda$, whose corresponding Areas are pA and qB, be multiply'd by R, or $e+fz^n+gz^{2n}$, and afterwards be again divided by R, they become $pe+pfz^n+pgz^{2n} \times z^{\theta-1} R^{\lambda-1}$, and $qez^n+qfz^{2n}+qgz^{3n} \times z^{\theta-1} R^{\lambda-1}$. And by the 3d *Prop.* $az^\theta R^\lambda$ is the Area of a Curve whose Ordinate is $\theta ae \begin{smallmatrix}+\theta\\+\lambda n\end{smallmatrix} afz^n \begin{smallmatrix}+\theta\\+2\lambda n\end{smallmatrix} agz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$, and $bz^{\theta+n}R^\lambda$ is the Area of a Curve whose Ordinate is $\begin{smallmatrix}\theta\\+n\end{smallmatrix} bez^n \begin{smallmatrix}+\theta\\+n\\+\lambda n\end{smallmatrix} bfz^{2n} \begin{smallmatrix}+\theta\\+n\\+2\lambda n\end{smallmatrix} bgz^{3n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$. The Summ of these 4 Areas is $pA+qB+az^\theta R+bz^{\theta+n}R^\lambda$, and the Summ of their corresponding Ordinates.

$$\theta ae \begin{smallmatrix}+\theta\\+\lambda n\end{smallmatrix} afz^n \begin{smallmatrix}+\theta\\+2\lambda n\end{smallmatrix} agz^{2n} \begin{smallmatrix}+\theta\\+n\\+2\lambda n\end{smallmatrix} bgz^{3n} \text{ into } z^{\theta-1}R^{\lambda-1}$$
$$+pe \begin{smallmatrix}+\theta\\+n\end{smallmatrix} be \quad \begin{smallmatrix}+\theta\\+n\\+\lambda n\end{smallmatrix} bf \quad +qg$$
$$+pf$$
$$+pg$$
$$+qe \quad +qf$$

If the First, Third and Fourth Term be separately put equal to nothing; by the first Term, $\theta ae+pe$ will be made $=0$ or $-\theta a = p$, by the Fourth $-\theta b - nb - 2\lambda nb = q$, and by the Third (striking out p and q) $\frac{2ag}{f} = b$. From whence the second Term becomes $\frac{\lambda naff - 4\lambda nage}{f}$, and therefore the Summ of the four Ordinates is $\frac{\lambda naff - 4\lambda nage}{f} z^{\theta+n-1} R^{\lambda-1}$, and the Summ of so many corresponding Areas is $az^\theta R^\lambda + \frac{2ag}{f} z^{\theta+n} R^\lambda$ $\theta aA - \frac{2\theta+2n+4\lambda n}{f} agB$. Divide these Summs by $\frac{\lambda naff - 4\lambda nage}{f}$, and if the latter Quote be called D; D will be the Area of a Curve whose Ordinate is the first Quote $z^{\theta+n-1}R^{\lambda-1}$. 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 $z^{\theta-1}R^{\lambda-1}$. 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 $z^{\theta-1}R^{\lambda-2}$ and $z^{\theta+n-1}R^{\lambda-2}$, 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

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the Areas A and B, and others which follow in the Progression. Therefore if the Index λ be encreased or diminished by a continual addition or subduction of Unities; and of the Areas, corresponding to the Ordinates coming out in these Forms, two of the most simple be known, all others are given *in infinitum*. Q. E. D.

Case 3.

And by these two Cases conjoined, if both the Index θ be any how increased or diminished by the continual addition or subduction of n; and the Index λ, by the perpetual addition or subduction of Unity, the Areas corresponding to the several arising Ordinates, will be given.

Case 4.

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 n to or from the Index θ; or Unity, to or from the Index λ. And 'tis the same case with Curves whose Ordinates are expressed by Binomials and one Area of those which are not Quadrable Geometrically, is given.

Prop. 8. *Theor.* 6.

If for $e+fz^n+gz^{2n}+$ &c. and $k+lz^n+mz^{2n}+$ &c. you put R and S as before, and in the Ordinate of any Curve $z^{\theta+n\sigma}R^{\lambda\pm\tau}S^{\mu+\upsilon}$ the given Quantities θ, n, λ, μ, e, f, g, k, l, m, &c. remain; and that for σ, τ, and υ, any Integer Numbers be successively written, and if the Areas of two of the Curves are given which are denoted 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 R and S consist conjointly of 5 *Nomes*; or if the Areas of 5 Curves be given, when S and R consist jointly of six *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 *Abscissæ* are equal, and the Fluxions of the *Areas* are as those Rectangles.

Corol. 1.

If any Relation between the *Abscissæ* of two Curves be assumed, and thence (by *Prop.* 1.) the Relation between the Fluxions of the *Abscissæ* be sought, 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 $z^{\theta-1}$ into $\overline{e+fz^n+gz^{2n}+\&c.}|^\lambda$, by assuming any Quantity for ν, and putting $\frac{n}{\nu}=S$ and $z^\nu=x$, change into another equal to it self, whose Ordinate will be $\frac{\nu}{n}x^{\frac{\nu\theta-n}{n}}$ into $\overline{e+fx^\nu+gx^{2\nu}+\&c.}|^\lambda$

Corol. 3.

And every Curve whose Ordinate is $z^{\theta-1}$ into $\overline{a+bz^n+cz^{2n}+\&c.}\times\overline{e+fz^n+gz^{2n}+\&c.}|^\lambda$, by taking any Quantity for ν and putting $\frac{n}{\nu}=S$, and $z^\nu=x$, will change into another equal to it self whose Ordinate shall be $\frac{\nu}{n}x^{\frac{\nu\theta-n}{n}}$ into $\overline{a+bx^\nu+cx^{2\nu}+\&c.}\times\overline{e+fx^\nu+gx^{2\nu}+\&c.}|^\lambda$

Corol. 4.

And every Curve whose Ordinate is $z^{\theta-1}$ into $a+bz^n+cz^{2n}+$ &c. $\times\overline{e+fz^n+gz^{2n}+\&c.}|^\lambda$. $\times\overline{k+lz^n+mz^{2n}+\&c.}|^\mu$, by taking any Quantity for ν and putting $\frac{n}{\nu}=S$ and $z^\nu=x$, changes into another Curve equal to it self, whose Ordinate is $\frac{\nu}{n}x^{\frac{\nu\theta-n}{n}}$ into $a+bx^\nu+cx^{2\nu}+$ &c. $\times\overline{e+fx^\nu+gx^{2\nu}+\&c.}|^\lambda\times\overline{k+lx^\nu+mx^{2\nu}+\&c.}|^\mu$

Corol. 5.

And every Curve whose Ordinate is $z^{\theta-1}$ into $\overline{e+fz^n+gz^{2n}+\&c.}|^\lambda$ by putting $\frac{1}{z}=x$, changes into another equal to it self, whose Ordinate is $\frac{1}{x^{\theta+1}}\times\overline{e+fx^n+gz^{2n}+\&c.}|^\lambda$ that is $\frac{1}{x^{\theta+1+n\lambda}}\times\overline{f+ex^n}|^\lambda$, if there are two *Nomes* in the *Vinculum* of the Root, or $\frac{1}{x^{\theta+1+2n\lambda}}\times\overline{g+fx^n+ex^{2n}}|^\lambda$ if there are three *Nomes*, &c.

Corol. 6.

And every Curve whose Ordinate is $z^{\theta-1}$ into $\overline{e+fz^n+gz^{2n}+\&c.}|^\lambda\times\overline{k+lz^n+mz^{2n}+\&c.}|^\mu$, by putting $\frac{1}{z}=x$, changes into another equal to it self, whose Ordinate is $\frac{1}{x^{\theta+1}}\times\overline{e+fx^n gx^{2n}+\&c.}|^\lambda$ $\times\overline{k+lx^n+mx^{2n}+\&c.}|^\mu$, that is $\frac{1}{x^{\theta+1+n\lambda+n\mu}}\times$ $\overline{f+ex^n}|^\lambda\times\overline{l+kx^n}|^\mu$ if there are two *Nomes* in the *Vinculum* of the Root, or $\frac{1}{x^{\theta+1+2n\lambda+n\mu}}$ $\times\overline{g+fx^n+ex^{2n}}|^\lambda\times\overline{l+kx^n}|^\mu$, 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 sides of the Ordinates: If the Areas in either Curve join to the Abscissa, the corresponding equal Area in the other Curve adjoins to the Abscissa produced.

Corol.

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Corol. 7.

If the Relation between the *Ordinate* y of any Curve and its *Abscissa* x be expressed by any affected Equation of this form, y^{α} into $e+fy^{n}z^{\delta}+gy^{2n}z^{2\delta}+hy^{3n}z^{3\delta}+$&c.$=z^{\theta}$ into $k+ly^{n}z^{\delta}+my^{2n}z^{2\delta}+$ &c. this Figure, assuming $S=\frac{n-\delta}{n}$, $x=\frac{1}{s}z^{s}$, and $\lambda=\frac{n-\delta}{\alpha\delta+\beta n}$, changes into another equal to it self, whose *Abscissa* x, from the *Ordinate* v being given, is determined by an Equation not affected; as $\frac{1}{s}v^{\alpha\lambda}\times\overline{e+fv^{n}+gv^{2n}+hv^{3n}+\&c.}|^{\lambda}\times\overline{k+lv^{n}+mv^{2n}+\&c.}|^{\lambda}=x$.

Corol. 8.

If the Relation between the Ordinate y of any Curve, and its Abscissa z be determined by any affected Equation in this Form, y^{α} into $\overline{e+fy^{n}z^{\delta}+gy^{2n}z^{2\delta}}=z^{\beta}$ into $\overline{k+ly^{n}z^{\delta}+my^{2n}z^{2\delta}+\&c.}+z^{\gamma}$ into $\overline{p+qy^{n}z^{\delta}+ry^{2n}z^{\delta}+}$ &c. then this Figure, assuming $S=\frac{n-\delta}{n}$ $x=\frac{1}{s}z^{s}$ $\mu=\frac{\alpha\delta+\beta n}{n-\delta}$ and $\nu=\frac{\alpha\delta+\gamma n}{n-\delta}$, changes into another equal to it self, whose *Abscissa* x, from the given Ordinate v being given, is determined by an Equation less affected, as v^{α} into $e+fv^{n}+gv^{2n}+$&c. $=S^{\mu}x^{\mu}$ into $k+lv+mv^{2n}+$ &c. $+S^{\nu}+x^{\nu}$ into $p+qv^{n}+rv^{2n}+$ &c.

Corol. 9.

Every Curve whose Ordinate is $\pi z^{\theta-1}$ into $\overline{e+\nu\atop+\eta}fz^{n}\,{+\nu\atop+2\eta}gz^{2n}+$&c. $\times\overline{e+fz^{n}+gz^{2n}\&c.}|^{\lambda-1}\times|\overline{a+b|ez^{\nu}+fz^{\nu+n}+gz^{\nu+2n}+\&c.}|^{\tau}|^{\omega}$, if $\theta=\lambda\nu$ and there be assumed $x=\overline{ez^{\nu}+fz^{\nu+n}+gz^{\nu+2n}+\&c.}|^{\pi}$, $\sigma=\frac{\tau}{\pi}$, and $\vartheta=\frac{\lambda-\pi}{\pi}$, changes into another equal to it self, whose Ordinate is $x^{\vartheta}\times\overline{a+bx^{\sigma}}|^{\omega}$. And observe that the former Ordinate in the *Corollary* becomes more simple by putting $\lambda=1$, 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 $\lambda=1=\tau=\sigma=\pi$, that I may pass by other Cases, *&c.*

Corol. 10.

For $ez+fz^{\nu+n}+gz^{\nu+2n}+$ &c. $\nu ez^{\nu-1}{+\nu\atop+\eta}fz^{\nu+n-1}\,{+\nu\atop+2\eta}gz^{\nu+2n-1}+$ &c. $k+lz^{n}+mz^{2n}+$ &c. and $nlz^{n-1}+2nmx^{2n-1}+$ &c. let R, r, S and s be substituted respectively, and then every Curve whose Ordinate is $\pi Sr+\phi Rs$ into $R^{\lambda-1}S^{\mu-1}\times\overline{aS^{\nu}+bR_{\tau}}|^{\omega}$ if it be $\frac{\mu-\nu\omega}{\lambda}=\frac{\nu}{\tau}=\frac{\phi}{\pi}$, $\frac{\tau}{\pi}=\sigma$, $\frac{\lambda-\pi}{\pi}=\vartheta$, and $R^{\pi}S_{\phi}=x$, changes into another equal to it self, whose Ordinate is $x^{\vartheta}\times\overline{a+bx^{\sigma}}|^{\omega}$. And observe, that the former Ordinate grows more simple, by putting Unities for τ, ν, λ or μ, and by effecting that the Radix of the Dignity may be extracted, whose Index is ω, or by putting $\omega=-1$ or $\mu=0$.

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.

Case 1.

Let the Ordinate be $az^{\theta-1}$, and then the Area will be $\frac{1}{\theta}az^{\theta}$, as will easily be collected from *Prop.* 5. by putting $b=o=c=d=f=g=h$ and $e=1$.

Case 2.

Let the Ordinate be $az^{\theta-1}\times\overline{fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}$ then if the *Curve* can be compared Geometrically with *Rectilineal 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 $\frac{a}{\theta}x^{\frac{\theta-n}{n}}\times\overline{e+fx+gx^{2}+\&c.}|^{\lambda-1}$ by *Cor.* 2. *Prop* 9. Then if out of the Index of the Dignities $\frac{\theta-n}{n}$ and $\lambda-1$ (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 simple. 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. And lastly, by assuming these to be the most simple Figures; and by proceeding in a Reverse or Inverse Method, may the required *Area* be computed.

Case 3.

Let the Ordinate be $z^{\theta-1}\times\overline{a+bz^{n}+cz^{2n}+\&c.}\times\overline{e+fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}$, then will this Figure, if squarable, be squared by *Prop.* 5. But if not, then the Ordinate must be distinguished into the Parts, $z^{\theta-1}\times a\times\overline{e+fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}$, $z^{\lambda-1}\times bz^{n}\times\overline{e+fz^{n}+gz^{2n}+\&c}|^{\lambda-1}$, &c. and by *Case* 2. 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 sought.

Case 4.

Let the Ordinate be $z^{\theta-1}\times\overline{a+bz^{n}+cz^{2n}+\&c.}\times\overline{e+fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}\times\overline{k+lz^{n}+mz^{2n}+\&c.}|^{\mu-1}$ and then if the Curve be Quadrable, it will be squared by *Prop.* 6. But if not, let it by *Cor.* 4. *Prop.* 9. changed into a more simple one, and then compared with the most simple Figures according to to *Prop* 8. and *Cor.* 6, 9, and 10, of *Prop.* 9 as was done in *Case* 2 and 3.

Case 5.

If the Ordinate consist 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 whose 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 consists of two Parts, which considered severally, are not affected Roots of Equations. Let the Equation be proposed $aayy+zzyy=2a^3y+2z^3y-z^4$, its Root when extracted will be $y=\frac{a^3+z^3+a\sqrt{a^4+2az^3-z^4}}{aa+zz}$ whose rational part $\frac{a^3+z^3}{aa+zz}$ and its Surd or Irrational Part $\frac{a\sqrt{a^4+2az^3-z^4}}{aa+zz}$ are the Ordinates of Curves that may either be squared by this Proposition, or compared with the most simple Figures, with whom they admit a Geometrical Comparison.

Corol. 2.

And every Curve whose Ordinate is determined by any affected Equation, which by *Cor.* 7. *Prop.* 9. doth not go into an Equation not affected, 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 first *Corollary*, if quadrable at all, or else is compared with the most simple Figures, and with which it admits a Geometrical Collation.

Scholium.

When Figures are to be squared, it will be too troublesome always to have recourse to these General Rules: wherefore it is better once to *square* 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 z denotes the *Abscissa*, y the *Rectangular Ordinate*, t the *Area* of the Curve to be squared, and d, e, f, g, h and n represent given Quantities with their Signs $+$ and $-$.

A Table *of the more Simple Quadrable Curves.*

The Forms of the Curves.	*The Areas of the Curves.*
Form 1.	
$dz^{n-1}=y$	$\frac{d}{n}z^n=t.$
Form 2.	
$\frac{dz^{n-1}}{ee+2efz^n+ffz^{2n}}=y.$	$\frac{dz^n}{nee+nefz^n}=t,$ or $\frac{-d}{nef+nffz^n}=t.$
Form 3.	
1. $dz^{n-1}\sqrt{e+fz^n}=y.$	$\frac{2d}{3nf}R^3=t.$ supposing $R=\sqrt{e+fz^n}$
2. $dz^{2n-1}\sqrt{e+fz^n}=y.$	$\frac{-4e+6fz^n}{15nff}dR^3=t.$
3. $dz^{3n-1}\sqrt{e+fz^n}=y.$	$\frac{16ee-24efz^n+30ffz^{2n}}{105nf^3}dR^3=t.$
4. $dz^{4n-1}\sqrt{e+fz^n}=y.$	$\frac{-96e^3+144eefz^n-180eff z^{2n}+210f^3z^{3n}}{945nf^4}dR^3=t.$
Form 4.	
1. $\frac{dz^{n-1}}{\sqrt{e+fz^n}}=y.$	$\frac{2d}{nf}R=t.$
2. $\frac{dz^{2n-1}}{\sqrt{e+fz^n}}=y$	$\frac{-4e+2fz^n}{3nff}dR=t.$

3. dz^{3n-1}

3. $\frac{dz^{3n-1}}{\sqrt{e+fz^n}}=y.$ | $\frac{16ee-8efz^n+6ffz^{2n}}{15nf^3}dR=t.$

4. $\frac{dz^{4n-1}}{\sqrt{e+fz^n}}=y.$ | $\frac{-96e^3+48eefz^n-36effz^{2n}+30f^3z^{3n}}{105nf^4}dR=t.$

A TABLE *of those more Simple Curves which may be compared with the Ellipsis and the Hyperbola.*

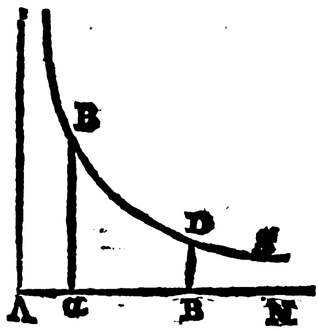

Fig. 5.

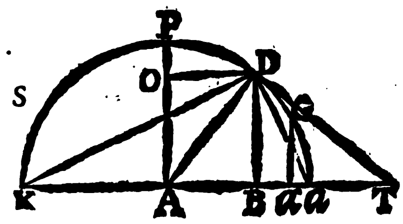

Fig. 6.

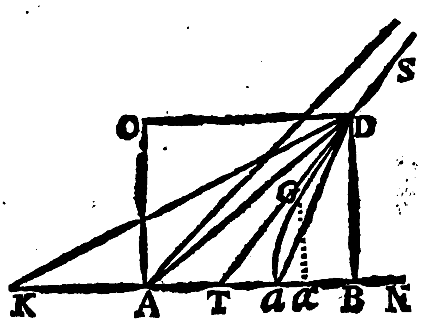

Fig. 7.

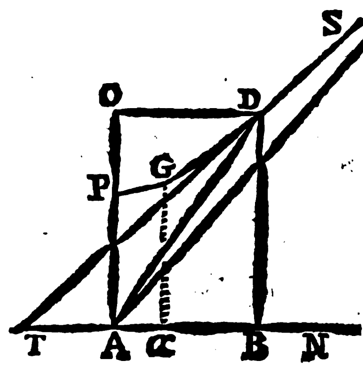

Fig. 8.

Let aGD or PGD or GDS be a Conick Section whose Area is required to the Quadrature of a Curve proposed, and let its Centre be A, its Axis Ka, its Vertex a, its Semi-Conjugate Axis AP, the given beginning of the Abscissa A, or a, or a; the Abscissa AB, or aB, or $aB=x$, the Rectangular Ordinate $BD=v$, and the Area $ABDP$ or $aBDG$ or $aBDG=s$, the Ordinate aG being applied at the Point a. Join KD, AD, aD, and let the Tangent DT be drawn, meeting the Abscissa AB in T, and then let the Parallelogram $ABDO$ be compleated. If then to the Quadrature of the Curve proposed the Areas of two Conick Sections are required; let the Abscissa of the latter be ξ, the Ordinate Υ, and the Area σ. And let this Character $\div$ stand for the difference of two Quantities, when 'tis uncertain which is the greater, and consequently which can be taken from the other.

		The Forms of the Curves.	*Of the Conick Section.* Absciss.	Ordinate.	*The Area of the Curves.*
		Form 1.			
Fig. 5.	1.	$\frac{dz^{n-1}}{e+fz^n}=y.$	$z^n=x.$	$\frac{d}{e+fx}=v.$	$\frac{1}{n}s=t=\frac{aGDB}{n}$
	2.	$\frac{dz^{2n-1}}{e+fz^n}=y.$	$z^n=x.$	$\frac{d}{e+fx}=v.$	$\frac{d}{nf}z^n-\frac{e}{nf}s=t.$
	3.	$\frac{dz^{3n-1}}{e+fz^n}=y.$	$z^n=x.$	$\frac{d}{e+fx}=v.$	$\frac{d}{2nf}z^{2n}-\frac{de}{nff}z^n+\frac{ee}{nff}s=t.$
		Form 2.			
Fig. 6, 7.	1.	$\frac{dz^{\frac{1}{2}n-1}}{e+fz^n}=y.$	$\sqrt{\frac{d}{e+fz^n}}=x.$	$\sqrt{\frac{d}{f}-\frac{e}{f}xx}=v.$	$\frac{2xv\div 4s}{n}=t=\frac{4}{n}ADGa$
	2.	$\frac{dz^{\frac{1}{2}n-1}}{e+fz^n}=y.$	$\sqrt{\frac{d}{e+fz^n}}=x.$	$\sqrt{\frac{d}{f}-\frac{e}{f}xx}=v.$	$\frac{2de}{nf}z^{\frac{n}{2}}+\frac{4es-2exv}{nf}=t.$
	3.	$\frac{dz^{\frac{1}{2}n-1}}{e+fz^n}=y.$	$\sqrt{\frac{d}{e+fz^n}}=x.$	$\sqrt{\frac{d}{f}-\frac{e}{f}xx}=v.$	$\frac{2de}{3nf}z^{\frac{3n}{2}}-\frac{2dee}{nff}z^{\frac{n}{2}}+\frac{2eexv-4ees}{nff}=t.$

Form 3.

Form 4.

Fig. 6, 7, 8. 1. $\frac{d}{z}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=xx.\ \sqrt{f+exx}=v.\ \frac{4de}{nf}$ into $\frac{v^3}{2ex}-s=t=\frac{4de}{nf}$ into a GDT, or APDB ÷ TDB

Or thus, $\frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{8dee}{nff}$ into $s-\frac{1}{2}xv\ \frac{fv}{4e}+\frac{ffv}{4eex}=t=\frac{8dee}{nff}$ into aGDA $+\frac{ffv}{4ex}$

2. $\frac{d}{z^n+1}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=xx.\ \sqrt{f+exx}=v.\ \frac{2d}{n}s=t=\frac{2d}{n}$ APDB, or $\frac{2d}{n}$ aGDB.

Or thus, $\frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{4de}{nf}$ into $s-\frac{1}{2}xv-\frac{fv}{2e}=t=\frac{4de}{nf}\times$ a G D K.

3. $\frac{d}{z^{2n+1}}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{d}{n}s=t=\frac{d}{n}\times$ a G D B or B D P K.

4. $\frac{z^{3n+1}}{d}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{3dfs-2dv^3}{6ne}=t.$

Form 4.

Fig. 6. 1. $\frac{d}{z\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=xx.\ \sqrt{fx+exx}=v.\ \frac{4d}{nf}$ into $\frac{1}{2}xv\div s=t=\frac{4d}{nf}$ into PAD or into aGDA

Or thus, $\frac{1}{z^n}=x\ \sqrt{fx+exx}=v.\ \frac{8de}{nff}$ into $s-\frac{1}{2}xv-\frac{fv}{4e}=t=\frac{8de}{nff}$ into aGDA.

2. $\frac{d}{z^{n+1}\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=xx.\ \sqrt{f+exx}=v.\ \frac{2d}{ne}$ into $s-xv=t=\frac{2d}{ne}$ into POD, or into AODG a.

Or thus, $\frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{4d}{nf}$ into $\frac{1}{2}xv\div s=t=\frac{4d}{nf}$ into a DG a.

3. $\frac{d}{z^{2n+1}\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{d}{ne}$ into $3\div 2xv=t=\frac{d}{ne}$ into 3aDGa ÷ ΔaEB.

4. $\frac{d}{z^{3n+1}\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{10dfxv-15dfs-2dexxv}{6nee}=t.$

Form 5.

1. $\frac{dz^{n-1}}{e+fz^n+gz^{2n}}=y.\ \sqrt{\frac{d}{e+fz^n+gz^{2n}}}=x.\ \sqrt{\frac{d}{g}+\frac{ff-4eg}{4gg}xx}=v.\ \frac{xv-2s}{n}=t.$

Or thus, $\sqrt{\frac{dz^{2n}}{e+fz^n+gz^{2n}}}=x.\ \sqrt{\frac{d}{g}+\frac{ff+4eg}{4gg}xx}=v.\ \frac{xv-2s}{n}=t.$

2. $\frac{dz^{2n-1}}{e+fz^n+gz^{2n}}=y\ \begin{cases}\sqrt{\frac{d}{e+fz^n+z^{2n}}}=x. & \sqrt{\frac{d}{g}+\frac{ff+4eg}{4gg}xx}=v. \\ fz^n+gz^{2n}=\xi. & \frac{1}{e+\xi}=\Upsilon.\end{cases}\ \frac{d\sigma+2fs-fxv}{2ng}=t.$

Form 6. where p is put for $\sqrt{ff-4eg}$.

1. $\frac{dz^{\frac{1}{2}n-1}}{e+fz^n+gz^{3n}}=y.\ \begin{cases}\sqrt{\frac{2dg}{e-p+2gz^n}}=x. & \sqrt{d+\frac{-f+p}{2g}xx}=v. \\ \sqrt{\frac{2dg}{f+p+2gz^n}}=\xi. & \sqrt{d+\frac{-f+p}{2g}\xi\xi}\Upsilon.\end{cases}\ \frac{2xv-4s-2\xi\Upsilon+4\sigma}{np}=t.$

2. $\frac{dz^{\frac{3}{4}n-1}}{e+fz^n+gz^{2n}}=y.\ \begin{cases}\sqrt{\frac{2dez^n}{fz^n-pz^n+2e}}=x. & \sqrt{d+\frac{-f+p}{2e}xx}=v. \\ \sqrt{\frac{2dez^n}{fz^n+pz^n+2e}}=\xi. & \sqrt{d+\frac{-f+p}{2e}\xi\xi}=\Upsilon.\end{cases}\ \frac{4s-2xv-4\sigma+2\xi\Upsilon}{np}=t.$

Form 7.

1. $\frac{d}{z}\sqrt{e+fz^n+gz^{2n}}=y.\ \begin{cases}z^n=x. & \sqrt{e+fx+gxx}=v. \\ \frac{1}{z^n}=\xi. & \sqrt{g+f\xi+e\xi\xi}=\Upsilon.\end{cases}\ \frac{4de\xi\Upsilon+2def\Upsilon-2dffv-8dee\sigma+4dfgs}{4neg-nff}=t.$

Fig. 6, 7. 2. $dz^{n-1}\sqrt{e+fz^n+gz^{2n}}=y.\ z^n=x.\ \sqrt{e+fx+gxx}=v.\ \frac{d}{n}s=t=\frac{d}{n}$ into a G D F.

3. dz^{2n-1}

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3. $dz^{2n-1}\sqrt{e+fz^n+gz^{2n}}=y.\ z^n=x.\ \sqrt{e+fx+gxx}=v.\ \frac{d}{3ng}v^3-\frac{df}{2ng}s=t.$

4. $dz^{3n-1}\sqrt{e+fz^n+gz^{2n}}=y.\ z^n=x.\ \sqrt{e+fx+gxx}=v.\ \frac{6dgx-5df}{24ngg}v^3+\frac{5dff-4deg}{16ngg}s=t.$

Form 8.

Fig. 6. 1. $\frac{dz^{n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.\ z^n=x\sqrt{e+fx+gxx}=v.\ \frac{8dgs-4dgxv-2dfv}{4neg-nff}=t=\frac{8dg}{4neg-nff}\times a\,GDB\pm\triangle DBA.$

2. $\frac{dz^{2n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.\ z^n=x.\ \sqrt{e+fx+gxx}=v.\ \frac{-4dfs+2dfxv+4dev}{4neg-nff}=t.$

3. $\frac{dz^{3n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.\ z^n=x.\ \sqrt{e+fx+gxx}=v.\ \frac{\begin{smallmatrix}3dff\\-4deg\end{smallmatrix}s\begin{smallmatrix}-2dff\\+4deg\end{smallmatrix}xv-2defv}{4negg-nffg}=t.$

4. $\frac{dz^{4n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.\ z^n=x.\ \sqrt{e+fx+gxx}=v.\ \frac{\begin{smallmatrix}36defg\\-15deff\end{smallmatrix}s\begin{smallmatrix}+8degg\\-2dffg\end{smallmatrix}xxv\begin{smallmatrix}-28defg\\+10deff\end{smallmatrix}xv\begin{smallmatrix}+10deeg\\-16deef\end{smallmatrix}v}{24neg^3-6nffg}=t.$

Form 9.

1. $\frac{dz^{n-1}\sqrt{e+fz^n}}{g+hz^n}=y.\ \sqrt{\frac{d}{g+hz^n}}=x.\ \sqrt{\frac{df}{h}+\frac{eh-fg}{h}xx}=v.\ \frac{\begin{smallmatrix}4fg\\-4eh\end{smallmatrix}s\begin{smallmatrix}-2fg\\+2eh\end{smallmatrix}xv+\frac{2dfv}{x}}{nfh}=t.$

2. $\frac{dz^{2n-1}\sqrt{e+fz^n}}{g+hz^n}=y.\ \sqrt{\frac{d}{g+hz^n}}=x.\ \sqrt{\frac{df}{h}+\frac{eh-fg}{h}xx}=v.\ \frac{\begin{smallmatrix}4egh\\-4fgg\end{smallmatrix}s\begin{smallmatrix}-2egh\\+2fgg\end{smallmatrix}xv+\frac{2}{3}dh\frac{v^3}{x^3}-2dfg\frac{v}{x}}{nfhh}=t.$

Form 10.

Fig. 6, 7. 1. $\frac{dz^{n-1}}{g+hz^n\sqrt{e+fz^n}}=y.\ \sqrt{\frac{d}{g+hz^n}}=x.\ \sqrt{\frac{df}{h}+\frac{eh-fg}{h}xx}=v.\ \frac{2xv-4s}{nf}=t=\frac{4}{nf}ADGa.$

2. $\frac{dz^{2n-1}}{g+hz^n\sqrt{e+fz^n}}=y.\ \sqrt{\frac{d}{g+hz^n}}=x.\ \sqrt{\frac{df}{h}+\frac{eh-fg}{h}xx}=v.\ \frac{4gs-2gxv+\frac{2dv}{x}}{nfh}=t.$

Form 11.

1. $dz^{-1}\sqrt{\frac{e+fz^n}{g+hz^n}}=y.\ \left\{\begin{matrix}\sqrt{g+hz^n}=x.\ \sqrt{\frac{eh-fg}{h}+\frac{f}{h}xx}=v.\\ \sqrt{h+gz^{-n}}=\xi.\ \sqrt{\frac{fg-eh}{g}+\frac{e}{g}\xi\xi}=\tau.\end{matrix}\right\}\ \frac{dxv3z^{-n}-4dfs-4de\sigma}{nfg-neh}=t.$

2. $dz^{n-1}\sqrt{\frac{e+fz^n}{g+hz^n}}=y.\ \sqrt{g+hz^n}=x.\ \sqrt{\frac{eh-fg}{h}+\frac{f}{h}xx}=v.\ \frac{2d}{nh}s=t.$

3. $dz^{2n-1}\sqrt{\frac{e+fz^n}{g+hz^n}}=y.\ \sqrt{g+hz^n}=x.\ \sqrt{\frac{eh-fg}{h}+\frac{f}{h}xx}=v.\ \frac{dhxv^3\begin{smallmatrix}-3dfg\\-deh\end{smallmatrix}s}{2nfhh}=t.$

In these Tables the Series of the Curves, of any 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 Co-efficients 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 $-\frac{3}{2},-\frac{5}{4},-\frac{7}{6},-\frac{9}{8},-\frac{11}{10}$, &c. and in the Fourth Form, by $-\frac{1}{2},-\frac{3}{4},-\frac{5}{6},-\frac{7}{8},-\frac{9}{10}$, &c. and the Co-efficients of the Denominators, 3, 15, 105, &c. are produced by multiplying the Numbers, 1, 3, 5, 7, 9, &c. into one another continually.

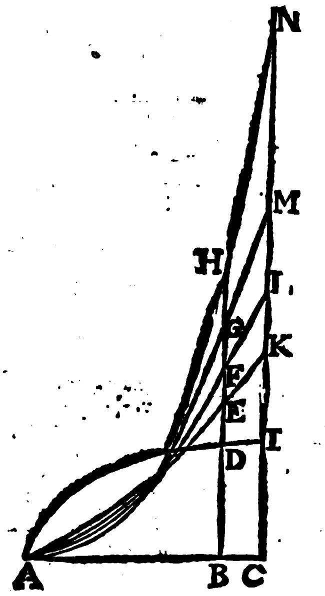
But in the Second Table, the *Series* of the Curves of the First, Second, Fifth, Sixth, Ninth and Tenth Form, are found by Division alone; and of the other Forms remaining, by help of *Prop.* the Third and Fourth, produced both ways *in infinitum.*

And as these Series may be varied by changing the Sign of the Number n: So, for instance, the Curve $\frac{d}{z}\sqrt{e+fz^n}=y$ becomes $\frac{d}{z^{\frac{1}{2}n+1}}\sqrt{fez^n}$.

Prop. 9. Theor. 8.

Let $ADIC$ be any Curve having its Absciss $AB=z$ and its Ordinate $BD=y$; 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 BF, is equal to the Area of the Second AEB divided by 1; and let $AGMC$ be a Fourth Curve whose Ordinate BG is equal to the Area AFB of the Third divided by Unity; and let $AHNC$

$AHNC$ 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^2y, z^3y, z^4y, &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^3y, x^4y, &c. and their common Abscissa z.

Let all these Areas terminate at the whole given Abscissa AC, and at the Ordinate given in Position and infinitely produced CI: And then shall the first of the Areas thus posited, $ADIC$ be $= A = P$: The Second $AEKC = tA - B = Q$. The Third $AFLC = \frac{ttA - 2tB + C}{2} = \frac{1}{2}R$. The Fourth $AGMC = \frac{t^3A - 3ttB + 3tC - D}{6} = \frac{1}{6}S$. The Fifth $AHNC = \frac{t^4A + t^3B + 6ttC - 4tD + E}{24} = \frac{1}{24}T$.

Corol.

Whence if the Curves, whose Ordinates are y, zy, z^2y, z^3y, &c. or y, xy, x^2y, x^3y, &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 Areas 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 $\overline{z+o}|^n$, then may it be resolv'd into this Converging Series $z^n + noz^{n-1} + \frac{nn-n}{2}ooz^{n-2} + \frac{n^3 - 3nn + 2n}{6}o^3z^{n-3} +$ &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 *Nascent*, 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 $\frac{n^3 - 3nn + 2n}{6}o^3z^{n-3}$ shall be the Fluents third *Increment* or *Difference*, and to which as Nascent, the Third Fluxion is proportional, &c. 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 $BE\left(=\frac{ADB}{1}\right)$ be a *Fluent* or flowing Quantity, the first Fluxion will be as the Ordinate BD: If BF be the Fluent $\left(=\frac{AEB}{1}\right)$ the first Fluxion of it shall be as the Ordinate BE, and the second as the Ordinate BD. If $BH\left(=\frac{AGB}{1}\right)$ 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 $ADB = BE \times 1$: If it be the Second Fluxion, let the Area $AEB = BF \times 1$ be sought; if it be the Third Fluxion, let the Area $AFB = DG \times 1$ be sought; and the Area, when found, 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, &c. still without any other Fluent, then the Fluents may be found by the Method of the *Quadrature 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 $aa\dot{v} = \dot{a}vz + vv\dot{z}$, $\frac{aa\dot{v}}{av+vv} = \dot{z}$. Suppose then v to flow uniformly, and let its Fluxion be $\dot{v} = 1$, then shall $\frac{aa}{av+vv} = \dot{z}$; and by squaring the Curve whose Ordinate is $\frac{aa}{av+vv}$ and Abscissa v, you will have the Fluent or Flowing Quantity z.

Again, let the Equation be $aa\dot{v} = a\dot{z} + \dot{v}v$, and let v be $= BF$, $\dot{v} = BE$, $\ddot{v} = BD$, and $z = AB$: Then by the Relation between $\ddot{v}$ and $\dot{v}$ 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.

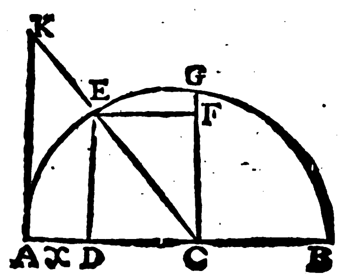
Such Equations as involve three unknown Quantities may sometimes be reduced to such as involve only two Unknown Quantities; in which Cases the Fluents will be found from the Fluxions, as

Corol. 2.

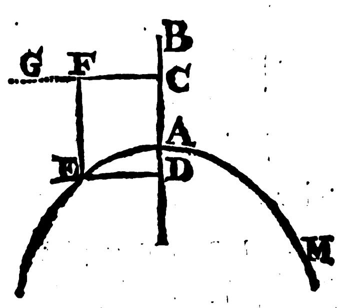
If n be suppos'd equal to any Term in the following Series, 1, 2, 3, 4, 5, 6, 7, *&c.* Every Curve whose Ordinate is $\frac{x-n}{\sqrt{dx \mp xx}}$ will be squared by this *Series*, and come out in finite Terms.

Corol. 3.

If m be equal to any Term in this Series, 0, 1, 2, 3, 4, 5, 6, 7, *&c.* Every Curve whose Ordinate is $\frac{x^m}{\sqrt{dx-xx}}$ depends upon the Quadrature of the 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 erected at Right-angles, and CE drawn: Then will the Se-



ctor AEC divided by $\frac{dd}{8}$, be equal to the Area of the Curve whose Ordinate is $\frac{x^0}{\sqrt{dx-xx}}$; after the same Manner if on the Centre C, and the Transverse Axis $AB=d$, an Equilateral Hyperbola be described; as AE: Let $AD=x$ and DE erected Normally, and CE drawn: Then shall the Se-



ctor ACE divided by $\frac{dd}{8}$ be equal to the Area of the Curve whose Ordinate is $\frac{x^0}{\sqrt{dx+xx}}$.

Corol. 4.

If m be suppos'd equal to any Term not included within the former Limits; The Curve whose Ordinate shall be, $\frac{x^m}{\sqrt{dx \mp xx}}$ can neither be squared 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 $\frac{m-3}{m}$ into $\frac{m-5}{m-2}$ into $\frac{m-7}{m-4}$, &c. $=P$.

$-\frac{1}{m+2}x^{m-1}y^3=-Q$.

$-\frac{rr}{m}$ into $\frac{m-1}{m+2}x^{m-3}y^3=-R$.

$-\frac{r^4}{m-2}$ into $\frac{m-2}{m+2}$ into $\frac{m-3}{m}x^{m-5}y^3=-S$, &c.

Corol. 1.

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 $x^m\sqrt{rr \mp xx}$ will come out finite, and be expressed by the Theorem.

Corol. 2.

If n be equal to any Term in this Series 2, 3, 4, 5, 6, *&c.* The Curve whose Ordinate is $x^{2n}\sqrt{rr \mp xx}$ 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 $x^m\sqrt{rr \mp xx}$ 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 whose Abscissa is x, and its Ordinate $\frac{x^m}{\sqrt{rr-xx}}$: Let B be the Area of another; whose Abscissa x is the same with the former; but its Ordinate $\frac{x^{m-2n}}{\sqrt{rr-xx}}$; Then I say,

$$A=r^{2n}B \text{ into } \frac{m-1}{m} \text{ into } \frac{m-3}{m-2} \text{ into } \frac{m-5}{m-4}$$

into $\frac{m-7}{m-6}$, *&c.* $=P$.

$-\frac{1}{m}x^{m-1}y=-Q$.

$-\frac{rr}{m-2}$ into $\frac{m-1}{m}x^{m-3}y=-R$.

$-\frac{r^4}{m-4}$ into $\frac{m-1}{m}$ into $\frac{m-3}{m-2}x^{m-5}y=-S$.

$-\frac{r^6}{m-6}$ into $\frac{m-1}{m}$ into $\frac{m-3}{m-2}$ into $\frac{m-5}{m-4}$ $x^{m-7}y=-T$, &c.

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Carol. 1.

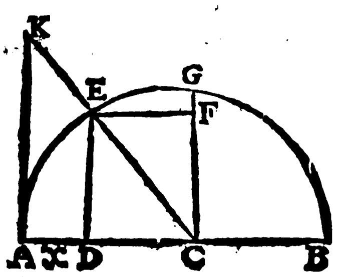
If m be equal to any Term of this Series 1, 3, 5, 7, 9, &c. the Curve whose Ordinate is $\frac{x^m}{\sqrt{rr\mp xx}}$ will be found by this Theorem in finite Terms.

Carol. 2.

If n be equal to any Term in the following Series 1, 2, 3, 4, 5, 6, &c. The Curve whose Ordinate is $\frac{x^{2n}}{\sqrt{rr\mp xx}}$ is exactly quadrable by this Theorem.

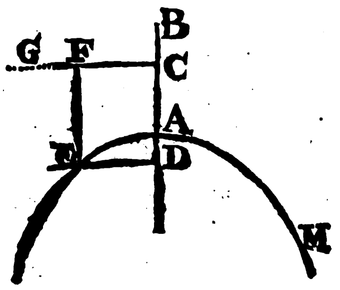
Carol. 3.

If m be equal to any Term of this Series 0, 2, 4, 6, 8, 10, &c. The Quadrature of the Curve whose Ordinate is $\frac{x}{\sqrt{rr-xx}}$ 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 CAE divided by $\frac{1}{2}rr$, be equal to the Area of the Curve, whose Ordinate is $\frac{x}{\sqrt{rr-xx}}$.

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 EC: I say, the Hyperbolick Sector ACE divided by $\frac{rr}{2}$ is equal to the Area of the Curve whose Ordinate is $\frac{x}{\sqrt{rr+xx}}$.

Carol. 4.

If m be expounded by any other Term different from any of the Preceeding ones; Then will the Curve whose Ordinate is $\frac{x^m}{\sqrt{rr\mp xx}}$ 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 Area,

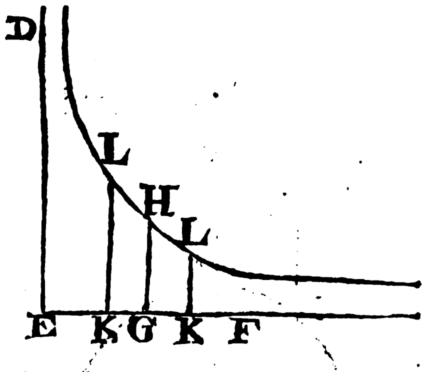
$$A=d^n B-\frac{x^m}{m}-\frac{dx^{m-1}}{m-1}-\frac{ddx^{m-2}}{m-2}, \text{ \&c.}$$

And if the Ordinate be $\frac{x^m}{d+x}$; Then the Area,

$$A=\frac{x^m}{m}-\frac{dx^{m-1}}{m-1}+\frac{ddx^{m-2}}{m-2}, \text{ \&c. } \mp d^n B.$$

Corollary.

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 Asymptotes DE, EF, let an Hyperbola be described passing thro' H; and taking $GK=x$, towards E in the first Case, and towards F in the latter, let the Ordinate KL be drawn: Then shall the Area $HGKL$ divided by dd be equal to the Area of the Curve, whose Ordinate is $\frac{x^0}{d+x}$. And from hence, supposing the Quadrature of the Hyperbola, will the Solid, generated by the Revolution of the Portion of a Cissoid round the Diameter of the Generating Circle, be given in Finite Terms.

Theor. 6.

as above. Let there be this Equation $a - bx^m = cxy^n\dot{y} + dy^{2n}\dot{y}\,y$. Suppose $\dot{y}\,^n y = \dot{v}$, and it will stand $a - bx^m c x\dot{v} + dv\,\dot{v}$. This Equation, by squaring the Curve whose Abscissa is x and Ordinate $\dot{v}$, gives the Area v; and the other Equation $\dot{y}\,^n y = \dot{v}$, by working backward to the *Fluents*, will give $\frac{1}{n+1} y^{n+1} = v$: whence the Fluent y 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 $\overline{ax^m + bx^n}|^p = rex^{r-1}y^s + sexr\dot{y}y^{s-1} - f\dot{y}y^t$: and let $\dot{x} = 1$. Then will the latter part $rex^{r-1}y^s + sex^r\dot{y}y^{s-1} - f\dot{y}y^t$ by finding the Fluents in the Inverse Method, will become $ex^ry^s - \frac{f}{t+1}y^{t+1}$; which therefore is as the Area of a Curve whose Abscissa is x and its Ordinate $\overline{ax^m + bx^n}|^p$, and from thence the Fluent y will be given.

Let there be an Equation, $\dot{x} \times \overline{ax^m + bx^n}|^p = \frac{d\dot{y}y^{n-1}}{\sqrt{e+fyn}}$, then the Fluent, whose Fluxion is $\dot{x} \times \overline{ax^m + bx^n}|^p$ shall be as the Area of a Curve whose Abscissa is x and its Ordinate $\overline{ax^m + bx^n}|^p$; Also the Fluent, whose Fluxion is $\frac{d\dot{y}y^{n-1}}{\sqrt{e+fyn}}$ shall be as the Area of a Curve whose Abscissa is y, and its Ordinate $\frac{d\dot{y}y^{n-1}}{\sqrt{e+fyn}}$; that is (in *Case* 1. by *Form* 4. in *Table* 1.) as the Area $\frac{2d}{nf}\sqrt{e+fyn}$. Let therefore $\frac{2d}{nf}\sqrt{e+fy^n}$ be equal to the Area of a Curve whose Abscissa is x and Ordinate $\overline{ax^m + bx^n}|^p$, 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 so. 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.* Transf. 252 *p.* 708. You have a Method for the Quadrature of Figures, *Geometrically irrational*; by Mr. *J. Craig*.

See also, the same Author's *Methodus Figurarum Lineis rectis & Curvis comprehensarum Quadraturas determinandi. Lond.* 1685, 4°. And his Additions to it, in *Philos.* Transf. N. 235.

See also his *Tractatus Mathematicus de Figurarum Curvilinearum Quadraturis & Locis Geometricis. Lond.* 1693, 4°.

Vera Circuli & Hyperbolæ 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. 12*mo*. See *Phil. Transaction.* N. 185. where this Book is refuted by *Cluverius*, M. D. R. S. S.

De Quadratura Circuli, &c. *per* T. H*o*bbs. This Book Dr. *Wallis* hath twice refuted.

In *Philos. Collect.* N. 7. you have Mr. *Leibnitz*'s Method for the Quadrature of the Circle.

In *Philos. Transf.* 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 Astr. Professf.* of *Oxford* also in *Philos. Transf.* 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 Proposition 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 Circle, and the Areas of the Parts generated in the formation of those Curves, are to the Areas of the Segment of that generating Circle; as the Summ of the double Velocity of the Centre, and of the Velocity of the* Motus Circularis, *is to the Velocity of that* Motus Circularis.

In *Philos. Transact.* 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 Math. at *Groningen*.

In the *Act. Erud. Lipsiæ* for *Octob.* 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 *Acta* another Paper concerning the Quadrature of Curvilinear Figures.

In *Phil. Transf.* N. 284, there is a Specimen of a general Method for determining the Quadratures of Figures, by Mr. *J. 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 whose *Abscissa* is x, and its *Ordinate Applicate* $x^m\sqrt{dx - xx}$. Let *B* be the Area of a Curve whose Abscissa is the same as that of the former, but its Ordinate $x^{m-n}\sqrt{dx - xx}$; Let $\sqrt{dx - xx} = y$, then shall A be $= dnB$ into $\frac{2m+1}{2m+4}$ into $\frac{2m-1}{2m+2}$ into $\frac{2m-3}{2m}$ into $\frac{2m-5}{2m-2}$ into, &c. $= P$.

$$-\frac{1}{m+2}x^{m-1}y^3 = -Q\left[\frac{d}{m+1}\text{ into }\frac{2m+1}{2m+4}x^{m-2}y^3 = -R\right] - \frac{dd}{m}\text{ into }\frac{2m+1}{2m+4}\text{ into }\frac{2m-1}{2m+2}x^{m-3}y^3 = -S.$$

$$\left[-\frac{d^3}{m-1}\text{ into }\frac{2m+1}{2m+4}\times\frac{2m-1}{2m+2}\times\frac{2m-3}{2m}x^{m-4}y = -T, \&c.\right.$$

 Where

Where obſerve,

1. That n is ſuppoſed to be an Integer and Affirmative Number.

2. That the Quantity d^nB in the Series deſign'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 $\frac{2m+1}{2m+4}\frac{1}{m+2}x^{m-1}y^3$. 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. $\pm P$.

Corol. 1.

If m be put equal to any Term in the following *Series* $-\frac{1}{2}$, $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, $\frac{7}{2}$, $\frac{9}{2}$, &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

$A=d^nB$ 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 *Defect* 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 found equal to $\frac{2}{3}d\sqrt{d}$: And therefore, $A=\frac{2}{3}d\sqrt{d}\,\frac{2y^3}{3\sqrt{x^3}}$.

Corol. 2.

If n be ſuppoſed equal to any Term in the following *Series*, 3, 4, 6, 7, &c. The Quadrature of the Curve, whoſe Ordinate is $x^n\sqrt{dx-xx}$; or $x^n\sqrt{dx+xx}$, becomes finite; and will be exhibited by our *Series*. Thus for inſtance; let the *Area* of a Curve, whoſe Ordin. is $x^1\sqrt{dx-xx}$, 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^nB 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, $-Q$, $-R$, 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 $\frac{2m-2}{2m}=\frac{dd}{m}x^{m-3}y^3$: or dB into $\frac{2m-3}{2}=ddx^{m-3}y^3$; and putting 0 and 3, inſtead of m and n; it will come out thus, dB into $-\frac{3}{2}=\frac{y^3}{x^3}$, or $B=\frac{2y^3}{3x^3}$.

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. 4.

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* or 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 whoſe Abſciſſa is x, and ordinate $\frac{x^m}{\sqrt{dx-xx}}$. And Let B be the Area of a Curve whoſe Abſciſſa 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. $=P$. $\Big[-\frac{1}{m}x^{m-1}y=-Q$.

$\frac{d}{-m-1}$ into $\frac{2m-1}{2m}x^{m-2}y=-R$.

$-\frac{dd}{m-1}$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}x^{m-3}y=-S$.

$-\frac{ddd}{m-3}$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}$ into $\frac{2m-5}{2m-4}x^{m-4}y=T$.

N. B. The Obſervations made above on Theorem 1. will be of Uſe here alſo.

Corol. 1.

If m be ſuppoſed equal to any Term in this Series $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, $\frac{7}{2}$, $\frac{9}{2}$, &c. Then the Quadrature of the Curve whoſe Ordinate is $\frac{x^m}{\sqrt{dx+xx}}$ will be finite, and will be exhibited by this Series.

Corol. 2.

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rel, &c. (7) *Mus Domesticus, Major & Minor*: The common *Ratt* and *Mouse*; *Mus major Aquaticus*, the Water-Rat; the *Musk Rat*. *Mus Avellanarum Major & Minor*. The Dormouse or Sleeper, *Mus Noricus, Cricetus, Alpinus seu Marmotta*. (7) The *Cavia Cobaya*, or *Cuniculus Americanus*; the Guinea Pig: The *Agati* and *Paca* of *Brasile*: The *Mus Norwegicus* or *Leming*: The *Glis Gesneri* or the *Rell*: The *Mus Indicus, &c*.

To these several Kinds of Quadrupeds the following Anomalous ones must also be added;

1. Such Four-footed Viviparous Animals as have a longish Snout, 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 *Erinaceus Indicus albus*. Car. Mus. Leyden. (3) The *Tatu* or *Armadillo prima* of *Marcgrave*. (4) The *Tatuete* of Brasile; or the second Species of the *Armadillo*, according to *Marcgrave*. (5) *Tatu Apara*; his third Species of the *Armadillo*. (6) *Tatu Mustelinus*, Soc. Reg. Mus. The Weesel headed *Armadillo*. (7) *Talpa*, the Mole, Want, or Mold-warp. (8) The *Mus Araneus*, Shrew, hardy Shrew, Shrew mouse.

2. Quadrupedous and Viviparous Animals with a longish Snout, having their Feet divided into many Claws or Toes, but *without Teeth*, are these:

(1.) The *Tamandua-guacu* of Brasile, *Marcgr. Ursus Formicarius Cardani*; the great Ant Bear. (2) The *Tamanduais* of *Brasile*, or *Marcgrave's* lesser 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 Lungs, but having only one Ventricle in their Heart, are These. (1) *Rana aquatica*, the *Frog*, or *Frosh*. *Rana Arborea seu Ranunculus Viridis*, the small Tree or green Frog. (2) *Bufo, sive Rubeta*, the Toad. (3) *Testudo*, the Tortoise, Gr. χελώνη; of these there are Land and Water ones; and many different Species in Foreign Parts.

6. Oviparous Quadrupeds with a long Tail, stretcht out horizontally; are the *Lizard Kind*: As (1) *Lacertus omnium Maximus*; The *Crocodile*. (2) *Cordylus, sive Caudiverbera, Uromastix Græcis*, larger than the green Lizard. (3) *Tapayaxin Novæ Hispaniæ*. The *Lacertus Orbicularis* of *Hernandez*, Ch. 9. c. 16. *Lacertus Vulgaris*, the common Eft, Swift, or Newt. (4) *Lacertus Viridis*, the green Lizard. (5) *Lacertus Fucetanus Aldrovand*; at *Rome* and *Naples* called *Tarantola*. (6) *Lacertus Indicus*; called *Senembi*, and *Inguana*. (7) *Lacertus Brasiliensis*, called *Tejuguacu* and *Temapara*, by *Marcgrave*. (8) The *Taraguira, Ameira, Taraguico Aycuraba, Americima, Curapopepa, Teiunbam*, &c. of *Marcgrave*; the *Lacertus Indicus*, &c. (9) *Scincus, seu Crocodilus Terrestris*. (10) *Seps, sive Lacerta Chocidica*, a Kind of footed Serpent. (11) *Stellio*, the swift or spotted Lizard. (12) *Salamandra Terrestris, Salamandra Aquatica*, the Water-Eft. (13) *Lacerta volans Indica*. (14) *Chamæleo*, the *Chamelion*.

QUÆRENS *non invenit Plegium*, in the Law, is a Return made by the Sheriff on a *Writ* directed to him, with this condition inserted. *Si A fecerit B Securum de Clamore, &c*.

QUÆSTA, 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 *Quæstuarii*, and I believe *Quæstionarii*, vid. *Matt. West*. in Anno, 1279.

QUANTITAS *Acceleratrix* of any *Vis* or *Force*, is the Measure of the Velocity generated in a given Time, by that Force.

QUANTITY *of Motion*: Sir *Is. Newton* in his *Principia*, shews that this, which is found by taking the Summ of Motions tending the *same* Way, on their *Difference*, if they tend towards contrary Parts; is not at all changed by the Action of Bodies on one another.

For *Action* and *Re-action* 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 meet, 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 as six (3×2) to Ten. Wherefore the *Summ* of the Motions of both of them will be $6 + 10$, or sixteen Parts. Now after *B* hath overtaken *A*, and struck 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 9, 10, 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 lost 9; or will be perfectly at *rest*, losing all its 10 Degrees of Velocity; or lastly will move backwards 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 supposing *That* to be to the Velocity before the Reflection :: as the Motion afterwards to the Motion before. Thus in the last Case, where the Body *A* 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 saying, as the Motion of six Parts before the Reflection, to *That* of of 18 afterwards: So is the Velocity of two Parts before, to that of Six afterwards.

QUARREL, in the Law is *Quærela, à querendo*: And it extends not only to Actions personal, but also to *mixt*; and the Plaintiff is then called *Quærens*: And in most of the Writs it is said, *Quæritur*: 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 seized 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 signifies a Furlong, from the French *Quarente*, Forty: Because 'tis a Quantity 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. Angliç. Lib.* 2. *c.* 19. The Holding these Sessions was first Ordained by the Statute of 25 *Ed.* III. Statut. 1. *c.* 18.

QUARTER-*Wheeling*, 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 Sherburn 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 Reginæ*, is a Royal Revenue belonging to every Queen of *England*, during her Marriage to the King, both by Law, Custom 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 Consort by the Name of *Aurum Reginæ*.

QUICK-*Silver*: The Way and Manner how this strangely Fluid Mineral is gained; you have a good Account of by Dr. *Pope* in *Phil. Transf.* N. 2. Thus: 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*, situated on a Valley of the *Julian Alps*. They have been for 160 Years subject 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. The Town, 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-Trees as thick as they can be set: 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 found 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 *second Sieve*; and so 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 *Itches* and other *sordid 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 several of them; and I observed in all that he first poured out *Perfect Mercury*, and after that came a *Black Dust*, which being Wetted with Water, discovered it self to be *Mercury*, as the other was. They take the *Caput Mortuum* and Pound it, and Renew the Operation. There are 16 *Furnaces* for this

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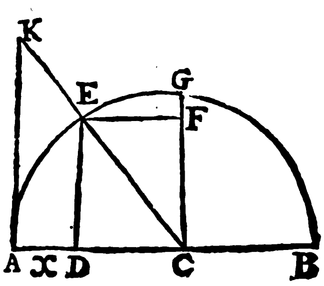
Theorem 6.

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 its Ordin. be $\frac{x^{m\,2n}}{rr+xx}$. I say its Area $A = \frac{x^{m\,1}}{m-1} - \frac{rrx^{m-3}}{m-3} + \frac{r^4x^{\cdot 5}}{m-5}$, &c. $\mp r2\cdot B$.

Corollary.

If m be equal to any Term in this Series 0, 2, 4, 6, 8, &c. The Quadrature of the Curve, whose Ordinate is $\frac{x^m}{rr+xx}$, depends upon the Rectification of the Circular Arch. For if with the Radius



$CA = r$, and on the Centre C, the Circle AEG be described: Let the Tangent CK be erected equal to x, and join CK meeting the Periphery in E. Then I say that AE divided by rr, shall be equal to the Area of the Curve whose Ordinate is $\frac{x^0}{rr+xx}$.

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.*

$x^m\sqrt{dx\mp xx}$; $\frac{x^m}{\sqrt{dx\mp xx}}$; $x^m\sqrt{rr\mp xx}$;.

$\frac{x^m}{\sqrt{rr\mp xx}}$; $\frac{x^m}{d\mp x}$; $\frac{x^m}{rr+xx}$; may be squared by this Series; as will sufficiently appear from this one Example.

Suppose the Cube of the Circular Arch corresponding to any Versed-sine be made the *Ordinate* of the Curve, whose *Abscissa* shall be that very Versed-sine: 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 $v^3\dot{x}$; Let the Area be $v^3x - q$. Then $v^3\dot{x} + 3v^2\dot{v}x - \dot{q} = v^3\dot{x}$; wherefore $\dot{q} = 3v^2\dot{v}x$: But $\dot{v} = \frac{d\dot{x}}{2\sqrt{dx-xx}}$; therefore $\dot{q} = \frac{3dv^2x\dot{x}}{2\sqrt{dx-xx}}$: but by Theorem 2. $\frac{x\dot{x}}{\sqrt{dx-xx}} = \frac{d\dot{x}}{2\sqrt{dx-xx}} - \dot{y} = \dot{v} - \dot{y}$: and therefore $\dot{q} = \frac{3}{2}dv^2\dot{v} - \frac{3}{2}dv^2\dot{y}$; and therefore $q = \frac{1}{2}dv^3 - \frac{3}{2}dv^2\dot{y}$: Where we can find the *Fluent*, whose Fluxion is $\frac{3}{2}dv^2\dot{y}$. Let this Quantity be $\frac{3}{2}dv^2y - r$. Then $\frac{3}{2}dv^2\dot{y} + 3dv\dot{v}y - \dot{r} = \frac{3}{2}dv^2\dot{y}$. And therefore $\dot{r} = 3dv\dot{u}y = \frac{3}{2}ddv\dot{x}$. Let $r = \frac{3}{2}ddvx - s$. Then $\frac{3}{2}ddv\dot{x} = \frac{3}{2}ddv\dot{x} + \frac{3}{2}ddx\dot{v} - \dot{s}$; and consequ. $\dot{s} = \frac{3}{2}ddx\dot{v} = \frac{3d^3x\dot{x}}{4\sqrt{dx-xx}} = \frac{3}{4}d^3\dot{v} - \frac{3}{4}d^3\dot{y}$; by Theor. 2. wherefore $s = \frac{3}{4}d^3v - \frac{3}{4}d^3y$; and therefore the Area sought is $v^3x - \frac{1}{2}dv^3 + \frac{3}{2}dv^2y - \frac{3}{2}ddvx + \frac{3}{4}d^3v - \frac{3}{4}d^3y$.

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 aforesaid 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 *Clawed*, or *Digitate* (*Unguiculata.*)

(I.) The *Hoofed* Animals with four Feet, are either *Whole Hoofed*; *Solidipeda*, Μονόνυχα, Μώνυχα, *Solidungula*: As, The *Horse*, *Ass*, the *Onager*, or *Wild Ass*: 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*, *Aristotle* has observed; that no one hath two Horns, (he might have said any) no one hath the *Talus* or *Astragalus*; nor have the Males any appearance of Breasts.

(2.) *Cloven-footed*; and that either into *Two Divisions* only: As the Δίχηλα or *Bisulcate* Kind, which are again subdivided into such as are

1. *Ruminant*, Μηρυκάζοντα, *i. e.* Such as *Chew the Cud*; and these either have hollow and *perpetual* Horns as the *Ox*, *Sheep*, and *Goat Kind*: Or *Deciduous*, as the *Hart* 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 *Bufalo*, (6) The *Bos Africanus* of *Bellonius*; Obs. *l.* 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 30*l.* Weight: (3) The *Ovis Strepsiceros Cretica Bellonii*: (4) The *Ovis Africana*, with short Hairs instead of Wool. (5) The *Ovis Guineensis*, or *Angolensis* of *Marcgrave*, (Hist. *Brasil.* l. 6. c. 10.)

Of the *Goat Kind*, are besides the common *Capra domestica*; (2) The *Ibex*, or German *Steinbock*; found in the Tops of the *Alps*. (3) The *Rupicapra*, French *Chamois*, German, *Goms*. (4) The *Gazella Africana*, or *Antilope*. (5) The *Gazella Indica*. (6) The

Gazella

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Gazella Africana. (7) The *Capra Sylvestris Africana Grimmii.* (8) The *Capra Mambrina* or *Syriaca* of *Gesner.* (9) The *Buselaphus* or *Moschelaphus Caii,* in *Gesner.* (10) The *Tragelaphus Caii,* in *Gesner.* (1) The *Tragelaphus Bellonii.*

Of the *Hart* or *Deer Kind*: As, (1) The *Cervus,* Ἔλαφος, the *Red Deer.* (2) The *Cervus Platyceros* 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 Plinii.* (7) The *Cuguacu-ete* and *Cuguacu-xapara* 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 the *Hog* and *Swine Kind*; and under this Head, besides the common Swine; they reckon, (1) 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 Coymalt* and *Quapizotl*; and by *Acosta* and some others, *Zaino.* See a most accurate Description of this Animal, in *Philos. Transf.* N. 153.

3. There are some Four-footed Animals whose Hoof is cloven into *Four Divisions*; and these seem to be not *Ruminant*: As the *Rhinoceros,* the *Hippopotamus,* the *Tapijerete* of *Brasile,* the *Capy-Bara* of *Brasile,* the *Animal Moschiferum.*

II. *Clawed* or *Digitate* (*Unguiculata*) 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 *anomalous,* 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 *Claws,* 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 *Ovis Indica* or *Peruviana vulgo,* much less than the *Glama.*

3. A third Species of this *Unguiculate* Kind of Quadrupeds includes such Animals as the Greeks called, Πολυώνυχα, and Ἀνθρωπόμορφα; which have the Foot divided into many *Claws* with broad Nails on them: As the *Ape* and *Monkey* Kind. Of these some have no Tails, and are called *Simiæ* or *Apes.* Others have Tails, and are called *Monkeys, Cercopitheci*; and such as have either long or short 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 Naturalists have described these. (1) The *Ourang-Outang,* or *Homo Sylvestris* of Dr. *Tyson,* described by him in a particular Discourse. (2) The *Guariba* of *Brasile, Marcgravii.* (3) The *Cagui* 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 Angolensis major.* (7) The *Cercopithecus Barbatus Guineensis,* 2 or 3 Sorts of it. (8) The *Cercopithecus non Barbatus Clusii.* (9) *Cercopithecus Clus.* called *Sagouin*; and, if Apes and Monkeys have their Snouts very prominent like Dogs, they are called *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, *&c.* 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 *Dog-kind*; or a *Lesser Sort*; having a long slender Body with very short Legs, as the *Weasel* or *Vermine Kind.* There are some of this Species of Quadrupeds, which have only Two large remarkable Teeth in each Jaw: and these 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 *Leopard.* (4) The *Lupus Cervarius* or *Lynx.* (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 Venaticus Graius* or *Græcus*; or according to some *Scoticus,* the *Grey hound.* (3) The *Graius Hybernicus* or *Irish Grey-hound.* (4) The *Canis Venaticus Sagax, Indagator, Sectator ferarum, &c.* the Hound. (5) The *Canis Venaticus Hispanicus* or *aviarius*: The *Spaniel* for Land or Water. (6) The *Vertagus* or Tumbler. (7) The *Canis* Οἰκουρὸς, *Domesticus,* the House-dog. (8) The *Canis Melitæus* or Lap dog. (9) The *Canis Getulus* or *Islandicus*; the *Shock*: And of all these Sorts there are many Varieties of Mongrels and Hebridous Breeds.

Another Sort of the Dog-kind is (4) The *Fox.* (5) The *Animal Zibethicum,* the *Civet-Cat,* as 'tis corruptly called; but by its Teeth and Snout is plainly of the Dog-Tribe. (6) The American *Coati,* or *Rackoon* or *Rattoon.* (7) The *Tzquiepatl,* (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 Morse, or Sea-Horse, mistaken by some for the *Hippopotamus.* The *Dutch* call him *Walras*; the *Danes* and *Islanders, Rosmarus.* (13) *Manati seu Vacca Marina*; the *Sea-Cow.*

Of the *Vermin* or *Weesel-kind* of Quadrupeds, is first, The *Mustela vulgaris* the Weesel; in *Yorkshire, Foumart* or *Fitcher,* (γαλῆ) (2) *Viverra Indica,* called *Quel* and *Quirpele*; and another Sort called *Mungo* and *Mungathia* of a reddish Grey. (3) The *Mustela,* the *Ermine* or *Stoat,* if white; and the *Mustela Sylvestris,* the Ferret. (4) *Putorius,* the Pole-cat, (5) *Martes, Foyna* (whence our word, a *Gown* of *Foins*) the Marten or Martlet. (6) *Mustela Zibellina,* the *Sable.* (7) The *Genetta.* (8) The *Ichneumon Bellonii.*

Of the *Hare Kind* of Quadrupeds, are first *Lepus,* the common Hare: (2) *Cuniculus,* the Rabbit or Coney. (3) The *Tapeti* or Brasile Coney, and the *Aperea* of Brasile. (4) The *Hystrix,* or Porcupine; and the *Hystrix Americanus,* or *Cuanda* of Brasile. (5) The *Castor, Fiber,* or the Beaver. (6) The *Sciurus vulg.* or *Squirrel.* The *Virginian, Zeylandick,* the *Barbary,* the *American* Flying Squirrel, *&c.*

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this Use, each of them carrying 24 *Retorts*; in all 384 *Retorts*.

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, so that in some places you might take up two or three *Spoonfuls* of *pure Mercury*) is called by them *Virgin Mercury*, and esteemed above the rest. The Officer told me, that making an *Amalgama* of *Gold* and *Virgin Mercury*, and putting it to the Fire, that *Mercury* would carry away all the *Gold* with it, which *Common Mercury* would not do.

The *Engines* for drawing the Water, are all moved by Water, brought thither in no Chargeable *Aqueduct* from a Mountain 3 *Miles* distant. The Water *Pumpt* 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 None stay under ground above 6 *Hours*; all of them in time (some later, some sooner) become *Paralytick*, and die *Hectick*. We saw a Man who had not been in the *Mines* for above *half a Year before*, so full of *Mercury*, that putting a piece of *Brass* in his *Mouth*, 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 *Palsey*.

They convey their Wood thus. About 4 *Miles* from the *Mines* on the sides of Two Mountains, 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 70000 or 80000 *Florins* yearly; but now they Cost him not above 28000. They produced

	Anno 1661.	Anno 1662.	Anno 1663.
	li.	*li.*	*li.*
Ordinary Mercury.	198481	225066	244119
Virgin Mercury.	6194	9612	11862
in all	204675	234678	255981

2. The Town of *Idria* in the County of *Goritia* and Province of *Friuli*, is seated low, and encompassed with Hills on all sides. A *River* of the same Name runs by it, and proves sufficient upon plentiful Rains to convey down the *Firr-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 *Newsol* 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 deepest part of the *Mine* from the Entrance, is between 120 and 130 *Fathoms*.

The *Virgin Quick-silver*, which they call *Jungfraw*, is that which discovers it self without the help of *Fire*. Sometimes it is plainly seen in the *Ore*, or falls down in *Drops*, and sometimes *Streams* out in good quantity; as about Seven *Years* ago it ran out of the Earth at first in a *Stream* as small as a Thread, and afterwards as big as a Packthread, but ceased in 3 or 4 Days. That also is accounted *Virgin Quick-silver*, which is separated 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 silver Ore* of this *Mine* ordinarily contains half, and sometimes $\frac{2}{3}$ of *Quick silver*.

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 wrought 200 *Years*, about the same space of time with *Newsol Mine*, but comes much short in time of the *Silver Mine* at *Schemnitz*; and much shorter yet of the notable *Lead Mines* in *Upper Carinthia*.

In a *Laboratory*, where the *Quick-silver* is separated by *Fire*, I saw an Heap of 16000 *Retorts* of *Iron*; every one of which costs a *Crown* at the best Hand from the *Iron Furnaces* in *Carinthia*. There are 800 *Retorts*, and as many *Recipients*, employed together, in drawing over the *Quick-silver* in 16 *Furnaces*; 50 in each *Furnace*, 25 of a side; 12 above, and 13 below of each side.

June 12. 1669, when I was there, they carried out 40 *Saumes* of *Quick silver* into Foreign Parts, each *Saume* containing 315 pound Weight, to the value of 4000 *Ducats* of *Gold*. Some of it is sent as far as *Cremnitz* in *Hungary*, for the Use of the *Gold Mines*: And very much carried away Southward; for they are not far from the *Sontius*, or *Lysonzo*, a considerable 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 up in double Leather: And in another House as much *Ore* as can be distilled in 2 *Years*, except they have great Plenty of *Rain* to bring down the *Wood*.

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 *Saltzburg* and *Carniola*.

Travelling sometimes in the Night, we had continually about us a great number of large *Glow-worms*, which put into Papers, gave a dimm Light like Candles in Lanthorns; and the Air also was full of *Flaming Flies*, affording some delight unto us.

The way to this Place from *Croatia* I found difficult; and coming from it to *Aidoschini* and *Croatia*, I passed over *Swartzenburg*, or the *Black Mountain*, from whence I descended 10 *Miles* in a Rocky Country, and far more Stony than the *Craw*, or *Campus lapidosus*, in *Provence*.

In the Valley of *Lancy*, which runs between the Mountains of *Turin*, grows a Plant like the *Doronicum*, (so also called by the Inhabitants and *Botanists*,) near the *Roots* whereof you may find *Pure Quick-silver*, running in small Grains like *Pearls*; the *Juice* of which Plant being expressed, and exposed to the Air of a Clear Night, there will be found as much *Mercury*, as there is lost of *Juice*.

QUIETUS, was formerly a Writ of Discharge granted to those Barons and Knights, who personally attended the King in his Wars, or any Foreign Expedition; by which they were exempted from the Claim of *Scutage*, or a Tax on every Knights Fee.

QUINQUAGESIMA; See *Quadragesima*.

QUINTAL, or *Quintan*, was an old Sportive Exercise, practised usually at Weddings, and was either so dangerous or ludicrous as to be forbid often by Ecclesiastical Authority; The manner of it was thus: A Post was erected perpendicularly 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 Tilt at the Board, and to be either so skilful or lucky to escape the Blow which the Sand Bagg would be likely to give the Runner at this Quintan, by the turning round of the Beam. This seems to have been the same with that Sport called *Arietum Levatio*, which is frequently prohibited in our Old Synods and Episcopal Constitutions. *Kennet Par. Antiquities.*

QUINTAL, also was formerly used for a Weight of Lead, Iron and common Metals, of usually an Hundred Pounds; at Six-score to the Hundred.

QUINQUE-*Portus*, the *Cinque* or *Five Ports* of the Kingdom of *England*, were so called formerly by way of Eminence: They are *Hastings*, *Dover*, *Romney*, *Hithe*, and *Sandwich*. There belongs to them also, two Ancient Towns, which are *Winchester*, and *Rye*; and several other Places which are called their *Members*; as *Seaford*, *Feversham*, *Folkstone*, &c.

These had formerly, and have still, great Privileges allowed them on the account of finding the King a certain Number of Ships of War, on occasion: The Numbers of which are these. *Hastings* is bound to find twenty one Ships, each carrying twenty one Men and a Boy. *Romney* is to find Five Ships, with 24 Men and a Boy in each. *Hithe* also must find Five Ships, and in 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 owe the Crown, is to attend with these Ships at their own Charges for fifteen Days, and to set out to those Places whither 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 of a Corner, or any Place else of a Ground-plat, to make a Court or Yard, *&c.*

QUOINS are the Stones and Bricks placed in the Corner of any Building; and if any stick without the Brick-work (their Edges being Cypher'd off) they are called *Rastick Quoins.*

RACHAT, *Rachetum*, from the French *Racheter*, to redeem, was formerly used for the same as *Theft-boote*, viz. the Compensation or Redemption of a Thief. *Skene de verb. signif.*

RADECHENISTORS in Dooms-day book, is used for *Liberi-Homines*; and *Spelman* thinks it to be what *Bracha* calls *Rade-knights*.

RADIAL-*Curves* are Curves of the Spiral kind, whose Ordinates, if they may be so called, do all terminate in the Centre of the including Circle, and appear like so many *Radii* 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 *Rad-knight*. 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 the Roof of a Building: They should not stand farther than 12 Inches from one another.

RAGEMAN, is a *Statute* so called, of Justices assigned by K. *Edw.* 1. and his Counsel, to go a Circuit through all *England*, and to hear and determine all Complaints of Injuries done within 5 Years next before *Michaelmas*, in the fourth Year of his Reign. *Cowel.*

RAIN-BOW. In order yet further to explain the *Phænomena* of the Rain-bow; Sir *Isaac Newton* in his Excellent Treatise of Opticks, *p.* 126. advances this Proposition.

By the Properties of Light (discovered by his New Experiments) to explain the Colours of the Rain-bow.

This Bow never appears but where it rains in the Sun-shine; and it may be artificially made by spouting out Water, which by breaking aloft shall scatter into Drops, and fall like Rain; for the Sun on these Drops certainly causes the Bow to appear to an Eye duly posited to the artificial Rain, and the

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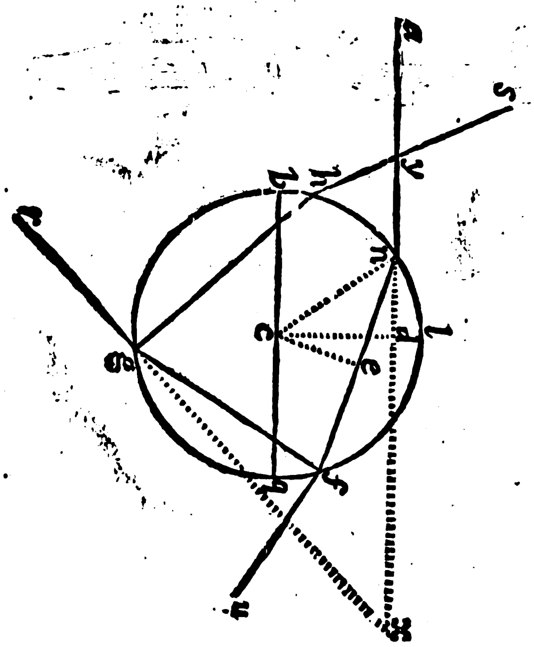
the Sun. And hence it is now agreed, that this Bow is made by the Refraction of the Sun's Light in Drops of falling Rain. This was understood by some of the Ancients, and of late more fully discovered and explained, by *Antonius de Dominis*, A. Bp. of *Spalato in Libro de Radiis visus & lucis*; Printed 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 since they understood not the true Origin of Colours, its necessary to pursue it here a little further.

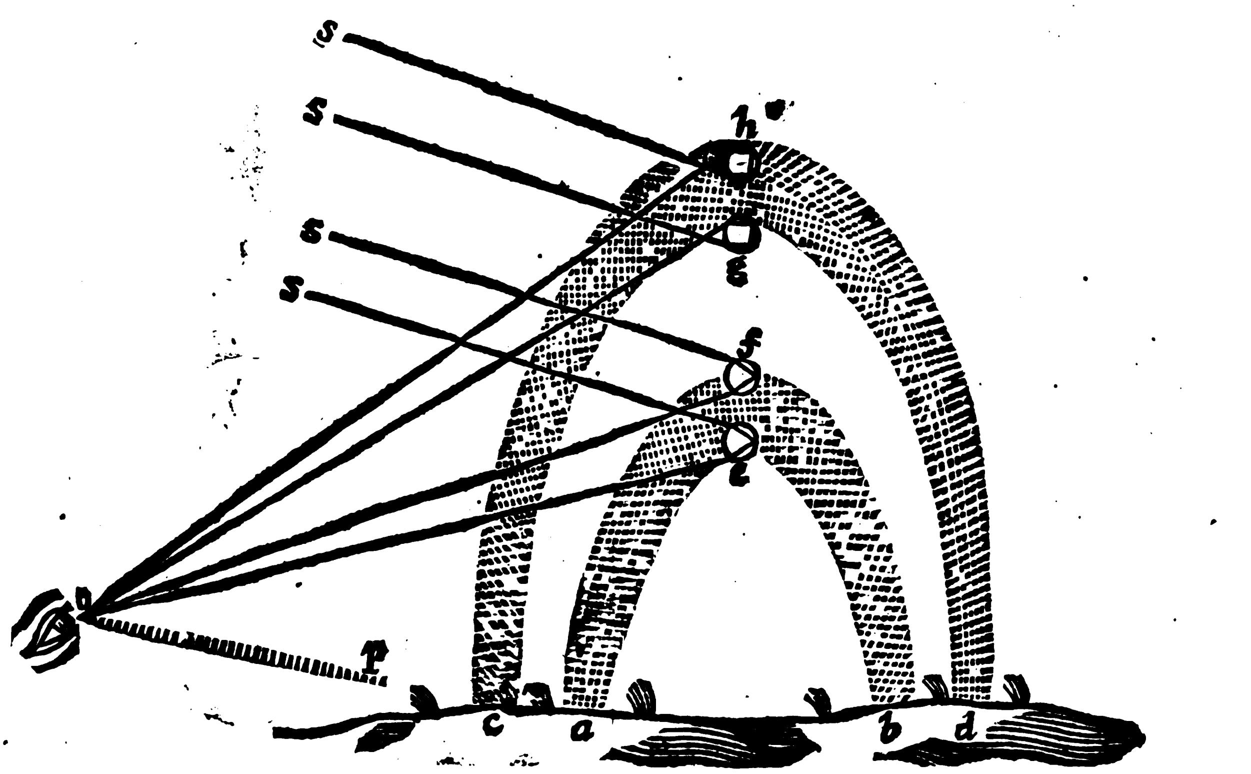
For understanding therefore how the Bow is made, let a Drop of Rain or any other Spherical Transparent Body be represented by the Sphere



b n f o described with the Centre *c*, and Radius *c n*, 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 towards *u*, or be reflected to *g*; and at *g* let it either go out by Refraction at *r*, or be reflected to *h*; and at *h* let it go out by Refraction towards *s*, cutting the Incident Ray in *y*: Produce *a n* and *r g* till they meet in *x*; and on *a x* and *n f* let fall the Perpendiculars *c d* and *c e*; and produce *c d* till it fall on the Circumference at *l*; parallel to the Incident Ray draw the Diameter *b q*, and let the Line of Incidence out of Air into Water be to the Line of Refraction, as 1 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 f* will first increase and then decrease, and so will the Angle *a x r*, which the Rays *a n* and *g r* contain: And the Arch *q f*, and Angle *a x r* will be biggest when *n d* is to *c n* :: as $\sqrt{11-rr}$ is to $\sqrt{3rr}$; in which case *n e* is to *d n*, as 2 *r* to 1. Also the Angle *a y s*, which the Rays *a n* and *h s* contain, will first decrease and then increase, and grow less, when *n d* is to *c n* :: $\sqrt{11-rr}$ is to $\sqrt{8rr}$: In which case *n e* will be to *n d* :: as 3 *r* to 1, and so the Angle which the next emergent Rays, *viz.* after 3 Reflexions, contains with the incident Ray *a n*, will come to its limit when *n d* is to *c n* :: as $\sqrt{11-rr}$ is to $\sqrt{15rr}$; and *n e n d* :: as 4 *r* to 1, and the Angle with the Ray next 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 *c n* :: as $\sqrt{11-rr}$ is to $\sqrt{24rr}$; in which Case *n e* will be to *n d* :: as 5 *r* 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 *c d*, 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 *b l*, 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 by Computation the greatest Angle *a x r* will be found 42° 2', and the least Angle *a y s* 50° 57'. And in the most refrangible Rays, the Sines 1 and *r*, are 109 and 81; and thence by Computation the greatest Angle *a x r* will be found to be 40° 17'; and the least Angle *a y s* 54° 7'.



Supposing now then *o* be the Spectator's Eye, and *op* a line drawn parallel to the Sun's Rays, and let *poe*, *pof*, *pog*, and *pob*, be Angles of 40° 17': 42° 2': 50° 57', and 54° 7' respectively; and these Angles turned about their common side *op*, shall with their other sides *oe*, *of*, *og*, and *ob*, describe the Verges of 2 Rain-bows *afbe*, and *cbdg*: For if *e*, *f*, *g*, *h*, be Drops placed any where in the Conical Superficies described by *oe*, *of*, *og*, *oh*, and be illuminated by the Sun's Rays *se*, *sf*, *sg*, *sh*: The Angle *seo* being equal to the Angle $poe = 40° 17'$, shall be the greatest Angle in which the most refrangible Rays can after one Reflexion be refracted to the Eye: And therefore all the Drops in the Line *oe*, 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 *sfo* being = to the Angle $pof = 42° 2'$, shall 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 copiously to the Eye from the Drops in the Line *of*, and strike the Senses 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 Inside 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° 51', 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 refrangible Rays shall come most copiously to the Eye from the Drops in the Line *og*, and strike the Sense with the *deepest Red* in that Region. And the Angle *sho* being equal to $poh = 54° 7'$, shall be the least Angle in which the *most* refrangible Rays, after 2 Reflexions can emerge out of the Drops; and that those Rays shall come most copiously to the Eye from the Drops in the Line *oh*, and so strike the Senses with the *deepest Violet* in that Region. And by the same Argument, the Drops in the Regions between *g* and *h*, 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 *h*, or from the inside of the Bow to the outer, in this Order: Red, Orange, Yellow, Green, Blue, Indico, Violet. And since these 4 Lines *oe*, *of*, *og*, *oh*, may be situated any where in the above-mentioned Conical Surface, what is said 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 Reflexion in the Drops, 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 *goh*, shall be 3° 10'; and the Distance between *gof*, shall be 8° 55'. The greatest Semidiameter of the innermost, (*i. e.*) the Angle *pof* being 42° 2'; and the least Semidiameter of the outermost *pog* 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 confirmed, by the known Experiment of hanging up in the Sun-shine a Glass-globe filled with Water; and then viewing it in such a Posture, that the

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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 side 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 side of the Globe which is towards the Sun: And if the Angle be made greater, (suppose by lifting up the Globe to *h*) 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 so, as to make the Angle of a just Magnitude.

RAINS: Our Seamen call that Tract of the Sea to the Northwards of the Equator betw. 4 and 10 Degrees of Latitude, and lying between the Meridian of *Cape Verde*, and that of the Eastermost Islands of the same Name, or of the *Cape Verde* Islands, they call this Tract the *Rains*: Because there are almost continual Calms, constant Rains, and Thunder and Lighning 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 strait Line made by the Soldiers of a Battalion, or Squadron drawn up side by side, *Doubling of Ranks* is putting two into one.

RAPACIOUS *Animals*, are in general such as live upon Prey: And 'tis 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 pointed Beak and Talons, fitted for ravine and tearing of Flesh; strong and brawny Thighs for striking down their Prey: A bread thick fleshy Tongue like that of a humane Creature; 12 Feathers in their Train; and 14 flag 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 fly 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 *Frænum* to the *Anus*, divides the *Scrotum* and *Perinæum* 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 Re-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 84 to 90 Guns.

Third Rates 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.

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 *Rate*; 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 *Knights 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 *If. 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.

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The incomparable Sir *Is. Newton* in his Opt. Book 2. Part 3. *p.* 65. After having premised *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 several 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 solid or impervious Parts of Bodies as hath commonly been believed, as appears from the following Considerations.

(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 reflecting Parts than Water or Glass. But if that could be supposed it would not do, because the Reflexion is as strong or stronger 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 adjacent 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 Pores enough 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 soever it falls, it finds Pores enough in the Glass 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: Besides, 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 Measure 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 striking of the Rays upon the Parts of the Glass.

(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 Glass, how comes the *Blue*, at the same Obliquity of Incidence, wholly to impinge on those Parts so as to be all reflected, and yet the *Red* find Pores enough 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 should 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 reflected 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 *white*.

Nor is it only at the least Thickness of Bubbles and thin Plates that there is no manifest Reflexion, but at many others continually greater and greater: For he found (in Obser. 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 thin Plates or Bubbles at the *same place* to reflect 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 instance) exhibit a *Blue*, should have the Fortune to dash upon the *Parts*; 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 *Parts* polished.

(7) Were the Rays of Light reflected by impinging on the solid 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 visible. And then if Light were reflected by impinging upon the solid 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 fretting Substances can reflect Light so regularly as it doth; and this can't well be solved, unless the Reflexion of the Ray be effected, not by a single Point of the reflecting 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 Light at a distance, he shews in another Place. (See *Light.*) And if Light be reflected not by impinging on the solid Parts of Bodies but by some other Principle, 'tis probable that these Rays which do impinge on the solid Parts of Bodies, are not

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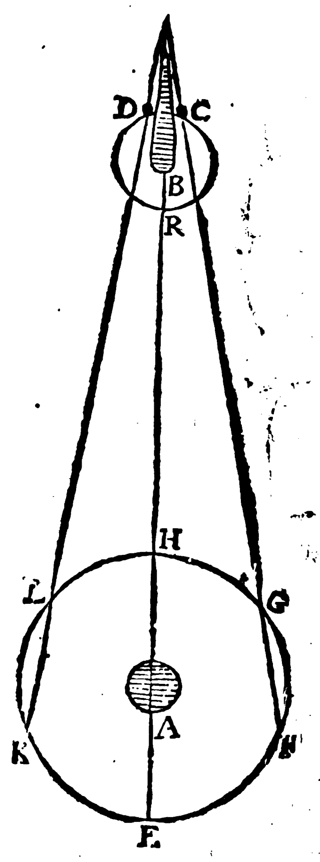
reflected but *stifled* and *lost* in the Bodies; for otherwise two Sorts of Reflexions must be allowed. Should all the Rays be reflected which impinge on the Internal Parts of Water or Chrystal, these Substances would rather have a cloudy, than a transparent Colour. To make Bodies look black many of the Rays must be stopt, retained and lost in them, and it seems 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 Considerations. 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 refracted the Light as obliquely as is possible, 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 Glass 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 distance, as they pass out 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, nor yet be at any considerable distance one from another, as it may be not above the $\frac{1}{100000}$ part of an Inch.

For then the Rays which, at passing out of the hinder Surface of the first Glass, would have been reflected and turn again to it, if the Distance of the 2° Glass had been considerable, will now all readily in that part, pass through the Second Prism or Object Glass, just as if there were a hole thro' it. See Sir *If. Newt.* 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 *G F* be in length equal to the Semi-diameter of the Earth's annual Orbit *AE*, or *A H*: As let also *L K* 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

But if the Propagation of Light take up any sensible Time, 'tis plain that the Observers posited in G and 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 Emersions 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 *Jupiter*, the Immersions of the *Satellites* into his Shadow do anticipate the mean Time which they should happen in, according to Calculation; 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 Astronomers. There was indeed some doubt about this matter started by *Cassini*; but our Accurate Mr. *Halley* Savilian Professor of Geometry at *Oxford*, hath cleared up all the Difficulty; and demonstrated that this Progressive Motion of the Rays of Light, to such a Distance, and in such a given Time, is absolutely necessary to account for the *Phænomena* 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, seems 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 Seven. 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 Motion of the Earth it self in the Annual Orbit, which yet is pretty swift, (*viz.* at the Rate of $3\frac{1}{2}$ *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 Satellites 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 us, the longer will be the Distance between the *true* and *apparent* Time of their Eclipses: Thus, tho' the Moon's Eclipses will appear to us to be nearly at the same Time, at which they really happen; yet those of the Sun must appear later, those of the Satellites of *Jupiter*, later yet; and those 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 Observation.

4. Supposing the Distance of the fixed Stars 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 *Syrius*, 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*.

REACTION; 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 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, &c. 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 *hinder* 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 *Velocities*, but of the *Motions* 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 themselves.

REAFFORESTED is used, where a Forest hath been *Disafforested*, and then made a Forest again: 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; is the 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 the *Reserve-Line*.

REAR-*Rank*, is the last Rank of a Battallion when drawn up.

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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 ſee an Act both from Equity and a Mathematical *Calculus* in the *Acta Eruditorum Lipſiæ*, from *October*. 1683, by G. G. *Leibnitz*.

REBELLIOUS *Aſſembly*, is a gathering together of Twelve or more Perſons, intending or going about, practiſing 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 get 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 ſignifies 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 the

RECEIVER *of the Fines*, which is an Officer that receives the Money of all ſuch 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, Forfeitures, Aſſeſments, *&c.* within that Dutchy.

RECEPTACLE *of the Chyle*, was known and deſcribed by *Bartholomæus Euſtachius* many Years before the Diſcovery of the Lacteal Veins, *vid. Keil'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 deſcending Trunk of the great Artery, between the *Celiack* and *Emulgent* Arteries, ſurrounded by ſeveral Lymphatick Glands, which are called *Glandulæ 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 Duct about the Bigneſs of a Gooſe-quill.

RECLINATION *of a Plane*, 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 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 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 ſhut up, and cannot ſtir out of a Cloyſter, *&c.* See *Littleton*, 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 Novæ Aſſiſæ*, is a new Trial.

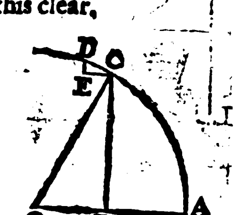
RECTA *Directrix*, is a Line in Conicks made by the mutual Interſection of the Vertical Plane, with the Plane of the Baſe. *De la Hire*.

RECTA *Priſa Regis*, 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 Privileges to the Barons of the Cinque Ports, among other things, diſcharges them particularly from this Duty.

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,

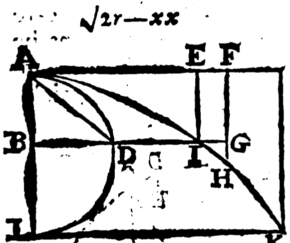
RECTITUDO was then uſed for a *Right* or *Legal Due*; and Oblations and Tithes were called *Rectitudines Dei*.

RECTIFICATION of Curves. To what hath been ſaid on this Point under *Rectifying* in Vol. 1. and under *Cycloid* in Vol. 2. 'twill be proper to add, what the ingenious Mr. *Moivre* advances in his Illuſtrious Specimens of the Uſe and Advantages of the Doctrine of Fluxions: Where he ſaith, that the *Rectification of Curve Lines* will be obtain'd, if we conſider the Fluxion of the Curve as a Hypothenuſe of a Rectangular Triangle, whoſe ſides 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.

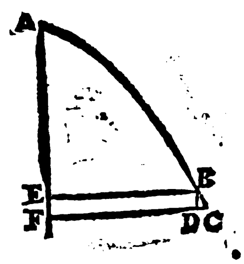


The right Sine C B being given, to find the Arch A C. Let AB $= x$. CB $= y$. OA $= r$. CE the Fluxion of the Abſciſſe, E D the Fluxion of the Ordinate, CD the Fluxion of the Arch CA. From the Property of the Circle $2rx - xx = yy$, whence $2r\dot{x} - 2x\dot{x} = 2y\dot{y}$, and therefore $\dot{x} = \frac{y\dot{y}}{r-x}$. But $CD^q = \dot{y}\dot{y} + \dot{x}\dot{x} = \dot{y}\dot{y} + \frac{y^2\dot{y}\dot{y}}{rr-2rx+xx} = \dot{y}\dot{y} + \frac{y^2\dot{y}\dot{y}}{rr-yy} = \frac{rr\dot{y}\dot{y}}{rr-yy}$, therefore $CD = \frac{r\dot{y}}{\sqrt{rr-yy}} = \frac{1}{\sqrt{rr-yy}} \times r\dot{y} = r\dot{y} \times \overline{rr-yy}^{\,-\frac{1}{2}}$. And conſequently if $\sqrt{rr-yy}$ be thrown into an infinite Series, and the several Members of it be multiplied into $r\dot{y}$, 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 resuming the Equation found above $2r\dot{x}-2x\dot{x}=2y\dot{y}$, we have $\dot{y}=\frac{r\dot{x}-x\dot{x}}{y}$, but $\dot{CD}^2=\dot{x}\dot{x}+\dot{y}\dot{y}=\dot{x}\dot{x}+\frac{rr\dot{x}\dot{x}-2rx\dot{x}\dot{x}+x^2\dot{x}\dot{x}}{yy}=\dot{x}\dot{x}+\frac{rr\dot{x}\dot{x}-2rx\dot{x}\dot{x}+x^2\dot{x}\dot{x}}{2rx-xx}$, that is, (reducing all to the same Denominator, and expunging contradictory Terms) $\frac{rr\dot{x}\dot{x}}{2rx-xx}$, whence $\dot{CD}=\frac{r\dot{x}}{\sqrt{2rx-xx}}$, and consequently the length of the 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 $\sqrt{2rx-xx}:r::\dot{x}:\frac{r\dot{x}}{\sqrt{2r-xx}}$



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 FH parallel to EI and infinitely near to it, as also BI cutting FH in G, and the Curve AK in H. Put AL $=d$. AB ($=$ EI) $=x$. GH $=\dot{x}$. 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 $=\frac{\frac{1}{2}d\dot{x}}{\sqrt{dx-xx}}$ and the Fluxion of the right Sine BD will be found to be $\frac{d\dot{x}-2x\dot{x}}{2\sqrt{dx-xx}}$; therefore I G $=\frac{d\dot{x}-x\dot{x}}{\sqrt{dx-xx}}$ and therefore $\dot{IH}^2$ ($=\dot{IG}^2+\dot{GH}^2$) $=\frac{dd\dot{x}\dot{x}-dx\dot{x}\dot{x}}{dx-xx}$; from whence $\dot{IH}=\frac{\dot{x}\sqrt{dd-dx}}{\sqrt{dx-xx}}=\frac{\dot{x}\sqrt{d}}{\sqrt{x}}=d^{\frac{1}{2}}x^{-\frac{1}{2}}\dot{x}$, and consequently AI $=2d^{\frac{1}{2}}x^{\frac{1}{2}}=2\sqrt{dx}=2$AD. This Conclusion may also be very easily deduc'd from the known Property of the Tangent. For since 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, $x:\sqrt{dx}::\dot{x}:\frac{\dot{x}\sqrt{dx}}{x}$, therefore I H $=\frac{\dot{x}\sqrt{dx}}{x}=d^{\frac{1}{2}}x^{-\frac{1}{2}}\dot{x}$. 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 $=\frac{dx\dot{x}-x^2\dot{x}}{\sqrt{dx-xx}}=\dot{x}\sqrt{dx-xx}$. 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 $=z$, B D $=\dot{x}$, D C $=\dot{y}$, B C $=\dot{z}$. The Equation expressing the Nature of the Parabola, being $ax=yy$, we have $a\dot{x}=2y\dot{y}$, whence $\dot{x}=\frac{2y\dot{y}}{a}$; but $\dot{BC}^2=\dot{BD}^2+\dot{CD}^2$, that is $\dot{z}\dot{z}=\dot{x}\dot{x}+\dot{y}\dot{y}=\frac{4y^2\dot{y}\dot{y}}{aa}+\dot{y}\dot{y}=\frac{4y^2\dot{y}\dot{y}+aa\dot{y}\dot{y}}{aa}$, and therefore $\dot{z}=\dot{y}\frac{\sqrt{4y^2+aa}}{a}=\dot{y}\frac{\sqrt{y^2+\frac{1}{4}aa}}{\frac{1}{2}a}$. If now by this Expression $\dot{y}\frac{\sqrt{y^2+\frac{1}{4}aa}}{\frac{1}{2}a}$ be thrown into an infinite Series, the Curve AB will easily be known. It appears farther, that giving an *Hyperbolical Space*, this Curve is

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is also given, and *vice versa*. For $\frac{1}{2} a \dot{z} = \dot{y} \sqrt{y^2 + \frac{1}{4} aa}$, and consequently $\frac{1}{2} a z$ is the Space whose Fluxion is $\dot{y} \sqrt{y^2 + \frac{1}{4} aa}$. 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 Absciffe AE $= y$, and its Ordinate EG $= x$.

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 whose 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 $= \frac{r\dot{x}}{\sqrt{2rx - xx}}$, which if we multiply by the Periphery belonging to the Radius BC, that is, by $\frac{c}{r} \sqrt{2rx - xx}$ (putting $\frac{c}{r}$ the Ratio of the Circumference to the Radius) we shall have $c\dot{x}$ for the Fluxion of the spherical Superficies, and consequently that Superficies it self, is cx.

RECTUM, was used formerly for a *Trial*: *Commune Rectum* was a Trial at Law; or in common Course of Law: And *Stare ad Rectum*, was to stand 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 six Hyperbolical Legs: See Curves.

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. *Nicholson's Hist. Library*.

RED *seer*, when a Piece of Iron in a Smith's Fire of his Forge is heated too much, it will *Red-seer*, 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 Extent* 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 Dined and Supped.

REFERENDARY, *Referendarius*, was a Term used 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 Court of Requests was taken away by 16. 17. Car. 1. *See Court of Requests, in Vol.* 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 *Test*; 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 *English*) *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 Pot*, into 3 *Branches*; one whereof in the midst 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 *Luted* on with *Colcothar*, *Rags*, *Flour* and *Whites* of *Eggs*. To the first *Glass Body* is *Luted* 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 *Head* to the *Receiver*. The two Upper *Receivers* or *Glass Bodies* need Exceeding good *Luting*, for the rest Ordinary *Lute* will serve.

The *Lute* is made of good *Lome*, some *Horse-dung*, 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-fortis* being *Distilled* off, is put into a large Earthen Pot, and there is added of *Fine Silver*, *one* or *two Penny weight* (which is called *Fixes*) to every *Pound* of *Aqua-fortis*, which within 4 *hours*, will purge it from all Dirt and Impurity, and make it fit for *Parting*, which is thus done.

If their *Silver Gilt* be *Fine* enough for *Wire*, they only *Melt* it in a *Wind Furnace*, and Cast 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 Taper-fashion'd, a *Foot* High, and 4 *Inches* at the Bottom; and then the *Glasses* are Charged with *Aqua-fortis* about 2 *thirds* of it, and set in a *Range* of *Iron* covered 2 *Inches* deep with *Sand*, and a *Gentle Charcoal-Fire* is made under it.

Small *Bubbles* will soon arise, and the Water also run over. If so, they take off the *Glasses*, and hold them till it doth *Defervescere*, or else 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

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When the *Water* hath been once *Quieted* from this *Ebullition*, it will Rise no more.

The *Greenness* of the *Water*, manifesteth the 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 *hour*, 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 sides of the *Bowl*) 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 softer 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 any Use.

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 *Silver*, and *Whiting*, *Verditer* is made thus. They put into a Tub a *Hundred Pound* weight of *Whiting*, and thereon pour the *Copper-water*, and stir them together every Day, for some *Hours* together. And when the Water grows pale, they take it out, and set by for farther 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 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 consisting of *Salt-Peter* deduced, (most of the *Spirit* of *Vitriol* 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 *Soap-Ashes*. Some use Cakes of *Pot-Ashes*, or other *Ashes* well cleansed, and so pressed well together with a *Muller*, that it becomes 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 parallel to the Circumference of the *Mould*; only a small *Channel* in that End, which is most remote from the *Blast*, for the Running off of the *Baser Metals*, and so is made *Declive* to the Center of the *Test*, where 'tis not above half an *Inch* deep.

The *Test* thus made, is set *Annealing* 24 *Hours*, and then 'tis set 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 *Test*. Whose Motion the *Refiner* helps with a long Rod of *Iron* drawn along the Surface of the *Silver* towards the fore mention'd *Slit*; and often stirring all the Metal, that the *Impurer* may the better rise; and by continuing this Course, *Separation* is made in 2 or 3 *Hours*.

The greatest part of the *Lead* flies away in *Smoak*.

If the *Lead* be gone before all the *Copper*, 'twill rise in small Red fiery 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 side of the *Test*, and helps its running over.

When the *Silver* is fully *Fined*, it looks like most pure *Quick-silver*; 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 *Dross* or *Filth* be in the *Melting-Pot*, they throw in some *Tincal*, which gathers the *Dross* 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 sorts 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 *Silver*, 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 *looser* 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 Narrower 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 Hole to receive the Nose of a great Pair of *Bellows*.

When

When the *Furnace* is *Annealed* with Charcoal and Hot, they throw two or three Shovels of Coal, to one of the fore-mention'd Stuff, and so proceed 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 pass 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 Men*.

To get the *Silver* from those *Metals*, and to *Refine* their *Copper* from the *Litharge*, they now use no other Art than that of the *Test*.

4. By *Quick-silver* 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 *Bolt-head* 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 head*.

REFLECTED *Dialling* is the Art of describing 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 come to directly, but only by the help of some reflecting Surface; as suppose on the Ceiling of a Room, &c 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 Glass 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 *true Hour* Lines, *Furniture*, &c tho' the Surface be never so irregular, as convex, concave, or of any form whatsoever.

First, draw on Past board or other Material, or get made in Brass an Horizontal Dial for the Latitude 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 Centre of the Glass they may be in the true Meridian-circle 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 *Opticks*, which is, *That the Angle of Incidence is equal to the Angle of Reflection.* And as any direct Dial may be made by help of a Point found in the direct Axis, so may any reflected Dial be also made by help of any Point found in the reflected Axis.

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 by applying the Side or Edge of a Quadrant to the 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 reversed Axis sought for.

Now if the reversed 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 reversed Axis point will fall, and find the Axis point from that 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 in the reversed Axis desired.

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 Hour-lines on any Ceiling 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 reversed 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 lower at pleasure, 'till it, as formerly, touch the said same Hour Thread, and mark again where-abouts on the Wall or Ceiling, the End of the said Thread

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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 any Plane, how irregular ſoever. For if you move a Thread, and alſo your Eye to and fro, until you 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 before) 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 or Ceiling, being in the reflected Hour-line deſired, by help of which two Points the whole Hour-line 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 ſo, that the Reflex or Spot of the Sun from the ſaid Horizontal Glaſs ſituated in the ſaid Window (as before) ſhining amongſt the ſaid reflected Hour-lines drawn on the Wall or Ceiling, will exactly ſhew the Hour of the Day deſired.

Now if Lines be drawn round about the ſaid Room, equal to the Horizon of the ſaid Glaſs, it will ſhew when the Sun is in or near the Horizon.

To draw the Æquator and Tropicks on any Wall or Ceiling to any Horizontal reflecting Glaſs.

1. *To draw the reflected Æquator or Equinoctial line on the Wall or Ceiling, which repreſents a great Circle.*

Take the Thread fixed in the Centre of the 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 be always perpendicular to the reverſed Axis) marking in the Meridian where the end of that 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 whatſoever, and is the reflected Equinoctial-line deſired.

Note that all great Circles are right Lines, and are always drawn or projected from a right Line.

2. *To draw the Tropicks. Note, that all Parallels of Declination are leſſer Circles, and are Conick Sections.*

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, when the Sun is in either of the Tropicks. Then take the Thread fixed in the Centre of the Glaſs, and by applying one Side of a Quadrant to the ſaid 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 Hour-line 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 Hour-lines, which is the Tropick deſired.

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 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 Parallels of Declination to any reflected Glaſs moſt 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 ſtill laid on the ſame Parallel of Declination on the Trigon: In the ſame manner find a Point in each Hour-line. Laſtly, 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 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 Horizon the Azimuths may be drawn, as by a Point found in the reflected Axis of the Equinoctial 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

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as was shewn in drawing 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 desired to be drawn, and at the further side 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 so 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 said 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 said Wall or Ceiling: Now by help of these two Points found in the reflected Azimuth-line, the whole Azimuth-line may be drawn; for if (as before in drawing the Hour-lines) a Thread be so situated, that it may interpose between the Eye and the said two Points, you may make many Points at pleasure to which the said 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 Azimuth line desired 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 Quadrant for the Elevation thereof, which will shew the Sun's Altitude at any appearance thereof.

Thus have I shewed the drawing of a reflected Dial from an Horizontal Glass, with all the usual Furniture thereon, though the Wall or Place on which it is to be drawn, be never so gibbous or irregular, or in what shape soever.

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 small.

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 considered.

1. *The Reflected Horizon.*
2. *The Reflected Meridian.*

Note the Horizon and Meridian are two great Circles.

1. *To draw the reflected Horizon according to the Situation of any reclining Glass whatsoever.*

First, let two Pieces of nealed Wire be fastened on the Window on each side of the said Glass, the Ends thereof being without the Room in the Air, at whose Ends let there be fastened a Thread which may be pulled straight at pleasure, by bending of the Wire, then bend those Wires upward or downward, until the Thread fastened at the End 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 see the reflecting Glass, and therein the said Horizontal Thread without the Room: Then on the said Thread cross the Room, I tie a slipping Knot 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 interposing the sight of the other. Then being careful to keep the Knot in that position, fasten one End of a Thread in the place of the Centre of the reclining reflecting Glass, and bring that Thread so, as just to touch the aforesaid Knot, 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 the reflected Horizon of the World. 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 said Glass I find from my Eye the said Knot, and part of the Horizontal Thread both in one right Line, the one interposing the sight of the other; and by the said Knot I bring the Thread, whose End is fastened in 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 said 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 reflected Horizon desired 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 Glass, so that the Thread and Plummet may hang without the Room: Then by help of the Sun's Azimuth you may draw the Meridian-line, (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 Plummet be in the direct Meridian of the World with the Centre of the Glass. Then (as before) tie a Thread cross the Room, in such sort that from or by some part of the said Thread both the reclining Glass and the Thread to which the Plummet is fastened may be seen at one Time: Then (as (as before) on the said Thread, which crosses the Room, I tie a slipping Knot, 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 interposing the sight of the other; being then very careful to keep that Knot in the same Position, 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 reflected Meridian of the World, according to the Situation of that Glass. Then again I remove that Thread, (overthwart the Room) on which the said Knot is, either higher or lower than it formerly was, at pleasure, 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 sight 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 said Thread being continued to touch the Wall or Ceiling: so is that Point of Touch on the Ceiling another Point found in the reflected 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 said reflected Meridian may be made at every Bending or Angle of the Wall or Ceiling, whereby the reflected Meridian desired may be drawn, by drawing a Line from Point to point obliquely in the Room, which will be the true reflected 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 help 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 situate the Centre of the Dial on the Centre of the Glass, and the Meridian of that Dial on the reflected Meridian of the World: Then to find the Point in the reflected reversed Axis on the Floor of the Room: Take a Thread, one End thereof being 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 whatsoever. 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 said 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 desired, 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 drawing the reflected Hour-lines to an Horizontal Glass.

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 Equinoctial-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 reflected 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 of the Glass, move the other End thereof to and fro in the Hour line proposed, until by applying one side of a Quadrant to the said Thread you find

find the said 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 in the reflected Parallel of Declination desired to 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 said Thread, whose End is fastened in the Centre of the Glass, equal to the Sun's Altitude in that Hour above the said reflected Horizon, by help of the said Quadrant, and where the other End of the said Thread falleth 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 Hour-lines, 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 manner may be drawn all or any other Parallel of Declination, which may have respect to the Sun's place, or the Length of the Day, as shall be desired.

Or,

To draw the said reflected Tropicks, or other Parallels of Declination, without any Tables calculated, only by help of a Trigon *first made on Past board, or other Material. Note, that all Parallels are lesser 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 Glass, then also will the Equinoctial 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 said 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 Hour-line 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 reflected Parallel must pass; then drawing a Line to pass through those several Points on the said Plane or Ceiling, which Line is the reflected Parallel of the Sun's Declination desired.

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 note that Azimuths are great Circles.

First, know that the reflected Vertical-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 reflected Axis of the Horizon differ from the direct Axis of the Horizon: Hence the reflected Vertical-point, whereby the reflected Azimuth-lines are drawn, 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 said Thread toucheth the said reflected Meridian on the Wall, Ground or Floor of the Room, which Point so found, is the reflected Vertical-point 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 the Meridian thereof in the reflected Meridian of the World, which said Past-board must be also situated in the reflected Horizon just as the Horizontal Dial was formerly directed to be situated 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 Glass be 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 said 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 said reflected Azimuth-line must also pass: In like manner may more Points be found for your further Guide, in drawing that Azimuth-line. But two Points being found will be sufficient.

To draw any Reflected Line by any two Points given 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

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Threads straight, fastening each of the other Ends in the two reflected Azimuth-points formerly found on the Wall or Ceiling. Then situate a Thread across 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 said Thread cross the Room may any Number of Points in the said reflected 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 reflected Azimuth-line (or other Lines) as was formerly done by a Thread so situated, 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 said Past-board, and then fasten it again on the further Side of the Room (as before) you may by help of the said Thread, fastened 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 reversed Axis, hath to the Hour-line drawn on the Horizontal Dial, in drawing the reflected Hour-lines; The same hath the reflected Vertical-point found on the Floor or Ground, to the Azimuths 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 Sun-beams 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 Place of the Centre of the reclining Glass, and the other End moved to and fro in any reflected Azimuth-line, until the said Thread be elevated any 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 pass.

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 Azimuth-line drawn on the Wall or Ceiling, I make another 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 desired, 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 that Declination, the Day is 15 Hours long in the Summer, and 9 in the Winter: Then (as is formerly directed) situate 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 Hour-lines desired, which will at any Appearance of the Spot by the Reflex of the Glass amongst those Hour-lines, shew how many of the Equal Hours is past since Sun-rising, as was desired. 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 Hours, Half-hours, or Quarters. And such a Declination may be found, that it shall so do in any Latitude desired.

Unequ. Hours.	15 H.	M	Equal H.	9 H	M.	Unequ. Hours.	15 H.	M.	Equal H.	9 H	M.
0	4	30	6	7	30						
1	4	45	7	8	15	7	1	15	1	0	45
2	7	00	8	9	00	8	2	30	2	1	30
3	8	15	9	9	45	9	3	45	3	2	15
4	9	30	10	10	30	10	5	00	4	3	00
5	10	45	11	11	15	11	6	15	5	3	45
6	12	00	12	12	00	12	7	30	6	4	30

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REFLECTING *Telescope*. See *Telescope*.

REFLECTION, is a Power the Human Mind hath of perceiving its own Operations, within it self, when it is employed about the *Ideas* it hath before gotten by Sensation; which *Operations*, when we come to reflect and consider on them, do furnish our Understanding with a great Number of Ideas, which could not be had by bare *Sensation*, of things without us: Such as *Perception Thinking, Believing, Doubting, Reasoning, 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 Hypothesis.

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 reflected at least Thickness of any Plate or Bubble; (see Obs. 13, 14, and 15, compared with 4 or 18th) The red 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.

REFORM, to *reform* in a Military Sense is to reduce a Body of Men either by disbanding the Whole, or only breaking a Part, and retaining the Rest, or sometimes by incorporating them in other Regiments. So that a

REFORMED *Officer* is one whose Troop or Company is Broke, and he continued in either whole or half Pay, doing Duty in the Regiment.

REFRACTED *Dials* are such as shew the true Hour only, by the means of some Refracting Transparent Fluid: As thus,

If you stick up a Pin 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; (see *Reflected Dialling*) assigning the Meridian Line on the Edges of the Bowl, point out 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 to the Latitude or Elevation of the Pole of the Place: Then with a Candle, or by bringing the Thread to cast a Shadow on any Hour-point formerly mark'd out on the Edges of the Bowl, that Shade in the Bowl is the true Hour-line; and if the Bowl be full of Water, &c. When this is done, it will never shew the true Hour by the Shadow of the Top of the Pin, but when filled again with the same Liquor.

REFRACTION, Sir *Is. Newton* in his Opticks *p.* 56, 57, 58. On this Natural Supposition that *Bodies refract Light by acting 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*.

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 $27\frac{1}{2}$ 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 nearly 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 Reflexion) 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 Densities of the same Bodies*; excepting that unctuous 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 Refraction of the Air is determined by that of the Atmosphere observed by Astronomers, and he shews that the whole Refraction of Light in passing thro' the Atmosphere, from the highest and rarest Part of it down to the lowest and densest, 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.

In particular he shews there, That the Refractions of a *Pseudo Topaz*, a *Selenitis*, Rock Chrystal, Island Chrystal, vulgar Glass, (*i. e.* Sand melted together) and Glass of Antimony; which are terrestrial stony Alcalizate Concretes; and of Air, (which probably is the Result of such Substances by fermentation) tho' these Substances be very differing from one another in Density, yet have they their refracting Powers almost in the same *Ratio* to one another as their Densities are: Excepting that the Refraction of that strange Substance, *Island Chrystal*, is a little greater than the Rest. And 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 respect of theirs; excepting so far as those two differ one from another.

Again, the Refraction of Camphire, Oil Olive, Line seed Oil, Spirits of Turpentine, Amber, which are fat sulphureous Bodies; and a Diamond, (which probably is an Unctuous Substance coagulated) have their refractive Powers in proportion to one another as their Densities; without any considerable Variation.

But the refractive Power of these *Unctuous* Bodies is 2 or 3 Times greater in respect of their Den-

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Denſities, than the refractive Powers of the former 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 Parts, as of earthly, lean, and alcalizate Ones.

Salts and *Vitriols* have refractive Powers in a middle Degree between thoſe 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 a 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 diſtilled often from Salt of Tartar, grows by every Diſtillation more and more aqueous and flegmatick.

So that it ſeems rational to attribute the *Refractive Power of all Bodies chiefly, if not wholly, to the ſulphureous 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 hotteſt in the Summer Sun, by the Action of the refracted or reflected 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 *conſimilar Ratio*, on the Rays of Light in order to produce that *Unuſual Refraction*, which is obſerved in that odd Body: Therefore 'tis 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 Figures; 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 ſame way.

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 *refracted*, or *turned out* of their way, in paſſing out of one Tranſparent Body or Medium into another; and a greater or leſs Refrangibility of Rays is their Diſpoſition to be turned more or leſs out of their way (in Obſervat. 24 of his Opticks) in 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 leaſt refrangible *Red*; and thoſe of intermediate Colours, having proportionably intermediate Degrees of Refrangibility.

REGAL *Fiſhes* are Whales and Sturgeons, *An.* 1. *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 Juſtice*; ſuch as his Power over *Weights and Meaſures*; of *Coining Money*; of *making Magiſtrates*, *&c.* or *Prerogatives of Favour*: Such as the Power of *making Communities* and *Colleges*, &c.

REGARDERS *of the Foreſt* } REGARDATORES *Foreſtæ* } 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. But *Spelman* thinks the Name at leaſt was given ſince; and that then they were the ſame with thoſe Officers, called *Cuſtodes Venationis*. Dr. *Kennet*'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 *Regii Profeſſores*.

REHABERE *facias ſeiſinam, 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 *Vent*, and the *Re-inforced* part of a Gun, is from the Baſe 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 *Fictio 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 conſideration of Law two *Times*, or other things are conſidered ſo, as if they were all one; and by this the thing ſubſequent is ſaid to take its Effect by *Relation*, at the *Time preceeding*. 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*, at the Time when it was *firſt* delivered. And ſo Bills of Parliament, to which the Queen aſſents on

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on the *last* Day of Parliament shall *Relate*, and be of Force from the *first* Day of the Session.

RELIEF, *Relevamen*, (in Doomsday *Relevatio*. *Relevium*) was a certain Summ of Money, which the Tenant holding by Knights Service, Grand Sergeanty, or other Tenure, for which Homage or Regal Service is due; or by Soccage, for which no Homage is duely paid to his Lord at his Entrance, *Mag. Cart. c.* 2. and 38. *E.* 1. Stat. 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.* 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 Estate, and to hold Possession of it. At first it consisted in Horses and Arms, till by the *Assise* of Arms in 27 *Henry* 2. every Man's Armour was preserved for his Heir, and the *Relief* payable in Money, of which the fixt Rates were determined by *Magna Charta*.

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. *Relevare* was the word for paying 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. *Kennet*'s Paroch. Antiquit.

RENEWING *of Leases and Lives*, &c. (See also *Reversions*) Tho' there be Variety of Tables extant 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. Newton*) 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 inserted 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 appear.

Suppose in a Lease of 31 Years, I would renew 7 Years lapsed; allowing 6 *l. per Cent.* profit. 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 1 *l.* 7 *s.* 7 *d.* 0 *q.* or according to the way of accounting in the following Tables; 1 Year, 2 Quarters, 1 Month, and 5 Decimal parts 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 to any other Rate of Interest.

As to the Nature of the following Tables, they differ a little from Mr. *Æcroids*, in the Rate of Interest for which they are calculated.

Mr. *Æcroids* are made at 11 *l.* 3 *s.* 6 *d.* $\frac{6}{17}$ *per Cent.* But this Table for renewing a Lease of 21 Years, is calculated at 11 *l.* 11 *s.* 8 *d.* $\frac{1}{4}$ $\frac{3}{110}$, and at 5, 6, 8 and 10 *per Cent.* So the Fine for renewing 7 Years lapsed in a Lease of 21 Years, by *Æcroid's* Tables is 1 *l.* 1 *s.* 3 *d.* (i. e.) 1 Year, and 3 Weeks purchase: But by our Tables it is but *one Years Value*, at 11 *l.* 11 *s.* 8 *d*, $\frac{1}{4}$, $\frac{1}{10}$ *per Cent.* The Reason of which is, because the *Rate of Interest is greater*: But when the *Rate of Interest is lesser*, then the *Fine is greater*.

Thus at 10 *l. per Cent.* The Fine for renewing 7 Years lapsed, is 1 Years, 1 Quarters, and 1 Weeks Value: But at 8 *l. per Cent.* the Fine for renewing 7 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 Years, at 12 *l.* 6 *s. per Cent.* The Fine for renewing 7 Years lapsed, is but one Years Value in these Tables; whereas in his, it is 1 *l.* 3 *s.* 8 *d.* That is one Year and above two Months Value. But at 5, 6, 8 and 10 *l. per Cent.* the *Fine is greater*, because the *Rate 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 of 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, *decreases* to 2 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 as 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 *lesser* the Rate of Interest is, the *greater* must be the *Fine* for renewing: And the *greater* that Rate is, the *lesser* must be the *Fine*: And consequently the Difference between these Tables and *Æcroids* arises only from the different Rate of Interest, for which they were calculated.

The following Tables for renewing and purchasing of Leases, do shew the Value in *Years*, *Quarters*, *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 exprest in Decimals of *Pounds*, *Shillings*, *Pence*, &c. Yet 'tis more familiar and commodious, and the Difference is very inconsiderable, for it will never be

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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 sustracted as in these 2 Examples.

	Y.	*Q.*	*M.*	*d. p*
Suppose I were to add these 2 Fines,	3	2	1	6
	2	3	1	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.

	Y.	*Q.*	*M.*	*d. p.*
If from	3	2	1	6
You take	2	3	1	7
Remains	0	2	2	9

The first Table which offers it self for Renewing of Leases, is for the Term of 21 Years, it shews the Values in Years, Quarters, Months, and Decimal-parts of a Month, as all the Rest do: the First part of this Table is calculated at 11 *l.* 11 *s.* 8 *d.* $\frac{1}{2}$, $\frac{3}{10}$, *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 Lapsed

		Y.Q.M.D.pts.		*l.*	*s.*	*d.*
at	5 *p c.* is	1 3 2 0	Which by the Table of Red. at 10 *l.* yearly Rent is	29	3	4
	6 *p. c.* is	2 1 2 6		24	13	4
	8 *p. c.* is	1 3 0 3		17	15	0
	10 *p. c.* is	1 1 0 3		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 esse*, whose 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.

	Y.	*Q.*	*M.*	*D p.*
The Value of 7 Years in Reversion, at 11 *l.* 11 *s.* 8*d. per Cent.* is	1	0	0	0
The Value of 4 Years in Reversion at the same Rate is Which subtract	0	1	2	7
	0	2	0	3

Which Remainder being given for a Fine, will make up the Lease to 17 Years, that is, 3 added to 14.

A Table

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A Table for the Renewing of any Number of Years lapſed in a Leaſe for 21 Years.

	11 l. 11 s. 8 d. $\frac{1}{4}$ p c.				5 per Cent.				6 per Cent.				8 per Cent.				10 per Cent.			
Years Lapſed.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.
1	0	0	1	4	0	1	1	3	0	1	0	5	0	0	2	4	0	0	1	6
2	0	0	2	5	0	2	2	8	0	2	1	2	0	1	2	0	0	1	0	4
3	0	1	1	0	1	0	1	5	0	3	2	2	0	2	1	7	0	1	2	3
4	0	1	2	7	1	2	0	5	1	1	0	4	0	3	1	7	0	2	1	5
5	0	2	1	6	1	3	2	8	1	2	1	8	1	0	2	0	0	3	0	8
6	0	3	0	6	2	1	2	3	2	0	0	6	1	1	2	5	1	0	0	4
7	1	0	0	0	2	3	2	0	2	1	2	6	1	3	0	3	1	1	0	3
8	1	0	2	6	3	1	2	1	2	3	1	9	2	0	1	4	1	2	0	5
9	1	1	2	5	3	3	2	4	3	1	1	5	2	1	2	8	1	3	1	0
10	1	2	2	7	4	2	0	1	3	3	1	5	2	3	1	5	2	0	1	8
11	2	0	0	3	5	0	1	1	4	1	1	8	3	1	0	7	2	2	0	0
12	2	1	1	3	5	2	2	5	4	3	2	5	3	3	0	2	2	3	1	6
13	2	2	2	8	6	1	1	2	5	2	0	6	4	1	0	2	3	1	0	7
14	3	0	1	8	7	0	0	3	6	0	2	1	4	3	0	7	3	3	0	3
15	3	2	1	3	7	2	2	8	6	3	1	1	5	1	1	7	4	1	0	4
16	4	0	1	5	8	1	2	8	7	2	0	6	6	0	0	2	4	3	1	2
17	4	2	2	5	9	1	0	2	8	1	0	5	6	2	2	4	5	1	2	7
18	5	1	1	3	10	0	1	1	9	0	1	0	7	1	2	2	6	0	1	9
19	6	0	0	9	10	3	2	4	9	3	2	1	8	0	2	8	6	3	1	9
20	6	3	1	5	11	3	1	3	10	3	0	8	9	0	1	1	7	2	2	8
	Total Value.				Total Value.				Total Value.				Total Value.				Total Value.			
	7	2	0	3	12	3	0	8	11	3	0	1	10	0	0	2	8	2	1	7

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 1 Years value is the Worth of 7 Years lapſed, or in Reverſion; which Fine, and conſequently Rate of Intereſt, by ſome is obſerved in a Leaſe for 20 Years; but at other Rates of Intereſt: The Fine for Renewing 7 Years lapſed in this Leaſe of 20 Years, you will find by the Table as followeth, *viz.*

The Fine for Renewing 7 Years lapſed.

		Y.	Q.	M.	D.pts.		l.	s.	d.
at	5 *p. c.* is	3	0	0	8	Which by the	30	13	4
	6 *p. c.* is	2	2	1	4	Table of Red.	26	3	4
	8 *p. c.* is	1	3	1	9	at 10 *l.* yearly	19	1	8
	10 *p. c.* is	1	1	1	8	Rent is	14	0	0

The Years *in eſſe* may be valued as a Leaſe of ſo many Years, or their Value may be found, by ſubtracting the Value of the Years lapſed, from the Value of the whole Leaſe, as was directed before in the Leaſe of 21 Years.

The Value of ſome of the Years in Reverſion may alſo be found in this Leaſe, as is directed before in the former Leaſe; however to make all plain, I ſhall give one Example: As ſuppoſe, I am to find the Value of 4 of the 7 Years in Reverſion in this Leaſe; then according to the Rule given in the Leaſe of 21 Years, I do thus; becauſe 4 wants 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.

Example.

	Y.	Q.	M.	D.p.
The Value of 7 Years in Reverſion at 6 *l. per Cent.*	2	2	1	4
The Value of 3 Years at the ſame Rate is Which ſubtract	0	3	2	9
Remains	1	2	1	5

This Remainder being given for a Fine will make up this Leaſe to 17 Years, that is 4 added to 13.

A Table

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A Table for the Renewing of any Number of Years lapsed in a Lease for 20 Years.

Years Lapsed.	12 l. 6 s. p c. Years.	Quarters.	Months.	Decimal Parts	5 per Cent. Years.	Quarters.	Months.	Decimal Parts.	6 per Cent. Years.	Quarters.	Months.	Decimal Parts.	8 per Cent. Years.	Quarters.	Months.	Decimal Parts.	10 per Cent. Years.	Quarters.	Months.	Decimal Parts.
1	0	0	1	2	0	1	1	5	0	1	0	7	0	0	2	6	0	0	1	8
2	0	0	2	5	0	3	0	3	0	2	1	7	0	1	2	3	0	1	0	7
3	0	1	1	0	1	0	2	2	0	3	2	9	0	2	2	3	0	1	2	9
4	0	1	2	6	1	2	1	5	1	1	1	4	0	3	2	6	0	2	2	2
5	0	2	1	5	2	0	1	0	1	3	0	1	1	1	0	1	0	3	1	8
6	0	3	0	6	2	2	0	8	2	0	2	1	1	2	0	8	1	0	1	7
7	1	0	0	0	3	0	0	8	2	2	1	4	1	3	1	9	1	1	1	8
8	1	0	2	6	3	2	1	2	3	0	1	0	2	1	0	3	1	2	2	3
9	1	1	2	5	4	0	1	8	3	2	1	0	2	2	2	0	2	0	0	1
10	1	2	2	9	4	2	2	8	4	0	1	3	3	0	1	2	2	1	1	3
11	2	0	0	7	5	1	1	2	4	2	2	0	3	2	0	8	2	3	0	0
12	2	1	1	9	5	3	2	9	5	1	0	1	4	0	0	8	3	0	2	0
13	2	3	0	6	6	2	2	0	5	3	1	6	4	2	1	2	3	2	1	7
14	3	1	0	0	7	1	1	5	6	2	0	6	5	0	2	2	4	0	1	8
15	3	2	2	9	8	0	1	5	7	1	0	0	5	3	0	8	4	2	2	6
16	4	1	0	6	8	3	1	9	8	0	0	0	6	2	0	0	5	1	1	0
17	4	3	2	1	9	2	2	8	8	3	0	5	7	0	2	8	6	0	0	2
18	5	2	1	6	10	2	1	1	9	2	1	6	8	0	0	4	6	3	0	2
19	6	1	2	2	11	2	0	0	10	2	0	3	8	3	1	7	7	2	1	1
	Total Value.				Total Value.				Total Value.				Total Value.				Total Value.			
	7	1	0	8	12	1	2	5	11	1	2	6	9	3	0	8	8	2	0	1

The third Table for renewing of Leases, is for the Term of 40 Years; it is calculated according to five several Rates of Interest, and in its manner of using differs not from the other, nevertheless an Example will be convenient, which therefore I shall give; as suppose there be 14 Years lapsed or run out in a Lease for 40 Years, What must I give to make up this Lease again, according to those several Rates of Interest signified 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? For answer I find by the Table that the Fine for Renewing 14 Years lapsed.

		Y.	Q.	M.	D.	pts.		l.	s.	d.
at	5 p. c. is	2	3	0	4		Which by the Table of Red. at 10 l. yearly Rent is	27	16	8
	6 p. c. is	2	0	0	2			20	03	4
	8 p. c. is	1	0	1	3			11	01	8
	10 p. c. is	0	2	1	4			6	03	4
	12 p. c. is	0	1	1	1			3	08	4

The Years *in esse*, as was said before, are valued as a Lease of so many Years, as in a Lease for 40 Years, if 14 Years are run out, then there are 26 *in esse*, whose Value are as a Lease of 26 Years, and may be found by the Table for Purchasing, &c.

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 6 of the 14 Years in Reversion in this Lease of 40 Years, then because 6 wants 8 of 14, I take the Value of 8 Years in Reversion from the Value of 14 in Reversion, and the Remainder is the Value of the 6 Years required, which will make the Lease up to 32 Years.

A Table

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A Table for the Renewing of any Number of Years lapsed in a Lease for 20 Years.

	5 *per Cent.*				6 *per Cent.*				8 *per Cent.*				10 *per Cent.*				12 *per Cent.*			
Years Lapsed.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.
1	0	0	1	7	0	0	1	1	0	0	0	5	0	0	0	2	0	0	0	1
2	0	1	0	5	0	0	2	4	0	0	1	1	0	0	0	5	0	0	0	3
3	0	1	2	3	0	1	0	6	0	0	1	8	0	0	0	8	0	0	0	4
4	0	2	1	3	0	1	2	0	0	0	2	5	0	0	1	2	0	0	0	6
5	0	3	0	4	0	2	0	4	0	1	0	2	0	0	1	6	0	0	0	8
6	0	3	2	5	0	2	2	0	0	1	1	0	0	0	2	0	0	0	1	0
7	1	0	1	8	0	3	0	6	0	1	1	9	0	0	2	5	0	0	1	2
8	1	1	1	2	0	3	2	3	0	1	2	8	0	1	0	0	0	0	1	5
9	1	2	0	7	1	0	1	1	0	2	0	9	0	1	0	5	0	0	1	8
10	1	3	0	4	1	1	0	1	0	2	2	0	0	1	1	2	0	0	2	2
11	2	0	0	2	1	1	2	2	0	3	0	2	0	1	1	9	0	0	2	6
12	2	1	0	1	1	2	1	4	0	3	1	4	0	1	2	6	0	1	0	1
13	2	2	0	2	1	3	0	8	0	3	2	8	0	2	0	4	0	1	0	5
14	2	3	0	4	2	0	0	2	1	0	1	3	0	2	1	4	0	1	1	1
15	3	0	0	7	2	0	2	9	1	1	0	0	0	2	2	4	0	1	1	7
16	3	1	1	2	2	1	2	8	1	1	1	7	0	3	0	5	0	1	2	4
17	3	2	2	0	2	2	2	7	1	2	0	6	0	3	1	7	0	2	0	2
18	3	3	2	9	2	3	2	9	1	2	2	6	1	0	0	0	0	2	1	1
19	4	1	1	0	3	1	0	2	1	3	1	8	1	0	1	5	0	2	2	1
20	4	2	2	3	3	2	0	0	2	0	1	2	1	1	0	2	0	3	0	2
21	5	0	0	8	3	3	1	5	2	1	0	8	1	1	1	9	0	3	1	4
22	5	1	2	5	4	0	2	4	2	2	0	6	1	2	0	8	0	3	2	9
23	5	3	1	5	4	2	0	6	2	3	0	5	1	3	0	0	1	0	1	4
24	6	1	0	8	4	3	2	1	3	0	0	8	1	3	2	4	1	1	0	2
25	6	3	0	3	5	1	0	8	3	1	1	3	2	0	2	0	1	1	2	0
26	7	1	0	0	5	2	2	8	3	2	2	1	2	1	1	8	1	2	1	3
27	7	3	0	1	6	0	2	1	4	0	0	1	2	2	2	0	1	3	0	7
28	8	1	0	4	6	2	1	7	4	1	1	5	2	3	2	4	2	0	0	5
29	8	3	1	1	7	0	1	7	4	3	0	3	3	1	0	3	2	1	0	6
30	9	1	2	1	7	2	2	0	5	0	2	4	3	2	1	5	2	2	1	0
31	10	0	0	5	8	0	2	7	5	2	2	0	4	0	0	1	2	3	1	9
32	10	2	2	2	8	3	0	8	6	0	2	0	4	1	2	2	3	1	0	2
33	11	1	1	3	9	1	2	3	6	2	2	5	4	3	1	8	3	2	2	0
34	12	0	0	9	10	0	1	3	7	1	0	5	5	1	1	9	4	0	1	5
35	12	3	0	8	10	3	0	8	7	3	2	0	5	3	2	7	4	2	1	6
36	12	2	1	2	11	2	0	7	8	2	1	2	6	2	1	1	5	0	2	4
37	13	1	2	0	12	1	1	2	9	1	1	0	7	1	0	4	5	3	1	0
38	15	1	0	4	13	0	2	3	10	0	1	6	8	0	0	4	6	2	0	6
39	16	0	2	3	14	0	1	0	10	3	2	9	8	3	1	3	7	1	1	1
	Total Value.				Total Value.				T tal Value.				Total Value.				Total Value.			
	17	0	1	7	15	0	0	3	11	3	2	0	9	3	0	2	8	0	2	8

A Table for the Renewing of any Number of Years lapsed in a Lease for 20 Years.

Years Lapsed.	17 .. 18 s. per Cent. Years.	Quarters.	Months.	Decimal Parts	5 per Cent. Years.	Quarters.	Months.	Decimal Parts.	6 per Cent. Years.	Quarters.	Months.	Decimal Parts.	8 per Cent. Years.	Quarters.	Months.	Decimal Parts.	10 per Cent. Years.	Quarters.	Months.	Decimal Parts.
1	0	0	2	3	0	2	1	4	0	2	0	7	0	1	2	5	0	1	1	6
2	0	1	2	0	1	1	0	1	1	0	1	8	0	3	2	6	0	3	0	7
3	0	2	2	3	1	3	2	1	1	3	0	3	1	2	0	0	1	1	0	3
4	1	0	0	0	2	2	1	7	2	1	2	3	2	0	1	0	1	3	0	4
5	1	1	1	5	3	1	1	7	3	0	1	8	2	2	2	6	2	1	1	2
6	1	3	0	9	4	0	2	1	3	3	1	7	3	1	1	7	2	3	2	7
7	2	1	1	0	5	0	0	0	4	2	2	2	4	0	1	5	3	2	1	9
8	2	3	2	3	5	3	1	3	5	2	0	3	4	3	2	1	4	1	1	9
9	3	2	2	1	6	3	0	2	6	1	2	0	5	3	0	4	5	0	2	8
	Total Value.				Total Value.				Total Value.				Total Value.				Total Value.			
	4	2	0	1	7	2	2	6	7	1	1	2	6	1	2	5	6	0	1	7

This being the last Table for Renewing of Leases, is for the Term of 10 Years: The First part thereof is calculated according to the Rate of about 17 *l.* 18 *s. per Cent.* so that the Fine for renewing 4 Years lapsed is one Years Value, but at 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

	Y. Q. M. D. p.		*l.*	*s.*	*d.*
at	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	08	4
	8 *p. c.* is 2 0 1 0	duction at 10 *l.*	20	16	8
	10 *p. c.* is 1 3 0 4	*per Ann.*	17	16	8

The Years *in esse* are valued as before directed in the other Leases; 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 *y.* 2 *q.* 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.*
against 50 *l.*	under 2 Quarters	25	00	0
	under 2 Months	8	06	8
	under 4 Dec. parts	1	13	4
against 5 *l.*	under 2 Quarters	2	10	0
	under 2 Months	0	16	8
	under 4 Dec. parts	0	03	4
	Summ of all is	38	10	0

Then for the 6 years Value I say, 6 times 55 *l.* is 330 *l.* which added to 38 *l.* 10 *s.* 0 *d.* the Summ is — 330 00 0; 368 00 0

Which is the Value reduced into Pounds, Shillings, and Pence required.

Suppose again the Fine for renewing any Number of Years lapsed in any Lease, to be 2 *y.* 3 *q.* 2 *m.* 9 *d. p.* and yearly Rent 156 *l.* then what is this Fine in Money? For Answer I say, twice 156 is 312 *l.* which is the 2 years Value, then by the Table I find

		l.	*s.*	*d.*
against 100 *l.*	under 3 Quarters	75	00	0
	under 2 Months	16	13	4
	under 5 Dec. parts	4	03	4
	under 4 Dec. parts	3	06	8
against 50 *l.*	under 3 Quarters	37	10	0
	under 2 Months	8	06	4
	under 5 Dec. parts	2	01	8
	under 4 Dec. parts	1	13	4
against 6 *l.*	under 3 Quarters	4	10	0
	under 2 Months	1	00	0
	under 5 Dec. parts	0	05	0
	under 4 Dec. parts	0	04	0
	Summ is	154	13	8
	The 2 years Value add, *viz.*	312	00	0
	The Summ is	466	13	8

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, or 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.*

A Table

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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.	3 Quarters.			2 Quarter.			1 Quarter			2 Months.			1 Month.			1 Dec. part.			2 Dec. part.			3 Dec. part.			4 Dec. part.			5 Dec. part.		
	l.	s.	d.	l.	s.	d.		s.	d	l.	s.	d.	l.	s.	d	l.	s.	d.	l.	s.	d	l.	s.	d.	l.	s.	d.	l.	s.	d.
1	0	15	0	0	10	0	0	0	0	0	3	4	0	1	8	0	0	2	0	0	4	0	0	6	0	0	8	0	0	10
2	1	10	0	1	0	0	0	15	0	0	6	8	0	3	4	0	0	4	0	0	8	0	1	0	0	1	4	0	1	8
3	2	5	0	1	10	0	0	15	0	0	10	0	0	5	0	0	0	6	0	1	0	0	1	6	0	2	0	0	2	6
4	3	0	0	2	0	0	1	0	0	0	13	4	0	6	8	0	0	8	0	1	4	0	2	0	0	2	8	0	3	4
5	3	15	0	2	10	0	1	5	0	0	16	8	0	8	4	0	0	10	0	1	8	0	2	6	0	3	4	0	4	2
6	4	10	0	3	0	0	1	10	0	1	0	0	0	10	0	0	1	0	0	2	0	0	3	0	0	4	0	0	5	0
7	5	5	0	3	10	0	1	15	0	1	3	4	0	11	8	0	1	2	0	2	4	0	3	6	0	4	8	0	5	10
8	6	0	0	4	0	0	2	0	0	1	6	8	0	13	4	0	1	4	0	2	8	0	4	0	0	5	4	0	6	8
9	6	15	0	4	10	0	2	5	0	1	10	0	0	15	0	0	1	6	0	3	0	0	4	6	0	6	0	0	7	6
10	7	10	0	5	0	0	2	10	0	1	13	4	0	16	8	0	1	8	0	3	4	0	5	0	0	6	8	0	8	4
20	15	0	0	10	0	0	5	0	0	3	6	8	1	13	4	0	3	4	0	6	8	0	10	0	0	13	4	0	16	8
30	22	10	0	15	0	0	7	10	0	5	0	0	2	10	0	0	5	0	0	10	0	0	15	0	1	0	0	1	5	0
40	30	0	0	20	0	0	10	0	0	6	13	4	3	6	8	0	6	8	0	13	4	1	0	0	1	6	8	1	13	4
50	37	10	0	25	0	0	12	10	0	8	6	8	4	3	4	0	8	4	0	16	8	1	5	0	1	13	4	2	1	8
60	45	0	0	30	0	0	15	0	0	10	0	0	5	0	0	0	10	0	1	0	0	1	10	0	2	0	0	2	10	0
70	52	10	0	35	0	0	17	10	0	11	13	4	5	16	8	0	11	8	1	3	4	1	15	0	2	6	8	2	18	4
80	60	0	0	40	0	0	20	0	0	13	6	8	6	13	4	0	13	4	1	6	8	2	0	0	2	13	4	3	6	8
90	67	10	0	45	0	0	22	10	0	15	0	0	7	10	0	0	15	0	1	10	0	2	5	0	3	0	0	3	15	0
100	75	0	0	50	0	0	25	0	0	16	13	4	8	6	8	0	16	8	1	13	4	2	10	0	3	6	8	4	3	4
200	150	0	0	100	0	0	50	0	0	33	6	8	16	13	4	1	13	4	3	6	8	5	0	0	6	13	4	8	6	8
300	225	0	0	150	0	0	75	0	0	50	0	0	25	0	0	2	10	0	5	0	0	7	10	0	10	0	0	12	10	0
400	300	0	0	200	0	0	100	0	4	66	13	4	33	6	8	3	6	8	6	13	4	10	0	0	13	6	8	16	13	4
500	375	0	0	250	0	0	125	0	0	83	6	8	41	13	4	4	3	4	8	6	8	12	10	0	16	13	4	20	16	8
600	450	0	0	300	0	0	150	0	0	100	0	0	50	0	0	5	0	0	10	0	0	15	0	0	20	0	0	25	0	0

The way of purchasing by Lives was commonly to reckon one Life as a Leafe of 7 Years, two Lives as a Leafe of 14 Years, and three Lives as a Leafe of 21 Years: But this way feeming Unequal, there is another way which is more agreeable to Reafon, and it is this, *viz.* for every Life to decreafe one Year, as if one Life be reckoned as a Leafe for 10 Years, then two will be as a Leafe of 19, and three as a Leafe of 27 Years, &c. fo that at 7 *l. per Cent.* one Life is reckoned worth a little above 7 Years Purchafe, two Lives 10 Years, 1 Quarter, and 1 Month's Purchafe, &c. as the Table for purchafing of Lives fheweth.

So if you reckon one Life as a Leafe of 9 Years, then two will be as a Leafe of 17, three as a Leafe of 24, &c. as is evident by the Table; and one Life will be worth above 6 Years and 2 Quarters Purchafe, 2 Lives 9 Years and 3 Quarters Purchafe, 3 Lives 11 Years, 1 Quarter, 2 Months, and 6 Decimal parts Purchafe, &c.

So if one fingle Life be reckoned as a Leafe of 12 Years, then two will be as a Leafe of 23, three as a Leafe of 33 Years, &c. fo that at 6 *per Cent.* one Life is worth above 8 Years and a Quarters Purchafe, two Lives above 12 Years and a Quarters Purchafe, &c. as the Table fhews.

Now fuppofe any of thofe Perfons which have their Lives upon an Eftate fhould die, to take in others to make up the Number again, is done by the Table of Reverfions at the Beginning of the Book: Example, fuppofe there be three Lives upon an Eftate, which at 7 Years Purchafe for the firft Life, are valued at almoft 12 Years Purchafe, and as a Leafe of 27 Years, at 7 *l. per Cent.* and if one of thofe Perfons fhould die, what muft be given to make up the Number again? Then I fay, one Life which is dead was as a Leafe of 10 Years, and therefore to take in a New Life, I may reckon 10 Years of the 27 lapfed, and to take as it were a Fine for renewing 10 Years lapfed in a Leafe of 27 Years: now to find this Fine, I take the Summ of the Reverfions 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 the Summ to be 2 *l.* 4 *s.* 5 *d.* 2 *q.* that is two Years, and almoft one Quarters Purchafe, which I may take for renewing or taking in a New Life; fo if two Lives be dead I may reckon 19 Years lapfed in a Leafe of 27 Years, and find the Summ of the Reverfions for 19 Years, for a Fine for taking in two Lives: But if there be 4 Lives upon the Eftate, then at 7 *l. per Cent.* and at 10 Years for one Life, they will be reckoned as a Leafe of 34 Years, and fo I muft begin at 34 to fumm the Reverfions, or at 30 if one Life be reckoned as a Leafe of 9 Years, and then if one Life be dead, I muft reckon 9 Years lapfed in a Leafe of 30 Years, if two Lives are dead I muft reckon 17 Years lapfed in the fame Leafe, and if three are dead I muft reckon 24 lapfed: So at 6 *l. per Cent.*

A Table for the Purchasing of Lives.

Number of Lives.	Number of Years.	What they are worth at 7 *l. per Cent* Years.	Quarters	Months.	Dec. parts	Number of Lives.	Number of Years.	What they are worth at 7 *l. per Cent.* Years.	Quarters.	Months	Dec. parts	Number of Lives.	Number of Years.	What they are worth at 6 *l. per Cent.* Years.	Quarters.	Months.	Dec. parts
1	10	7	0	0	3	1	9	6	2	0	2	1	12	8	1	1	6
2	19	10	1	1	0	2	17	9	3	0	1	2	23	12	1	0	6
3	27	11	3	2	6	3	24	11	1	2	6	3	33	14	1	2	6
4	34	12	3	1	1	4	30	12	1	1	8	4	42	15	0	2	7
5	40	13	2	0	9	5	35	12	3	2	2	5	50	15	2	2	7
6	45	13	2	1	2	6	39	13	1	0	1	6	57	16	0	0	8
7	49	13	3	0	2	7	42	13	1	2	4	7	63	16	0	2	8
8	52	13	3	1	3	8	44	13	2	0	6	8	68	16	1	1	2
9	54	13	3	1	6	9	45	13	2	1	2	9	72	16	1	2	0

reckoning one Life as a Leafe of 12 Years, three Lives are as a Leafe of 33 Years, and fo if one of thefe Lives be dead, I may reckon 12 Years lapfed in a Leafe of 33 Years, if two Lives are dead, I may reckon 23 Years lapfed in the fame Leafe, and begin at 33 to fumm the Reverfions, under 6 *l. per Cent.* becaufe the Lives are valued according to the fame Rate of Intereft. This being underftood, it will not be difficult to do the like for any other Number of Lives, and at other Rates of Intereft, and Number of Years for one Life; for you may by the Table for purchafing of Leafes, &c. make Tables for purchafing of Lives according to what Rate of Intereft you think is moft convenient; as fuppofe you reckon one Life as a Leafe of 10 Years, and you would have 5 *l. per Cent.* profit, then that will be worth 7 Years and almoft 3 Quarters Purchafe, but at 8 *l. per Cent.* it is worth but 6 Years and almoft 3 Quarters Purchafe, &c.

The Table for purchafing is calculated for feveral Rates of Intereft, that fo the Purchafer may ufe that which is moft convenient for him, as in purchafing of Free-hold Land, 5 *l. per Cent.* may be enough, but for Copy hold or Leafes of Land 6 *l. per Cent.* for Leafes of Land and good Houfes 8 *l. per Cent.* and for Leafes of ordinary Houfes 10 *l.* or 12 *l. per Cent.*

The Ufe of the Table is very plain and eafie, as by Example will appear, *viz.*

Example.

What is a Leafe or Annuity of 20 Years worth at 5, 6, 8, 10, or 12 *per Cent. per Annum?*

			Y. Q. M. D. p.		*l.*	*s.*	*d.*
A Leafe for 20 Years at	5	*p. c.* is worth	12 1 2 5	Which at 20 *l. per Ann.* Rent is	249	3	4
	6		11 1 2 6		229	6	8
	8		9 3 0 8		196	6	8
	10		8 2 0 1		170	3	4
	12		7 1 2 6		149	6	8

To increafe the Number of Years in a Leafe do thus: Suppofe a Landlord would make a Leafe of Land up to 40 Years, wherein his Tenant hath 20 Years to come, what is it worth? Then I fay,

	Y.	Q.	M.	D. p.
A Leafe for 4 Years at 6 *per Cent.* is worth	15	0	0	3
20 Years at the fame Rate are worth — Which fubtract	11	1	2	6
The Remainder is	3	2	0	7

Which is the Fine to be given to make the Leafe up to 40 Years.

To buy a Leafe which is not to begin until your old Leafe is out; as thus, fuppofe a Man's Leafe is out within 4 Years, and he defires to have a New Leafe of 21 Years, to begin when his 4 Years are out, what is this Leafe worth in ready Money?

For Anfwer, I add 4 Years which is the Time he hath in his old Leafe, and 21 together, the Summ is 25, then I find the Worth of thefe 25 Years, and fubtract from it the Value of the 4 Years, the Remainder is the Value of the faid Leafe in ready Money.

Example.

	Y.	Q.	M.	D. p.
A Leafe for 25 Years at 6 *l. per Cent.* is worth	12	3	0	3
The 4 Years at the fame Rate are worth. Which fubtract	3	1	2	6
The Remainder is the Value of the Leafe in ready Money required, *viz.*	9	1	0	7

A Table

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.*

Number of Years to be purchaſed.	5 *per Cent.*				6 *per Cent.*				8 *per Cent.*				10 *per Cent.*				12 *per Cent.*			
	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.
1	0	3	2	4	0	3	2	3	0	3	2	1	0	3	1	9	0	3	1	7
3	1	3	1	3	1	3	1	0	1	3	0	4	1	2	2	8	1	2	2	3
3	2	2	2	6	2	2	2	1	2	2	0	9	2	1	2	8	2	1	1	8
4	3	2	0	5	3	1	2	6	3	1	0	7	3	0	2	0	3	0	0	5
5	4	1	1	0	4	0	2	5	3	3	2	8	3	3	0	5	3	2	1	2
6	5	0	0	9	4	3	2	0	4	2	1	5	4	1	1	2	4	0	1	3
7	5	3	0	4	5	2	1	0	5	0	2	4	4	3	1	4	4	2	0	7
8	6	1	2	5	6	0	2	5	5	3	0	0	5	1	1	0	4	3	2	6
9	7	0	1	3	6	3	0	6	6	1	0	0	5	3	0	1	5	1	0	9
10	7	2	2	6	7	1	1	3	6	2	2	5	6	0	1	7	5	2	1	8
11	8	1	0	7	7	3	1	6	7	0	1	6	6	1	2	9	5	3	2	3
12	8	3	1	4	8	1	1	6	7	2	0	4	6	3	0	7	6	0	2	3
13	9	1	1	7	8	3	1	2	7	3	1	8	7	0	1	2	6	1	2	1
14	9	3	1	7	9	1	0	5	8	0	2	9	7	1	1	4	6	2	1	5
15	10	1	1	5	9	2	2	5	8	2	0	7	7	2	1	2	6	3	0	7
16	10	3	1	0	10	0	1	2	8	3	1	2	7	3	0	8	6	3	2	7
17	11	1	0	2	10	1	2	7	9	0	1	5	8	0	0	2	7	0	1	4
18	11	2	2	2	10	3	0	9	9	1	1	5	8	0	2	4	7	1	0	0
19	12	0	1	0	11	0	1	9	9	2	1	2	8	1	1	3	7	1	1	4
20	12	1	2	5	11	1	2	6	9	3	0	8	8	2	0	1	7	1	2	6
21	12	3	0	8	11	3	0	1	10	0	0	2	8	2	1	7	7	2	0	7
22	13	0	1	9	12	0	0	4	10	0	2	4	8	3	0	2	7	2	1	7
23	13	1	2	8	12	1	0	6	10	1	1	4	8	3	1	5	7	2	2	6
24	13	3	0	5	12	2	0	5	10	2	0	3	8	3	2	8	7	3	0	4
25	14	0	1	1	12	3	0	3	10	2	2	1	9	0	0	9	7	3	1	1
26	14	1	1	4	13	0	0	0	10	3	0	7	9	0	2	0	7	3	1	7
27	14	2	1	7	13	0	2	5	10	3	2	2	9	0	2	8	7	3	2	3
28	14	3	1	7	13	1	1	8	11	0	0	6	9	1	0	6	7	3	2	7
29	15	0	1	6	13	2	1	0	11	0	1	9	9	1	1	3	8	0	0	2
30	15	1	1	3	13	3	0	1	11	1	0	1	9	1	2	0	8	0	0	6
31	15	2	1	1	13	3	2	2	11	1	1	2	9	1	2	7	8	0	1	0
40	17	0	1	8	15	0	0	3	11	3	2	0	9	3	0	3	8	0	2	9
50	18	1	0	0	15	2	2	7	12	0	2	8	9	3	2	0	8	1	0	6
60	18	3	2	2	16	0	2	0	12	1	1	5	9	3	2	6	8	1	0	9
70	19	1	1	1	16	1	1	6	12	1	2	3	9	3	2	8	8	1	0	9
80	19	2	1	2	16	2	0	1	12	1	2	7	9	3	2	9	8	1	1	0
90	19	3	0	0	16	2	1	0	12	1	2	8	9	3	2	9	8	1	1	0
	Fee Simple.				Fee Simple.				Fee Simple.				Fee Simple.				Fee Simple.			
	20	0	0	0	16	2	2	0	12	2	0	0	10	0	0	0	8	1	1	0

How

How to buy the Reversion of any Lease or Annuity.

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 suppose of 30 Years at 6 *per Centum?* Then for Answer look the Value of the whole Lease, which

	Y.	Q.	M.	D.	p.
will be found to be ———	13	3	0	1	
Then find the Value of the 6 Years which will be Which subtract	4	3	2	0	
The Remainder is the Value of the Reversion required, *viz.*	8	3	1	1	

The Value of the Years lapsed or in Reversion of any Lease, may also be found by the Table for purchasing; for the Value of the Years *in esse*, subtracted from the Value of the whole Lease, the remainder is the Value of the Years in Reversion, as is shewed in the Preface; therefore, suppose in a Lease of 31 Years there be 12 Years lapsed, what must be given to renew this Lease again at 6 *per Centum?* Then I find the Value of

	Y.	Q.	M.	D.	p.
the whole Lease to be ———	13	3	2	2	
And because there are 12 Years lapsed, there are 18 Years *in esse* whole Value is Which subtract	10	3	0	9	
The Remainder is the Value of the Years in Reversion required, *viz.*	3	0	1	3	

Years.	The increase of 1 *l.* yearly at 6 *per Cent.*				The Value of 1 *l.* Annuity to be paid at the end thereof at 6 *l. per Cent.*				What Annuity 1 *l.* ready Money will purchase at 6 *l. per Cent.*			
	l.	*s.*	*d.*	*q.*	*l.*	*s.*	*d.*	*q.*	*l.*	*s.*	*d.*	*q.*
1	1	1	2	1	1	0	0	0	1	1	2	0
2	1	2	5	2	2	1	2	0	0	10	6	0
3	1	3	9	3	3	3	8	0	0	7	6	0
4	1	5	3	0	4	7	5	3	0	5	9	0
5	1	6	9	0	5	12	8	3	0	4	9	0
6	1	8	4	1	6	19	6	1	0	4	2	0
7	1	10	0	3	8	7	10	1	0	3	7	0
8	1	11	10	2	9	17	11	1	0	3	2	0
9	1	13	9	1	11	9	9	3	0	2	11	0
10	1	15	9	3	13	3	7	0	0	2	8	0
11	1	17	11	2	14	19	5	0	0	2	6	1
12	2	0	3	0	16	17	4	2	0	2	4	2
13	2	2	7	3	18	17	7	2	0	2	3	0
14	2	5	2	2	21	0	3	2	0	2	1	3
15	2	7	11	0	23	5	6	0	0	2	0	2
16	2	10	9	2	25	1	5	0	0	1	11	2
17	2	13	10	0	28	4	3	0	0	1	10	3
18	2	17	1	0	30	18	1	0	0	1	10	0
19	3	0	6	0	33	15	2	0	0	1	9	1
20	3	4	2	0	36	15	8	0	0	1	8	3
21	3	7	11	3	39	19	10	0	0	1	8	3
22	3	12	0	3	43	7	10	0	0	1	7	3
23	3	16	4	2	46	19	10	0	0	1	7	1
24	4	0	11	2	50	16	3	2	0	1	7	0
25	4	5	10	0	54	17	3	1	0	1	6	2
26	4	10	11	3	59	3	1	0	0	1	6	1
27	4	16	5	1	63	14	1	0	0	1	6	0
28	5	2	2	3	68	10	6	2	0	1	5	3
29	5	8	4	0	73	12	9	1	0	1	5	2
30	5	14	10	0	79	1	2	0	0	1	5	1

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The Use of these Tables aforegoing is easie, as 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 1 *l.* &c. 3 *l.* 4 *s.* 2 *d.* which shews that 1 *l.* in 20 Years time will increase to 3 *l.* 4 *s.* 2 *d.* which I multiply by 30 thus,

	l.	*s.*	*d.*
30 times 3 *l.* is	90	0	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.* 0 *d.*

The Use of the Second is thus, What will an Annuity of 30 *l.* forborn 20 Years amount to in that time? Then for Answer I look against 20 Years, and under the Value of 1 *l.* Annuity, *&c.* I find 36 *l.* 15 *s.* 8 *d.* which 36 *l.* 15 *s.* 8 *d.* is the Value of 1 *l.* Annuity forborn 20 Years, then I multiply 36 *l.* 15 *s.* 8 *d.* by 30 *l.* thus,

	l.	*s.*	*d.*
30 times 36 *l.* is	1080	00	0
30 times 15 *s.* is	22	10	0
30 times 8 *d.* is	1	00	0
Summ	1103	10	0

That is, 36 *l.* Annuity forborn 20 Years will at the End of that Term amount to 1103 *l.* 10 *s.* 0 *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 *What Annuity* 1 *l. ready Money*, &c. 1 *s.* 8 *d.* 3 *q.* which shews that 1 *l.* ready Money will purchase an Annuity of 1 *s.* 8 *d* 3 *q.* for 20 Years, which I multiply by 300 *l.* thus,

	l.	*s.*	*d.*
300 Shillings are	15	00	0
300 times 8 *d.* is	10	00	0
300 times 3 *q.* is	00	18	9
Summ	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 Cent.*

RENTS *of Assise* were the certain and determined Rents of Ancient Tenants, and were paid in a set Quantity of Money or Provisions: They were so called, because they were *assised*, and made certain; and so distinguished from *Redditus Mobiles*, or such variable Rents as did rise and fall, like the Corn-rent now reserved to Colleges.

RENTS *Resolute*, are accounted among the Fee Farm-Rents, to be sold 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 Dissolution, tho' the Lands were demised 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 Prise*, upon Surety, 3 *E.* 1. 11.

REPOSE, is a Term in Painting, signifying the Place where the *Masses*, or great Lights and Shadows are assembled: And this being well understood hinders the Confusion of Objects; suffering not the View to be contracted altogether, but to proceed gradually and successively without Disturbance.

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 again. *Manwood, ph.* 1. p. 178.

REP *Silver.* The Ancient Servile Tenants were bound to reap their Lord's Corn: But to be acquitted from this Duty, they sometimes 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 *If. Newton*'s third) that *Repulse* or *Reaction* 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, 'tis 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 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 towards it. 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 Changes, not of the *Velocities* but of the Motion: For the Changes made on the Velocities in contrary Directi-

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Directions, are in a *Reciprocal Proportion to the Bodies.*

REQUESTS, See Court of Requests in Vol. I.

RESCRIPT in the Civil Law, is a Letter of the Emperour in answer to particular Persons who enquire the Law of him: But if it be sent to a Corporation or any Publick Body of Men who have consulted him, then they call it a *Pragmatick Sanction.*

RESEISER, is taking (or resuming) of Lands again into the Hands of the King, whereof a general *Livery*, or *Ouster le Maine*, was formerly missued, contrary to the Order and Form of Law: *Stanif. Prerog.* 26. see *Resumption.*

RESISTENCE of a *Fluid Medium*, The incomparable Sir *If. Newton* at the End of the Lat. Edit. of his Opticks, *Qu.* 20. saith that the Resistence of Fluid Mediums arises partly from the *Attrition* of the Parts of the Medium; and partly from the *Vis Inertiæ Materiæ*, 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 Resistence arising from the *Vis Inertiæ*, is as the Square of that Product. And by this difference may the two Kinds of Resistence in all Mediums be distinguished: And since the Kinds are thus distinct, it will appear that the Resistence of Bodies which are of a proper Magnitude and Velocity, whether they move in Air, Water, Quick-silver, or in any other Fluid, will almost all arise from the *Vis Inertiæ* of the Parts of the Fluid.

For that Part of the Resistence of any Medium which arises from Friction, Attrition, or Tenacity of the Particles of the Fluid, may be diminished, by supposing the matter to be divided into smaller Particles, and those also to be rendred more smooth and slippery. But that Part which arises from the *Vis Inertiæ* answers in Proportion to the Density of the Matter, and can neither be diminished by dividing the Matter into smaller Particles, nor by any other Means, than by the Diminution of the Density it self.

Whence it is, that *Density* of Fluid Mediums becomes very nearly *proportionable* to the *Resistence.* For those Liquors which differ insensibly as to Density, as Water, Spirit of Wine, Oil of Turpentine, warm Oil of Olives, and such like, have very little difference also as to the Force of Resistence. Water being 13 or 18 Times lighter, and consequently 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 Air such as we usually breath in, is about 8 or 9 hundred Times lighter, and rarer than Water, and he found the Resistence in Air to be less in that *Ratio*, by the same Kind of Trials. And in a thinner and rarer Air, the Resistence must still be less; till at last in the Thoughts of all, it will grow insensible. A Feather in the exhausted Receiver descends with equal Celerity as a Stone or a Piece of Lead, tho' in the open Air it find a very great Resistence to its Descent: And by all the Experiments he could make he found the Resistence of all Fluid Mediums to depend only on their Density and a little on their Tenacity: But there must needs be another Sort of Resistence, if the Pores of all Fluids were filled with another, yet more *Subtle Matter* or *Fluid.* Now if the Resistence in the *Exhausted Receiver* of the Air-Pump, should be only a 100 Times less than in the common Air, it would be a Million of Times less than that of Quick-silver: But it is certainly much less than that, and much less yet in the Celestial Spaces or 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 10000 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 1000000000000000000 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 renders 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 *Attrition* or Tenacity of its Particles. And therefore we may fairly conclude that the Resistence of Water arises chiefly from the *Vis Inertiæ* of its Matter. And consequently, if the Celestial Regions or Spaces, were equally *dense* with Water, they could not have a much less Resistence than it: If they were as *dense* as Quick-silver, they would have a Resistence 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 perfectly solid, in such a Medium, would lose above half of its Motion, before it could move 3 of its own Diameters in length.* And a Globe not perfectly solid, such as are those of the Planets, would be stopt much sooner. Wherefore there is a Necessity of supposing that the Regions where the Planets and Comets move should *be devoid of all matter:* Except perhaps some very thin and fine Vapours and Exhalations, or *Effluvia* which may arise from the Atmosphere of the Earth of the Planets and Comets. That *Fictitious Subtile Matter* therefore with which some have filled the Heavens, is by no means useful for the Solution of the *Phænomena* of Nature; since the Motions of the Planets and Comets may be much better explained without by the Laws of Gravity; and *Gravity* it self hath never yet been well accounted for by that *Subtile Matter.* In Reality, that *Subtle Matter* can only serve to obstruct and disturb the Motions of the Heavenly Bodies, and if there were any such thing would destroy and overthrow the Course and Order of Nature. And if you suppose it interspersed also within the hidden Pores and *Meatus* of Bodies, it will do nothing

thing

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thing there but stop and obstruct the *Vibrating Motions* of the Particles of Matter, in which their *Heat* and all their Energy and Active Power consists. And as it is of no use but to do Mischief, so 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 Measure 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 swift with another that is lighter, *&c.*) will move through the same Medium more strongly in proportion to its greater Intensive or Specifick Gravity.

In the *Acta Eruditorum Lipsiæ* 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. He reduces his Thoughts on this Subject into a Dissertation. Entitled, A Discourse concerning the Resistance of *Mediums*, and the Motion of *Projects* in resisting Mediums.

As to the *Geometrical Considerations* of the Resistance of Bodies of different Figures in one and the same Medium: Mr. *James Bernouli* in the *Acta Lipsiæ* 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 Resistance of a Square moved according to the Direction of its Side, and of its Diagonal, is as the Diagonal to the Side.

3. The Resistance of a Circular Segment (less than a Semi-circle) carried in a Direction 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 Diameter, to the same less $\frac{1}{3}$ of the Square of the Base of 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 Resistances of an Hyperbola, or a Semi-Ellipsis; when the Base and when the Vertex goes foremost, may be thus computed: Let it be, as the Summ (or Difference) of the Transverse 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 mentioned.

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 Basis 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 Sheriff'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 easily 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: He fix'd a small Tube, whose Diameter was $\frac{1}{10}$ part of an Inch, to the Neck of the Bladder; and then filling the Bladder with Air, he put a Weight of 2 *lb.* 4 *z.* on the Top of it: And repeating the Experiment several 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, swinging Seconds, and by a Calculation which he there gives, he found the Force by which the Air is forced out of the Lungs at every Exspiration to be equal to 100 *lb.* Weight: And therefore, *Action and Reaction being Equal*, the Pressure of the Air upon the Lungs every Exspiration must be equal to the Pressure of 100 *lb.* Weight. That is, supposing the Gravity of the Air to be always the same, and the Diameter of the *Trachæa* the same also in every Exspiration. But since we find by the Barometer, that there is 3 Inches difference between the greatest and the least Gravity 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 breathing, is sufficient to break the Globules of the Blood, and to dissolve all the Cohesions they might con-

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contract in 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, press *undequaque*; 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 unite, 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 (*cæteris paribus*) is greatest.

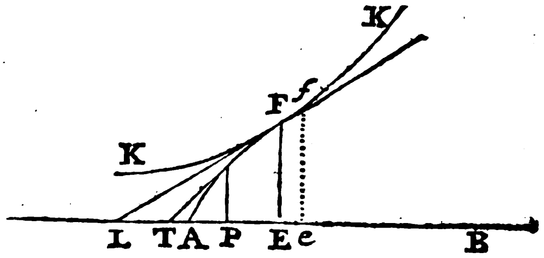
RESTITUTIO *in Integrum*, is a Writ of Restitution to put a Person into Re-possession of such Lands and Tenements, as whereof he had been wrongfullly disseized.

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 Reflection*; 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-house of all our *Ideas*. And our *Ideas* being nothing but *Actual 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 said to be 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 self.

RETRAXIT, in the Law, (so called from being the Effectual Word in the Entry,) is where the Plaintiff or Defendant comes into Court, and declares he hath *with-drawn* his Suit, and will proceed no further; and this is a Bar of all other Actions of a like or inferior Nature. The Difference between a *Retraxit* and a *Non-suit*, is that the former supposes the Plaintiff or Defendant 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.

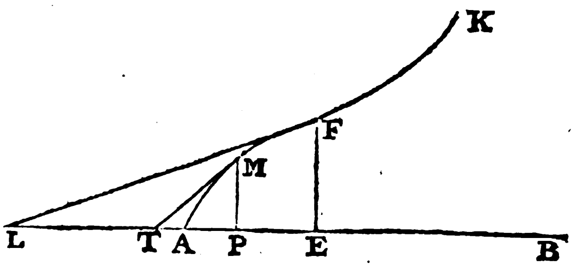
RETROGRADATION of a Planet. See an Account of the Reason of this Phænomenon, under the word *Direct*. in Vol. II.

RETROGRESSION *of Curves*: The same 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 Af-



fections of the Fluxions thereof, as it moves along, it will be an easie matter to determine the Point of contrary Flexion or Retrogression.

In the first place, let A B be the Diamater of the Curve-line AMK; and let the Ordinate PM, EF be parallel between themselves; and draw the Tangents MT, FL; then tis evident, that in Curves having a point of contrary Flexion, the Inter-

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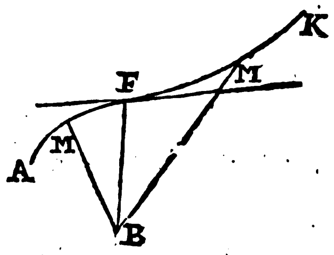


Intercepted Diameter encreases continually, and the Portion of the Diameter AT Intercepted between the Tangent MT, and A the beginning of the Absciffa increases also, till the point P arrive at E, and afterwards decreases again; and hence 'tis plain, that the Portion of the Sub-tangent AT becomes a *Maximum*, 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 afterwards it decreases again.

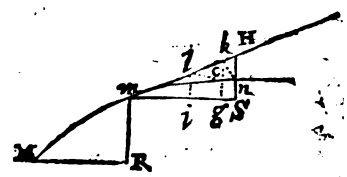
Hence to find a general Form which shall serve to Investigate the Points of contrary Flexion and Retrogression.

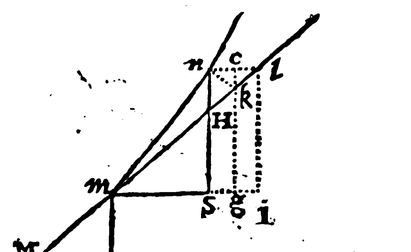
Suppose AE $= x$, EF $= y$; then is AL $= \frac{y\dot x}{\dot y} - x$, and the Fluxion thereof $\frac{\dot y^2 \dot x - y\ddot y \dot x}{\dot y^2} - \dot x$ must be $= o$, and by Transposition, and Division (by $\dot x$, supposing $\dot x$ an Invariable Quantity) $\frac{\dot y^2 \dot x - y\ddot y\dot x - \dot y^2 \dot x}{\dot y^2} = o$, and $\frac{-y\ddot y\dot x}{\dot y^2} = o$, or *Infinity*; and multiplying by $\dot y^2$ and dividing by $-y$, we have $\ddot y = o$, or *Infinity*: which for the future will serve for a General Form to find the points (F) of contrary Flexion and Retrogression; for the Nature of the Curve AFK being given, if we find the Value of $\dot y$ in $\dot x$, and again find the Fluxion of that Value (supposing $\dot x$, to be Invariable) we shall have the Value of $\ddot y$ in $\dot x^2$, 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 Flexion or Retrogression.

181. The point A the beginning of x may be so situated, that AL shall be $= x - \frac{y\dot x}{\dot y}$ instead of $\frac{y\dot x}{\dot y} - x$, and that AL or AE may be a *minimum* 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 $= x + \frac{y\dot x}{\dot y}$; for when the point T falls on the other side of P in respect of the beginning of x, then the Value of $\frac{y\dot x}{\dot y}$ will be Negative, and consequently, the Value of $-\frac{y\dot x}{\dot y}$ will be Positive, and therefore in such a Case AE + EL is $= x - \frac{y\dot x}{\dot y}$.

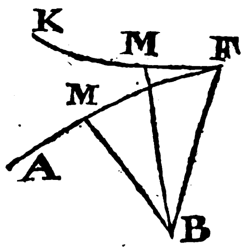
182. The point of contrary Flexion or Retrogression may be found otherwise, in this manner:



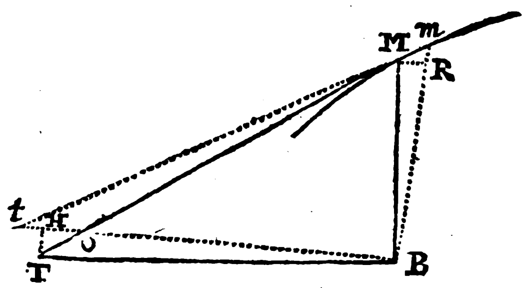


It is evident that if $\dot x$ be supposed invariable, and that the Ordinate y be a flowing Quantity, then S n is less than SH or R m, when the Curve is Concave towards the Axis: and S n is greater than SH or R m, when the Curve is Convex towards the Axis. Whence it follows, that the Value of H n or $\ddot y$ from being Positive becomes Negative in F, the point of Inflexion or Retrogression; that is $\ddot y$ is $= o$, or *Infinity*.

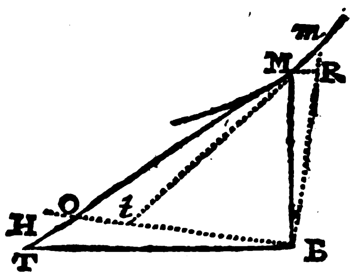
183. And if the Curve AFK respect a single point B, then draw the Ordinates BM, BF, BM, all concurring in the given point B. Then if you draw any Ordinate as BM, and the Tangent MT inter-



interfecting BT perpendicular to BM in T, and if the point *m* be taken infinitely near to M, and the Ordinate BM, B*t* a perpendicular thereto, and the Tangent *mt* be drawn; 'tis evident (if we suppose the Ordinate BM to increase as it comes to B*m*) that in F the concave part of the Curve, *Bt* surpasses BO, (*o* being the point where MT intersects B*t*) and in the part of the Curve which is Convex towards B, B*t* is less than BO; whence 'tis manifest that in F the point of contrary Flexion or Retrogression, the Value of O*t* 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



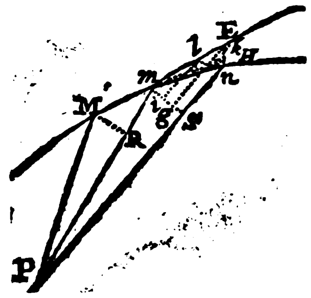
M R *m*, M B T and T H O are similar, and the little Sectors BMR, BTH are also similar; whence (supposing EM $= y$, MR $= \dot{x}$, RM $= \dot{y}$,) *m* R $(\dot{y})$: RM $(\dot{x})$: : BM (y) : BT $= \frac{y\dot{x}}{\dot{y}}$: : MR $(\dot{x})$: TH $= \frac{\dot{x}^2}{\dot{y}}$: : TH $\left(\frac{\dot{x}^2}{\dot{y}}\right)$: HO $= \frac{\dot{x}^3}{\dot{y}^2}$.

And if we take the Fluxion of BT $\left(\frac{y\dot{x}}{\dot{y}}\right)$ supposing $\dot{x}$ to be an Invariable Quantity, then is

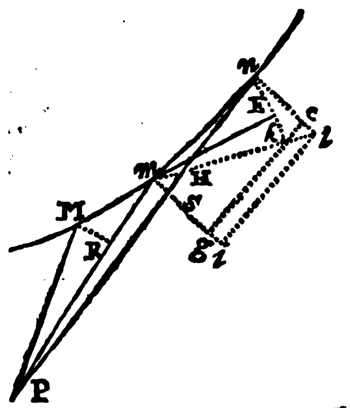
$$Bt - BT = Ht = \frac{\dot{y}^2\dot{x} - y\dot{x}\ddot{y}}{\dot{y}^2}$$ and OH +

$$Ht = \frac{\dot{x}^3 + \dot{y}^2\dot{x} - y\dot{x}\ddot{y}}{\dot{y}^2}.$$ Now because in the point of contrary Flexion or Retrogression, O*t* is either $= 0$, or *Infinity*, therefore in the said point $\frac{\dot{x}^3 + \dot{y}^2\dot{x} - y\dot{x}\ddot{y}}{\dot{y}^2}$ is $= 0$, or *Infinity*, and multiplying by $\dot{y}^2$, and dividing by $\dot{x}$, we have $\dot{x}^2 + \dot{y}^2 - y\ddot{y} = 0$, or *Infinity*; whence if the Nature of the Curve A F K be given, then the Value of $\dot{y}$ may be found in $\dot{x}$, and the Value of $\ddot{y}$ in $\dot{x}^2$; and if the said Values be substituted in the general Form, there will remain one unknown Quantity (x) and the Equation thus cleared, will serve 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 observ'd, 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 $\dot{x}$ for an invariable Quantity,



tity, the right angled Triangles H m S, H n k are similar; therefore $H m$ $(= \dot{z})$: m S $(\dot{x})$ :: H n $(-\ddot{y})$: $n\, k = \frac{\dot{x}\ddot{y}}{\dot{z}}$; and here it must be observed, that H n is Negative, because while B m $(\dot{y})$ Increases, m R $(\dot{y})$ Decreases. Now because the Sectors P m S, m E k are similar, it is B m (y) : m S $(\dot{x})$ :: m E $(\dot{z})$: E k = $\frac{\dot{x}\dot{z}}{y}$; and therefore E k + k n is $= \frac{\dot{x}\dot{z}^2 - y\dot{x}\ddot{y}}{y\dot{z}}$ and multiplying by $y\dot{z}$, and dividing by $\dot{x}$, we shall have $\dot{z}^2 - y\ddot{y}$, or (substituting $\dot{x}^2 + \dot{y}^2$ for $\dot{z}^2$) because of the right angled Triangle m S n, $\dot{x}^2 + \dot{y}^2 - y\ddot{y}$, which passes from being Positive to be Negative, in the point of contrary Flexion or Retrogression.

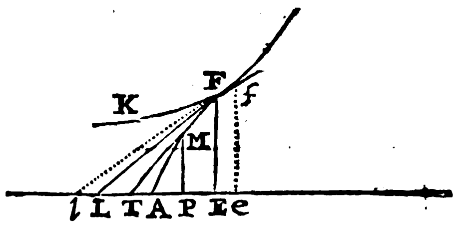
And if we suppose y to be Infinite, then the Terms $\dot{x}^2$, and $\dot{y}^2$ vanish, and are equal to nothing in respect of $y\ddot{y}$, and consequently the form $\dot{x}^2 + \dot{y}^2 - y\ddot{y} = 0$, or *Infinity*, will become $-y\ddot{y} = 0$, or *Infinity*, that is to say, dividing by $-y$, $\ddot{y} = 0$, or *Infinity*; which is the form of the first case; and this ought to be so, because the Ordinates BM, BF, BM are then parallel to one another.

Consectary 1.

186. When $\ddot{y} = 0$, then 'tis evident that the Fluxion of AL is nothing in respect of $\dot{x}$ the Fluxion of AE; and that the two Tangents F L, f L being infinitely near each other, ought to make but one streight Line f F L.

Consectary 2.

And when $\ddot{y}$ = Infinity, then the Fluxion of AL ought to be infinitely great in comparison of that of AE, or which is the same thing, the Fluxion of AE (or $\dot{x}$) is infinitely little in respect of that of AL; 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 $\dot{x}^2 + \dot{y}^2 - y\ddot{y} = 0$, 'tis evident that, $o\, t$ ought to be equal to nothing in respect of MR; and consequently, that the two Tangents MT, $m\, t$, infinitely near each other, must Co-incide, when the point M is the same with the point of contrary Flexion or Retrogression.

Consectary 4.

And when $\dot{x}^2 + \dot{y}^2 - y\ddot{y}$ = *Infinity*, then $o\, t$ is infinite in respect of MR, or which is the same thing, MR is infinitely little in comparison of $o\, t$, and consequently the Points M and m must Co-incide; 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.

Consectary 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.

Prop. 4.

If the Curve-line A F K *be given, and its Diameter* AB; *and if the Relation of the Absciss* AE (x) *to the Ordinate* EF (y) *be express'd by this Equation* $axx = xxy + aay$; *'tis requir'd to find the Value of* AE, *so that the corresponding Ordinate* EF *shall intersect the Curve* AFK *in the Point of contrary Flexion* F.

187. The Equation Curve is $y = \frac{xx}{xx + aa}$ and $\dot{y} = \frac{2a^3 x\dot{x}}{\overline{xx + aa}|^2}$; and taking the Fluxion of this

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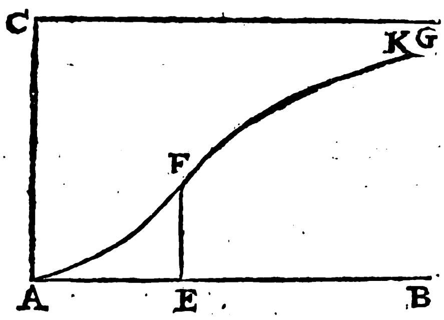
Quantity, and ſuppoſing $\dot x$ invariable, and putting the ſaid Second Fluxion equal to nothing; we have $\dfrac{2a^3\dot x^2 \times \overline{xx+aa}^2 - 8a^3x^2\dot x^2 \times \overline{xx+aa}}{\overline{xx+aa}^4}$ $=0$, and multiplying by $\overline{xx+aa}^4$, and dividing by $2a^3\dot x^2 \times \overline{xx+aa}$, we have $xx+aa-4xx=0$. And $3xx=aa$, that is x (AE) $=a\sqrt{\frac{1}{3}}$.



If we ſubſtitute $\frac{1}{3}aa$ in place of xx in the Equation of the Curve $y=\dfrac{axx}{xx+aa}$, then $y=\dfrac{\frac{1}{3}a^3}{\frac{4}{3}aa}=\frac{1}{4}a=$ EF; ſo that we may determine the Point of Inflexion F, without ſuppoſing the Curve AFK to be deſcrib'd.

If AC be drawn parallel to the Ordinate EF, and equal to the given Line a, and if CG be drawn parallel to AB, it will be an Aſſymptote to the Curve AFK. For if we ſuppoſe x to be infinite, then the Equation of the Curve $y=\dfrac{axx}{xx+aa}$ will become $y=\dfrac{axx}{xx}=a$, ſo that the Ordinate of the Curve EF cannot be $=a$ $=$ AC, before the Abſciſſa AE be infinite.

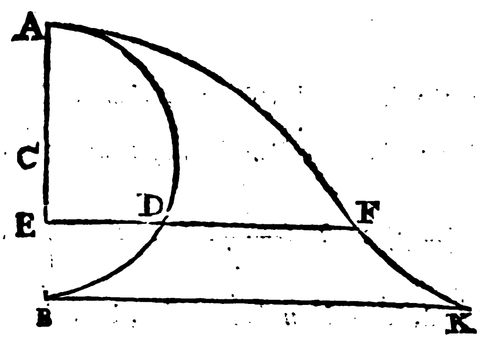
Corollary.

188. If the Equation of the Curve be $y-a=\overline{x-a}^{\frac{3}{5}}$ then $\dot y=\frac{3}{5}\,\overline{x-a}|^{-\frac{2}{5}}\times\dot x$, and $\ddot y=$ (ſuppoſing $\dot x$ invariable) $-\frac{6}{25}\,\overline{x-a}|^{-\frac{7}{5}}\,\dot x^2=$ $\dfrac{-6\dot x^2}{25\sqrt[5]{\overline{x-a}^7}},=0$. Then $-6\dot x^2$ is $=0$; which becauſe it makes nothing for the Reſolution of the Queſtion, therefore I put $\dfrac{-6\dot x^2}{25\sqrt[5]{\overline{x-a}^7}}=$ *Infinity*; whence the Denominator $25\sqrt[5]{\overline{x-a}^7}$ is $=0$, and conſequently, the unknown Quantity x (AE) is $=a$.

Prop. 2.

If AFK *be a protracted Semi-cycloid whoſe Baſe* BK *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 $=a$, BK $=b$, AB $=2r$, and the unknown Quanti-



ties AE $=x$, ED $=z$, the Arch AD $=u$; and EF $=y$; then by the Property of the Cycloid $y=z+\dfrac{bu}{a}$, and conſequently $\dot y=\dot z+\dfrac{b\dot u}{a}$; but by the Property of the Circle $z=\sqrt{2rx-xx}$ and conſequently, $\dot z=\frac{1}{2}\times\overline{2rx-xx}|^{-\frac{1}{2}}$ $\times\,2r\dot x-2x\dot x=\dfrac{r\dot x-x\dot x}{\sqrt{2rx-xx}}$ and $\dot u=$ $\sqrt{\dot x^2+\dot z^2}=\dfrac{r\dot x}{\sqrt{2rx-xx}}$, therefore ſubſtituting for $\dot z$ and $\dot y$ their reſpective Values, we have $\dot y=\dfrac{ar\dot x-ax\dot x}{a\sqrt{2rx-xx}}+\dfrac{br\dot x}{a\sqrt{2rx-xx}}$ $=\dfrac{ar\dot x-ax\dot x+br\dot x}{a\sqrt{2rx-xx}}$ and the Fluxion thereof (ſupppoſing $\dot x$ invariable) is, $\ddot y=$ $\dfrac{\overline{br-arr-br^2}\times\dot x^2}{\overline{2rx-xx}\times\sqrt{2rx-xx}}=0$, whence $brx-arr-br^2\times\dot x^2$ is $=0$, and dividing by $\dot x^2\times r$, we have $bx-ar-br=0$, and by Tranſpoſition $bx=$

$bx = ar + br$, and $x = r + \frac{ar}{b}$, and consequently $CE = \frac{ar}{b}$.

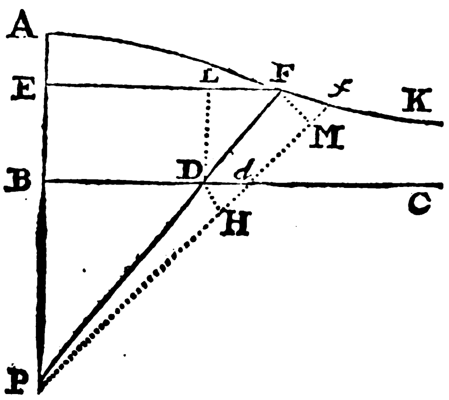
Hence 'tis manifest, that to have a Point of contrary Flexion F, *b must be greater than a; for if b, be less than a, then* CE *would exceed* CB.

Prop. 3.

Let it be requir'd to find F *the Point of contrary Flexion in* Nichomedes's *Conchoid* A F K.

190. Let B C 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 A F K, as P F, P A, then the Segments between the Assymptote and the Curve *v. g.* A B, D F are always equal to a given Line a,

Draw P A perpendicular, and F E parallel to B C, and suppose the known Quantities $AB = FD = a$; $BP = b$; and the unknown Quantities $BE = x$, $EF = y$, and draw D L parallel to B A, then because the Triangles D L F, P E F,



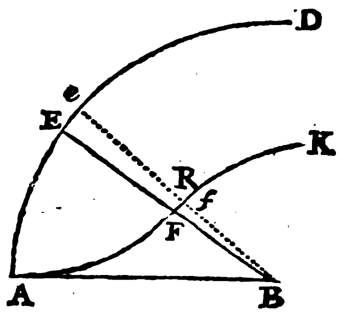
are similar; it is $DL\,(x) : LF\,(\sqrt{aa - xx}) :: PE\,(b + x) : FE = y = \frac{\overline{b+x}\sqrt{aa-xx}}{x}$ and consequently $\dot{y} = \frac{x^3\dot{x} + aab\dot{x}}{xx\sqrt{aa-xx}}$. And $\ddot{y} = \frac{\overline{2a^4b - aax^3 - 3aabxx}\,\dot{x}^2}{\overline{aax^3 - x^5} \times \sqrt{aa-xx}} = 0$, whence by Reduction there will arise $x^3 + 3bxx - 2aab = 0$, and one of the Values of the Root x will be $= PF$, which was requir'd.

If a be $= b$, the preceeding Equation will be changed into this other, $x^3 + 3axx - 2a^3 = 0$, which being divided by $x + a$ the Quotient is $xx + 2ax - 2a^2 = 0$, and consequently x is $= -a + \sqrt{3aa}$.

Prop. 4.

Let AED *be an Arch of a Circle, and* B *its Center, and let the Property of the Curve-line* AFK *be such, that drawing any Ray* BFE *at pleasure, 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 $az = rr - 2ry + yy$, and



consequently $\dot{z} = \frac{2y\dot{y} - 2r\dot{y}}{a} = Ee$; and because the Sectors B E e, B F R are similar, it is $BE\,(r) : BF\,(y) :: Ee\left(\frac{2y\dot{y} - 2r\dot{y}}{a}\right) : FR = \dot{x} = \frac{2yy\dot{y} - 2ry\dot{y}}{ar}$ and the Fluxion thereof (supposing $\dot{x}$ invariable) is $4y\dot{y}^2 - 2a\dot{y}^2 + 2yy\ddot{y} - 2ay\ddot{y} = 0$. And consequently $y\ddot{y} = \frac{a\dot{y}^2 - 2y\dot{y}^2}{y - a}$. Now if we substitute these Values of $\dot{x}^2$ and $y\ddot{y}$ in the general Theorem $y\ddot{y} = \dot{x}^2 + \dot{y}^2$, there will arise this Equation, $\frac{r\dot{y}^2 - 2y\dot{y}^2}{y - a} = \frac{4y^4\dot{y}^2 - 8ry^3\dot{y}^2 + 4rryy\dot{y}^2 + rraa\dot{y}^2}{aarr}$ which by Reduction, is $4y^5 - 12ry^4 + 12rry^3 - 4r^3yy + 3rraay - 2r^3aa = 0$. And one of the Values of the Root y will be $= BF$ requir'd.

Scholium 1.

That the Curve A F K, *which we may call a* Parabolical Spiral, *has a Point of contrary Flexion, may easily appear.*

For the Circumference A E D not differing sensibly near A, from the Tangent in A, its plain from

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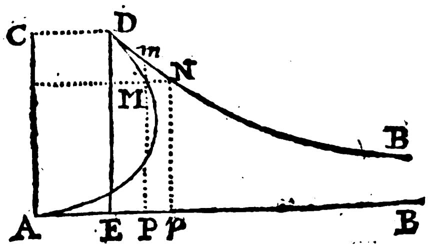
from the Nature of the Parabola, that the Curve muſt be concave towards that Tangent, and that afterwards the Curvature of the Circumference about its Centre becoming more and more ſenſible, the ſaid Curve muſt be concave towards the ſaid Centre B.

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 ſuch 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) *x* be 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 Trench* 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*, ſignifies 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 ſhews 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 Year 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 due:: So muſt 1 *l.* with its growing Intereſt, be to the Decreaſe of 1 *l.* at the Years End. (Then at 6 *l.* and 10 *l. per Cent.* the Work will ſtand thus.

As 106. 100 :: 1. .94339 or 18*s.* 10*d.* $\frac{1}{4}$.
110. 100 :: 1. .90909 or 18*s.* 2*d.*

From whence it appears that 1 *l.* in a Years Time at 6 *l. per Cent.* decreaſes to 18 *s.* 10 *d.* $\frac{1}{4}$ and at 10 *l. per Cent.* to 18 *s.* 2 *d.* So that 18 *s.* 10 *d.* $\frac{1}{4}$ Ready Money is worth 20 *s.* to be paid a Year hence at 6 *l. per Cent.* and 18 *s.* 2 *d.* Ready Money is worth 20*s.* to be paid a Year hence at 10 *l. 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. Intereſt increaſe to juſt 20 *s.* But at 10 *l. per Cent.* 20 *s.* in 21 Years decreaſes to 2 *s.* 8*d.* $\frac{1}{4}$. So that at the Rate of Intereſt 2 *s.* 8 *d.* $\frac{1}{4}$ to be paid now, will amount to 20 *s.* in 21 Years Time.

In order therefore to renew a Leaſe of 21 Years that hath but one Year lapſed, at the Rate of 10 *l. per Cent.* I 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.* $\frac{1}{4}$, which is the Fine to be paid to renew one Year lapſed in the ſaid Leaſe, and ſuppoſing the Rent to be 1 *l. per* Ann. for it is 21 Years e're the Leaſe is compleated; in which Time the Fine of 2 *s.* 8*d.* $\frac{1}{4}$. will amount to 20 *s.* and therefore by paying that Fine, the Leaſe may fairly be made up again.

Suppoſe again there be two Years lapſed in ſuch a Leaſe, allowing the ſame Rate of Intereſt. Looking into the following Table of Reverſions I find 20 *s.* to be paid 20 Years hence, is now worth in Ready Money 2 *s.* 11 *d.* $\frac{1}{4}$, add this Summ to the former of 2 *s.* 8*d.* $\frac{1}{4}$, and their Summ which is 5 *s.* 8 *d.* is the Fine to be paid to make the Leaſe to 21 Years again, ſuppoſing the Rent to be 1 *l.*

Suppoſe an Eſtate in Fee-Simple, whoſe real Value is 100 *l.* But that it is *Mortgaged*, or *Leaſed* out 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.* $\frac{1}{4}$, and multiplying that by 100, I find,

	l.	*s.*	*d.*
100 times 6 *s.* is	30	00	0
100 times 2 *d.* or 200 *d.* makes		16	0
And 100 times $\frac{1}{4}$, or 300 *q.* makes		6	3
Summ	31	2	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 Leaſes.*

A Table

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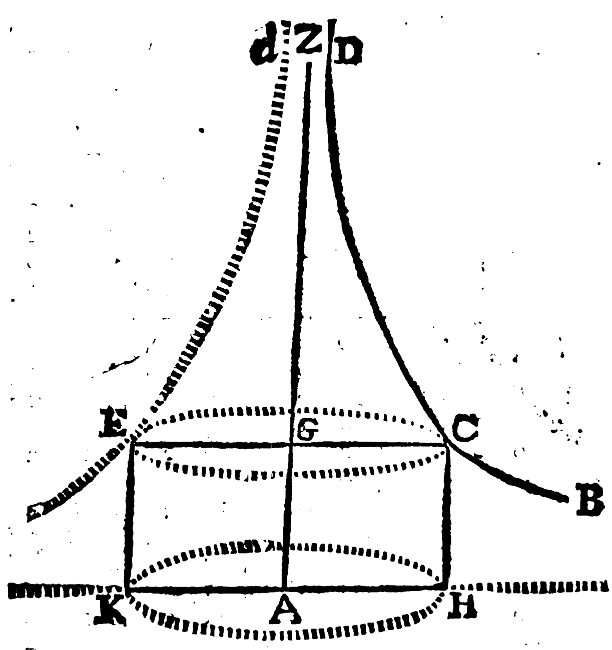
A Table of Reversions shewing what 1 *l.* due any Number of Years hence, under 41 is worth in ready Money at 5. 6, 7, 8, 10, and 12 *l.* *per Cent.*

Years.	5 *per cent.*			6 *per cent.*			7 *per cent.*			8 *per cent.*			10 *p. cent.*			12 *p. cent.*		
	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.
1	19	0	2	18	10	1	18	8	0	18	6	0	18	2	0	17	10	1
2	18	1	2	17	9	1	17	5	2	17	1	3	16	6	1	15	11	1
3	17	3	1	16	9	2	16	3	3	15	10	1	15	0	0	14	3	0
4	16	5	1	15	10	0	15	3	0	14	8	1	13	8	0	12	8	2
5	15	8	0	14	11	1	14	3	1	13	7	1	12	5	0	11	4	0
6	14	11	0	14	1	0	13	4	0	12	7	0	11	3	2	10	1	3
7	14	2	2	13	3	2	12	5	1	11	8	0	10	3	0	9	0	3
8	13	6	1	12	6	2	11	7	2	10	9	2	9	4	0	8	1	0
9	12	10	2	11	10	0	10	10	2	10	0	0	8	5	3	7	2	2
10	12	3	1	11	2	0	10	2	0	9	3	0	7	8	2	6	5	0
11	11	8	0	10	6	1	9	6	0	8	6	3	7	0	0	5	9	0
12	11	1	2	9	11	1	8	10	2	7	11	1	6	4	2	5	1	2
13	10	7	1	9	4	2	8	3	2	7	4	0	5	9	2	4	7	0
14	10	1	0	8	10	0	7	9	0	6	9	2	5	3	0	4	1	0
15	9	7	2	8	4	0	7	3	0	6	3	2	4	9	1	3	7	3
16	9	2	0	7	10	2	6	9	1	5	10	0	4	4	1	3	3	0
17	8	8	2	7	5	0	6	4	0	5	4	3	3	11	1	2	11	0
18	8	4	0	7	0	0	5	11	0	5	0	0	3	7	0	2	7	0
19	7	11	0	6	7	0	5	6	1	4	7	1	3	3	0	2	4	1
20	7	6	1	6	2	3	5	2	0	4	3	2	2	11	2	2	1	0
21	7	2	0	5	10	2	4	10	0	3	11	3	2	8	2	1	10	0
22	6	10	0	5	6	2	4	6	0	3	8	0	2	5	2	1	8	0
23	6	6	0	5	3	0	4	2	2	3	4	3	2	2	3	1	5	2
24	6	2	1	4	11	1	3	11	1	3	1	3	2	0	1	1	3	3
25	5	10	3	4	8	0	3	8	1	2	11	0	1	10	0	1	2	0
26	5	7	1	4	4	3	3	5	1	2	8	1	1	8	0	1	0	2
27	5	4	1	4	1	3	3	2	2	2	6	0	1	6	1		11	0
28	5	1	0	3	10	3	3	0	0	2	3	3	1	4	2		10	0
29	4	10	1	3	8	1	2	9	2	2	1	3	1	3	0		9	0
30	4	7	2	3	6	1	2	7	2	1	11	3	1	1	3		8	0
31	4	5	1	3	3	1	2	5	1	1	10	0	1	1	0		7	0
32	4	2	1	3	0	2	2	3	2	1	8	1		11	1		6	1
33	4	0	0	2	10	1	2	1	2	1	6	3		10	1		5	2
34	3	9	2	2	8	3	2	0	0	1	5	1		9	1		5	1
35	3	7	2	2	6	2	1	10	2	1	4	0		8	2		4	2
36	3	5	1	2	5	1	1	9	0	1	3	0		7	3		4	0
37	3	3	1	2	3	2	1	7	2	1	2	0		7	0		3	1
38	3	1	2	2	2	0	1	6	2	1	1	0		6	1		3	0
39	2	11	3	2	0	0	1	5	0	1	0	0		5	3		3	0
40	2	10	0	1	11	0	1	4	0	0	11	0		5	1		2	2

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 Ellepsis, 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 so moving is said to *Revolve*. Thus a Right-angled Triangle revolving round one of its Legs, as an Axis, generates by that Revolution a Cone. And to instance in a Case very wonderful; the Body called by *Torricellius Hyperbolicum Acutum*, tho'its self (as he demonstrates) be *Finite*; is yet formed by the *Revolution* of an *Infinite* Area: As in the Figure annexed.

Let A be the Centre of the Apollonian common Hyperbola DCB. AZ one of the Assymptotes, GC an Ordinate equal to the *Abscissa* GA. Compleat the Square GH. And supposing Z to be at an Infinite Distance, imagine the Space DCHAZ to *Revolve* about the Assymptote ZA, generating thereby the Body DCHAKE*d*, called the *Hyperbolicum Acutum: I say the Conick Body d*EGCD *is Finite and exactly Equal to the Cylinder* EKHC: *But yet the Assymptotick Space* GCD, *which its Revolution generates, is Infinite.*



For let a Unit, or 1. represent the Ordinate GC or GA. Then will the *Fluent* of the Space ZGC be $\frac{x^0}{0} = \frac{1}{0} =$ Infinite: And the *Fluent* of the Body *d*EGC is $x^{*} \frac{\ }{xx} = xyy =$ to the Cylinder EH.

RHANDIR in the Division of the Country of *Wales* before the Conquest; what they called a *Cantref* contained an hundred Towns, under which were so 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 *Gavel* had 4 *Rhandirs*, and in every *Rhandir* were 4 Tenements. *Taylor's Hist. of Gavel Kind*, p. 69.

RIAL, A Piece of Gold current, for ten Shillings: In 1 *H.* 6. by Indenture of the Mint, a 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 11 *s.* 3 *d.* In 2 *Eliz.* Golden Rials were coined at 15 *s.* 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 Shillings.

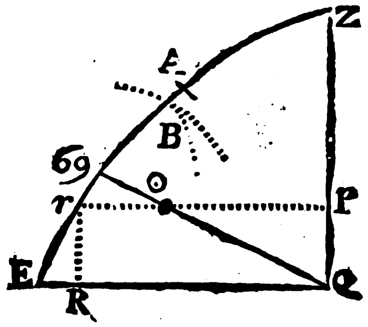
RIBBING *Nails* are such as are used to fasten the Ribbing, or to keep the Ribs of a Ship in their Place.

RIDING *Clerk*, one of the six Clerks in Chancery, who in his Turn, for one Year, keeps the Controllment-Books of all Grants that pass the Great Seal that Year. *Cowel.*

RIGHT

RIGHT *Ascension of the Sun.* To find this by the Projection of Part of the Analemma readily; having given either his *Place*, or Declination.

In the Quadrant E Q Z, draw *r p* representing the Parallel of the Sun's Declination; which (having taken E ♋ from the Chords = 23° 30′, and so draw *n* EQ) will find ⊙ for the Sun's place; or having the Point of ⊙ first, if through it you draw the Parallel *r p*, you will have E *r*, the Sun's present Declination. This done, ⊙ *p* will be the Sine of the Sun's right Ascension to the Radius *r p*



Wherefore (by the Sector) say as *r p*, to ⊙ *p* : : 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 *r p* from Q to R, on which Point R as a Centre, and with ⊙ *p* as a Radius, sweep 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 Point.

Here follow Tables of the Sun's Right Ascension, Declination, and Place in the Ecliptick, which I had from Mr. *James Hodgson*, the Worthy Master of the Queen's Mathematical School in *Christ's-Hospital*; Together with Tables of the Right Ascension, Declination, Longitude and Latitude of above Fifty of the principal fixed Stars: Most of the First and Second, and some few of the Third Magnitude. All which Tables are fitted for the 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 Universally and so previously necessary in all Astronomical Calculations, that they must have a Place in a Collection of this Nature.

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A *Table* of the *Sun's* Right Ascension in Hours and Minutes for the Year, 1709.

Days	*January.* h.	m.	*February.* h.	m.	*March.* h.	m.	*April.* h.	m.	*May.* h.	m.	*June.* h.	m.	Days
1	19	36	21	44	23	29	1	22	3	16	5	21	1
2	19	40	21	48	23	33	1	25	3	20	5	25	2
3	19	44	21	52	23	36	1	29	3	24	5	29	3
4	19	49	21	56	23	40	1	33	3	27	5	33	4
5	19	53	22	00	23	44	1	37	3	31	5	37	5
6	19	57	22	4	23	48	1	40	3	35	5	42	6
7	20	1	22	7	23	51	1	44	3	39	5	46	7
8	20	5	22	11	23	54	1	48	3	43	5	50	8
9	20	9	22	15	23	58	1	51	3	47	5	54	9
10	20	14	22	18	0	2	1	55	3	51	5	58	10
11	20	18	22	22	0	5	1	59	3	55	6	3	11
12	20	22	22	26	0	00	2	2	3	59	6	7	12
13	20	27	22	30	0	13	2	6	4	3	6	11	13
14	20	31	22	34	0	16	2	10	4	7	6	15	14
15	20	35	22	38	0	20	2	14	4	11	6	19	15
16	20	39	22	41	0	24	2	17	4	15	6	23	16
17	20	44	22	45	0	27	2	21	4	19	6	28	17
18	20	48	22	49	0	31	2	25	4	23	6	32	18
19	20	52	22	53	0	34	2	30	4	28	6	36	19
20	20	56	22	56	0	38	2	33	4	32	6	40	20
21	21	00	23	00	0	42	2	36	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	2	44	4	44	6	52	23
24	21	12	23	11	0	53	2	48	4	48	6	56	24
25	21	16	23	15	0	56	2	52	4	53	7	00	25
26	21	20	23	10	1	00	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	3	3	5	4	7	13	28
29	21	32			1	11	3	7	5	9	7	17	29
30	21	36			1	15	3	11	5	13	7	21	30
31	21	40			1	18							31

Days	*July.* h.	m.	*August.* h.	m.	*September.* h.	m.	*October.* h.	m.	*ovember.* h.	m.	*December.* h.	m.	Days
1	7	25	9	27	11	21	13	10	15	10	17	18	1
2	7	29	9	31	11	24	13	13	15	14	17	22	2
3	7	33	9	35	11	28	13	17	15	18	17	26	3
4	7	38	9	38	11	32	13	21	15	22	17	31	4
5	7	42	9	42	11	35	13	25	15	26	17	35	5
6	7	46	9	46	11	39	13	28	15	30	17	40	6
7	7	49	9	50	11	42	13	32	15	34	17	44	7
8	7	54	9	54	11	46	13	36	15	38	17	49	8
9	7	58	9	57	11	50	13	40	15	43	17	53	9
10	8	1	10	1	11	53	13	43	15	47	17	58	10
11	8	6	10	4	11	57	13	46	15	51	18	2	11
12	8	10	10	8	12	1	13	51	15	55	18	7	12
13	8	14	10	11	12	4	13	54	16	00	18	11	13
14	8	18	10	15	12	8	13	58	16	4	18	16	14
15	8	21	10	19	12	12	14	1	16	8	18	20	15
16	8	25	10	22	12	15	14	6	16	13	18	24	16
17	8	29	10	26	12	19	14	9	16	17	18	29	17
18	8	33	10	30	12	22	14	13	16	21	18	33	18
19	8	37	10	33	12	26	14	17	16	25	18	38	19
20	8	41	10	37	12	29	14	22	16	30	18	42	20
21	8	45	10	41	12	32	14	26	16	34	18	46	21
22	8	49	10	44	12	36	14	30	16	39	18	51	22
23	8	53	10	47	12	40	14	34	16	43	18	55	23
24	8	56	10	51	12	43	14	38	16	47	19	00	24
25	9	00	10	55	12	47	14	42	16	52	19	4	25
26	9	4	10	58	12	51	14	46	16	56	19	9	26
27	9	8	11	2	12	54	14	50	17	00	19	13	27
28	9	12	11	7	12	58	14	54	17	4	19	17	28
29	9	16	11	9	13	2	14	58	17	9	19	22	29
30	9	20	11	14	13	6	15	2	17	13	19	26	30
31	9	24	11	16			5	6			19	30	31

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A *Table* of the *Sun*'s Right Afcenfion in Hours and Minutes for the Year, 1710.

Days	*January.* h.	m.	*February.* h.	m.	*March.* h.	m.	*April.* h.	m.	*May.* h.	m.	*June.* h.	m.	Days
1	19	35	21	43	23	29	1	21	3	15	5	20	1
2	19	39	21	47	23	32	1	24	3	19	5	24	2
3	19	43	21	51	23	36	1	28	3	22	5	28	3
4	19	48	21	55	23	40	1	32	3	26	5	32	4
5	19	52	21	59	23	43	1	36	3	30	5	36	5
6	19	56	22	3	23	47	1	39	3	34	5	41	6
7	20	00	22	6	23	51	1	43	3	38	5	45	7
8	20	4	22	10	23	54	1	47	3	42	5	49	8
9	20	8	22	14	23	58	1	51	3	46	5	53	9
10	20	13	22	18	00	1	1	55	3	50	5	57	10
11	20	17	22	21	00	4	1	58	3	54	6	2	11
12	20	21	22	25	00	8	2	1	3	58	6	6	12
13	20	26	22	29	00	12	2	5	4	2	6	10	13
14	20	30	22	33	00	16	2	9	4	6	6	14	14
15	20	34	22	37	00	20	2	13	4	10	6	18	15
16	20	38	22	40	00	23	2	16	4	14	6	22	16
17	20	43	22	44	00	26	2	20	4	18	6	27	17
18	20	47	22	48	00	30	2	24	4	22	6	31	18
19	20	51	22	52	00	34	2	28	4	27	6	35	19
20	20	55	22	55	00	38	2	32	4	31	6	39	20
21	20	59	22	59	00	41	2	35	4	35	6	43	21
22	21	3	23	3	00	44	2	39	4	39	6	47	22
23	21	7	23	7	00	48	2	43	4	43	6	51	23
24	21	11	23	10	00	52	2	47	4	47	6	55	24
25	21	15	23	14	00	55	2	51	4	51	6	59	25
26	21	19	23	18	00	59	2	55	4	55	7	4	26
27	21	23	23	21	1	2	2	58	4	59	7	8	27
28	21	27	23	25	1	6	3	2	5	3	7	12	28
29	21	31			1	10	3	6	5	8	7	16	29
30	21	35			1	14	3	11	5	12	7	20	30
31	21	39			1	17			5	16			31

Days	*July.* h.	m.	*August.* h.	m.	*September.* h.	m.	*October.* h.	m.	*November.* h.	m.	*December.* h.	m.	Days
1	7	24	9	26	11	20	13	9	15	9	17	17	1
2	7	28	9	30	11	23	13	12	15	13	17	21	2
3	7	32	9	34	11	27	13	16	15	17	17	25	3
4	7	36	9	37	11	31	13	20	15	21	17	30	4
5	7	40	9	41	11	34	13	24	15	25	17	34	5
6	7	44	9	45	11	38	13	27	15	29	17	39	6
7	7	48	9	49	11	41	13	31	15	33	17	43	7
8	7	52	9	53	11	45	13	35	15	37	17	48	8
9	7	56	9	6	11	49	13	39	15	42	17	52	9
10	8	1	10	00	11	53	13	42	15	46	17	57	10
11	8	5	10	4	11	56	13	46	15	50	18	1	11
12	8	9	10	7	12	00	13	40	15	54	18	5	12
13	8	13	10	11	12	3	13	54	15	59	18	10	13
14	8	17	10	15	12	7	13	58	16	3	18	14	14
15	8	21	10	18	12	11	14	1	16	7	18	19	15
16	8	25	10	22	12	14	14	5	16	11	18	23	16
17	8	29	10	26	12	18	14	9	16	16	18	27	17
18	8	33	10	29	12	21	14	13	16	20	18	32	18
19	8	36	10	33	12	24	14	17	16	24	18	36	19
20	8	40	10	37	12	28	14	21	16	29	18	41	20
21	8	44	10	40	12	31	14	25	16	33	18	45	21
22	8	48	10	44	12	35	14	29	16	37	18	50	22
23	8	52	10	47	12	39	14	33	16	42	18	54	23
24	8	55	10	51	12	43	14	37	16	46	18	58	24
25	8	59	10	55	12	47	14	41	16	50	19	3	25
26	9	3	10	58	12	50	14	45	16	54	19	7	26
27	9	7	11	1	12	54	14	49	16	59	19	12	27
28	9	11	11	5	12	58	14	53	17	3	19	16	28
29	9	15	11	9	13	1	14	57	17	8	19	20	29
30	9	18	11	13	13	5	15	1	17	12	19	25	30
31	9	22	11	16			15	5			19	29	31

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A *Table* of the *Sun*'s Right Aſcenſion in Hours and Minutes for the Year, 1711.

Days	January		February		March		April		May		June		Days
	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	
1	19	34	21	42	23	28	1	21	3	14	5	19	1
2	19	38	21	46	23	31	1	24	3	18	5	23	2
3	19	42	21	50	23	35	1	28	3	22	5	27	3
4	19	47	21	54	23	39	1	31	3	25	5	31	4
5	19	51	21	58	23	42	1	35	3	29	5	35	5
6	19	55	22	2	23	46	1	39	3	33	5	40	6
7	19	59	22	5	23	50	1	43	3	37	5	44	7
8	20	3	22	9	23	53	1	46	3	41	5	48	8
9	20	7	22	13	23	57	1	50	3	45	5	52	9
10	20	12	22	17	00	1	1	54	3	49	5	56	10
11	20	16	22	20	00	4	1	57	3	53	6	1	11
12	20	20	22	24	00	8	2	1	3	57	6	5	12
13	20	25	22	28	00	11	2	5	4	1	6	9	13
14	20	29	22	32	00	15	2	9	4	5	6	13	14
15	20	33	22	36	00	19	2	12	4	9	6	17	15
16	20	37	22	39	00	22	2	16	4	13	6	21	16
17	20	42	22	43	00	26	2	20	4	17	6	26	17
18	20	46	22	47	00	29	2	24	4	21	6	30	18
19	20	50	22	51	00	33	2	28	4	26	6	34	19
20	20	54	22	54	00	37	2	32	4	30	6	38	20
21	20	58	22	58	00	40	2	35	4	34	6	42	21
22	21	2	23	2	00	44	2	39	4	38	6	46	22
23	21	6	23	6	00	48	2	43	4	42	6	50	23
24	21	10	23	9	00	51	2	47	4	46	6	54	24
25	21	14	23	13	00	55	2	51	4	50	6	58	25
26	21	18	23	17	00	59	2	54	4	54	7	3	26
27	21	22	23	20	1	2	2	58	4	58	7	7	27
28	21	26	23	24	1	6	3	2	5	2	7	11	28
29	21	30			1	10	3	6	5	7	7	15	29
30	21	34			1	13	3	10	5	11	7	19	30
31	21	28			1	17			5	15			31

Days	July		August		September		October		November		December		Days
	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	
1	7	23	9	25	11	19	13	8	15	8	17	16	1
2	7	27	9	29	11	22	13	11	15	12	17	20	2
3	7	31	9	33	11	26	13	15	15	16	17	24	3
4	7	35	9	36	11	30	13	19	15	20	17	29	4
5	7	39	9	40	11	33	13	23	15	24	17	32	5
6	7	43	9	44	11	37	13	26	15	28	17	38	6
7	7	47	9	48	11	40	13	30	15	32	17	42	7
8	7	51	9	52	11	44	13	34	15	36	17	47	8
9	7	55	9	55	11	48	13	38	15	41	17	51	9
10	7	59	9	59	11	51	13	41	15	45	17	55	10
11	8	3	10	3	11	55	13	45	15	49	18	00	11
12	8	7	10	6	11	59	13	49	15	53	18	4	12
13	8	11	10	10	12	2	13	53	15	58	18	9	13
14	8	15	10	14	12	6	13	57	16	2	18	13	14
15	8	19	10	17	12	10	14	00	16	6	18	18	15
16	8	23	10	21	12	13	14	4	16	10	18	22	16
17	8	27	10	25	12	17	14	8	16	15	18	26	17
18	8	31	10	28	12	20	14	12	16	19	18	31	18
19	8	35	10	32	12	24	14	16	16	23	18	35	19
20	8	39	10	36	12	28	14	20	16	27	18	40	20
21	8	43	10	39	12	31	14	24	16	32	18	44	21
22	8	47	10	43	12	35	14	28	16	36	18	49	22
23	8	51	10	46	12	38	14	32	16	41	18	53	23
24	8	54	10	50	12	42	14	36	16	45	18	57	24
25	8	58	10	54	12	46	14	40	16	49	19	2	25
26	9	2	10	57	12	49	14	44	16	53	19	6	26
27	9	6	11	1	12	53	14	48	16	58	19	11	27
28	9	10	11	5	12	57	14	52	17	2	19	15	28
29	9	14	11	8	13	00	14	56	17	7	19	19	29
30	9	18	11	12	13	4	15	00	17	11	19	24	30
31	9	21	11	15			15	4			19	28	31

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A *Table* of the *Sun's* Right Aſcenſion in Hours and Minutes for the Year, 1712.

Days	*January.* h.	m.	*February.* h.	m.	*March.* h.	m.	*April.* h.	m.	*May.* h.	m.	*June.* h.	m.	Days
1	19	33	21	41	23	30	1	22	3	16	5	22	1
2	19	37	21	45	23	34	1	26	3	20	5	26	2
3	19	41	21	49	23	37	1	30	3	24	5	30	3
4	19	46	21	53	23	41	1	34	3	28	5	34	4
5	19	50	21	57	23	45	1	38	3	32	5	38	5
6	19	54	22	1	23	49	1	41	3	36	5	43	6
7	19	58	22	4	23	52	1	45	3	40	5	47	7
8	20	2	22	9	23	55	1	49	3	44	5	51	8
9	20	6	22	13	23	59	1	52	3	48	5	55	9
10	20	11	22	16	0	3	1	56	3	52	6	00	10
11	20	15	22	19	0	6	2	00	3	56	6	4	11
12	20	19	22	23	0	10	2	3	4	00	6	8	12
13	20	24	22	27	0	14	2	7	4	4	6	12	13
14	20	28	22	31	0	17	2	11	4	8	6	16	14
15	20	32	22	35	0	21	2	15	4	12	6	21	15
16	20	36	22	38	0	25	2	18	4	16	6	45	16
17	20	41	22	42	0	28	2	22	4	20	6	29	17
18	20	45	22	46	0	32	2	26	4	24	6	33	18
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	1	0	46	2	41	4	41	6	49	22
23	21	5	23	5	0	50	2	45	4	45	6	53	23
24	21	9	23	8	0	54	2	49	4	49	6	57	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	1	7	10	27
28	21	25	23	23	1	8	3	4	5	5	7	14	28
29	21	29	23	27	1	12	3	8	5	9	7	18	29
30	21	33			1	16	3	12	5	14	7	22	30
31	2[illegible]	[illegible]			1	18			5	18			31

Days	*July.* h.	m.	*August.* h.	m.	*September.* h.	m.	*October.* h.	m.	*November.* h.	m.	*December.* h.	m.	Days
1	7	26	9	28	11	21	13	11	15	11	17	19	1
2	7	30	9	32	11	24	13	15	15	15	17	23	2
3	7	34	9	36	11	28	13	18	15	19	17	27	3
4	7	39	9	39	11	32	13	22	15	23	17	32	4
5	7	43	9	43	11	36	13	26	15	27	17	36	5
6	7	47	9	47	11	39	13	29	15	31	17	41	6
7	7	50	9	51	11	43	13	33	15	35	17	45	7
8	7	54	9	55	11	46	13	37	15	39	17	50	8
9	7	58	9	58	11	50	13	41	15	44	17	54	9
10	8	2	10	2	11	54	13	44	15	48	17	59	10
11	8	6	10	6	11	57	13	48	15	52	18	3	11
12	8	10	10	9	12	1	13	52	15	56	18	7	12
13	8	14	10	13	12	5	13	56	16	1	18	12	13
14	8	18	10	17	12	8	14	00	16	5	18	17	14
15	8	22	10	20	12	12	14	3	16	9	18	21	15
16	8	26	10	24	12	16	14	7	16	13	18	25	16
17	8	30	10	28	12	19	14	11	16	18	18	30	17
18	8	34	10	31	12	23	14	15	16	22	18	34	18
19	8	38	10	35	12	26	14	19	16	26	18	39	19
20	8	42	10	38	12	30	14	23	16	31	18	43	20
21	8	46	10	42	12	33	14	27	16	35	18	47	21
22	8	50	10	45	12	37	14	31	16	40	18	52	22
23	8	54	10	49	12	41	14	35	16	44	18	56	23
24	8	57	10	52	12	44	14	39	16	48	19	00	24
25	9	1	10	55	12	48	14	43	16	52	19	5	25
26	9	5	11	00	12	52	14	47	16	56	19	10	26
27	9	9	11	3	12	55	14	51	17	1	19	14	27
28	9	13	11	7	12	59	14	55	17	5	19	18	28
29	9	17	11	11	13	3	14	59	17	10	19	23	29
30	9	20	11	14	13	7	15	3	17	14	19	27	30
31	9	24	11	17			15	7			19	31	31

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A Table of the Sun's Declination for the Year 1709.

Days	*January.* Dec. S.		*February.* S		*March.* S *		*April.* N		*May.* N		*June.* N		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	21	38	13	38	3	15	8	45	18	11	23	12	1
2	21	27	13	18	2	51	9	7	18	26	23	16	2
3	21	17	12	58	2	27	9	28	18	41	23	19	3
4	21	6	12	37	2	3	9	49	18	55	23	22	4
5	20	55	12	16	1	40	10	11	19	9	23	24	5
6	20	43	11	55	1	16	10	32	19	23	23	26	6
7	20	31	11	34	0	52	11	53	19	36	23	27	7
8	20	18	11	13	0	29	11	14	19	49	23	28	8
9	20	5	10	52	0	5	11	34	20	2	23	29	9
10	19	52	10	30	N.	18	11	55	20	14	23	29	10
11	19	38	10	8	00	42	12	15	20	27	23	29	11
12	19	24	9	46	1	6	12	35	20	38	23	29	12
13	19	10	9	24	1	29	12	55	20	50	23	28	13
14	18	55	9	2	1	53	13	15	21	1	23	27	14
15	18	40	8	39	2	16	13	34	21	11	23	26	15
16	18	25	8	17	2	40	13	53	21	21	23	22	16
17	18	9	7	54	3	3	14	12	21	31	23	19	17
18	17	53	7	31	3	27	14	31	21	41	23	16	18
19	17	37	7	9	3	50	14	49	21	50	23	13	19
20	17	20	6	46	4	13	15	8	21	59	23	9	20
21	17	3	6	23	4	36	15	26	22	7	23	5	21
22	16	46	6	00	4	59	15	44	22	15	23	00	22
23	16	28	5	36	5	22	16	1	22	23	22	55	23
24	16	10	5	13	5	45	16	18	22	30	22	50	24
25	15	52	4	50	6	8	16	35	22	37	22	44	25
26	15	34	4	26	6	31	16	52	22	43	22	38	26
27	15	15	4	3	6	53	17	8	22	49	22	31	27
28	14	56	3	39	7	16	17	25	22	55	22	24	28
29	14	37			7	38	17	40	23	00	22	17	29
30	14	18			8	00	17	56	23	6	22	9	30
31	13	58			8	23			23	9			31

Days	*July.* N		*August.* N		*September.* N*		*October.* S		*November.* S		*December.* S		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	22	1	15	1	4	10	7	27	17	48	23	9	1
2	21	52	14	43	3	47	7	50	18	4	23	13	2
3	21	43	14	24	3	24	8	12	18	20	23	17	3
4	21	34	14	6	3	1	8	35	18	35	23	20	4
5	21	24	13	47	2	38	8	57	18	10	23	23	5
6	21	14	13	28	2	14	9	19	19	5	23	25	6
7	20	4	13	8	1	51	9	41	19	20	23	27	7
8	20	53	12	49	1	28	10	3	19	34	23	29	8
9	20	42	12	29	1	4	10	25	19	48	23	29	9
10	20	38	12	9	0	41	10	46	20	1	23	29	10
11	20	19	11	49	00	17	11	8	20	14	23	29	11
12	20	7	11	29	S.	6	11	29	20	27	23	28	12
13	19	55	11	8	00	29	11	50	20	39	23	27	13
14	19	42	10	47	00	53	12	11	20	51	23	25	14
15	19	29	10	27	1	16	12	31	21	3	23	23	15
16	19	16	10	6	1	40	12	52	21	14	23	21	16
17	19	2	9	44	2	3	13	12	21	24	23	18	17
18	18	48	9	23	2	27	13	32	21	35	23	15	18
19	18	33	9	2	2	50	13	52	21	45	23	11	19
20	18	19	8	40	3	14	14	12	21	54	23	7	20
21	18	4	8	18	3	38	14	31	22	3	23	2	21
22	17	49	7	56	4	1	14	50	22	12	22	57	22
23	17	33	7	34	4	24	15	9	22	20	22	51	23
24	17	17	7	12	4	47	15	28	22	28	22	45	24
25	17	1	6	50	5	10	15	46	22	35	22	38	25
26	16	45	6	27	5	33	16	4	22	42	22	31	26
27	16	28	6	5	5	56	16	22	22	48	22	24	27
28	16	11	5	42	6	19	16	40	22	54	22	16	28
29	15	54	5	20	6	42	16	57	22	59	22	8	29
30	15	37	4	57	7	5	17	14	23	4	21	59	30
31	15	10	4	23			17	31			21	50	31

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A Table of the Sun's Declination for the Year 1710.

Days	January. S.		February. S		March. S *		April. N		May. N		June. N		Days
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	21	40	13	43	3	20	8	39	18	8	23	12	1
2	21	30	13	23	2	57	9	1	18	23	23	15	2
3	21	20	13	3	2	33	9	23	18	38	23	18	3
4	21	9	12	42	2	9	9	44	18	52	23	21	4
5	20	58	12	21	1	46	10	5	19	6	23	24	5
6	20	46	12	00	1	22	10	27	19	20	23	26	6
7	20	34	11	39	0	58	10	48	19	33	23	27	7
8	20	21	11	18	0	35	11	9	19	46	23	28	8
9	20	9	10	57	0	11	11	29	19	59	23	29	9
10	19	55	10	35	N.	12	11	50	20	12	23	29	10
11	19	42	10	13	00	36	12	10	20	24	23	29	11
12	19	28	9	51	1	00	12	30	20	36	23	29	12
13	19	14	9	29	1	23	12	50	20	47	23	28	13
14	18	59	9	7	1	47	13	10	20	58	23	27	14
15	18	44	8	45	2	10	13	29	21	9	23	25	15
16	18	29	8	22	2	34	13	49	21	19	23	23	16
17	18	13	8	00	2	57	14	8	21	29	23	20	17
18	17	57	7	37	3	20	14	26	21	38	23	17	18
19	17	41	7	14	3	44	14	45	21	47	23	15	19
20	17	24	6	51	4	7	15	3	21	56	23	10	20
21	17	7	6	28	4	31	15	21	22	5	23	6	21
22	16	50	6	5	4	54	15	39	22	13	23	1	22
23	16	33	5	42	5	17	15	57	22	21	22	56	23
24	16	15	5	19	5	40	16	14	22	28	22	51	24
25	15	57	4	56	6	3	16	21	22	35	22	45	25
26	15	38	4	32	6	25	16	48	22	42	22	39	26
27	15	20	4	8	6	48	17	4	22	48	22	33	27
28	15	1	3	44	7	10	17	21	22	54	22	26	28
29	14	42			7	33	17	37	22	59	22	19	29
30	14	22			7	55	17	53	23	4	22	11	30
31	14	3			8	17			23	8			31

Days	July. N		August. N		September. N*		October. S.		November. S		December. S		Days
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	22	3	15	5	4	16	7	22	17	44	23	8	1
2	21	54	14	47	3	53	7	44	18	00	23	12	2
3	21	45	14	29	3	30	8	7	18	16	23	16	3
4	21	36	14	10	3	6	8	29	18	31	23	20	4
5	21	27	13	51	2	43	8	52	18	47	23	23	5
6	21	17	13	32	2	20	9	14	19	1	23	25	6
7	21	7	13	13	1	57	9	36	19	16	23	27	7
8	20	56	12	53	1	33	9	58	19	30	23	29	8
9	20	45	12	34	1	10	10	19	19	44	23	29	9
10	20	34	12	14	0	46	10	40	19	58	23	29	10
11	20	22	11	54	00	23	11	2	20	11	23	29	11
12	20	10	11	34	00	00	11	24	20	24	23	28	12
13	19	58	11	13	S.	24	11	45	20	36	23	27	13
14	19	45	10	52	00	47	12	5	20	48	23	26	14
15	19	32	10	32	1	11	12	26	21	00	23	24	15
16	19	19	10	11	1	34	12	47	21	11	23	21	16
17	19	5	9	50	1	58	13	7	21	22	23	18	17
18	18	51	9	28	2	21	13	27	21	32	23	15	18
19	18	37	9	7	2	44	13	47	21	42	23	11	19
20	18	22	8	45	3	8	14	7	21	52	23	7	20
21	18	7	8	24	3	31	14	26	22	1	23	3	21
22	17	52	8	2	3	55	14	46	22	10	22	58	22
23	17	37	7	40	4	18	15	5	22	18	22	52	23
24	17	21	7	18	4	41	15	24	22	26	22	46	24
25	17	5	6	55	5	4	15	42	22	24	22	40	25
26	16	49	6	33	5	27	16	00	22	40	22	33	26
27	16	32	6	11	5	50	16	18	22	46	22	26	27
28	16	15	5	48	6	13	16	36	22	52	22	18	28
29	15	58	5	24	6	36	16	53	22		22	10	29
30	15	41	5	2	6	59	17	10	23	3	22	1	30
31	15	23	4	39			17	27			21	52	31

A Table of the Sun's Declination for the Year 1711.

Days	January. S.		February. S		March. S*		April. N		May. N		June. N		Days
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	21	42	13	48	3	26	8	34	18	4	23	10	1
2	21	32	13	28	3	2	8	56	18	19	23	14	2
3	21	22	13	8	2	39	9	17	18	34	23	18	3
4	21	11	12	47	2	15	9	34	18	48	23	21	4
5	21	00	12	26	1	52	10	00	19	2	23	28	5
6	20	49	12	5	1	28	10	22	19	16	23	25	6
7	20	37	11	44	1	4	10	43	19	30	23	27	7
8	20	25	11	23	0	41	11	03	19	43	23	28	8
9	20	12	11	2	0	17	11	24	19	56	23	29	9
10	19	59	10	41	N.	7	11	45	20	8	23	29	10
11	19	45	10	19	00	30	12	5	20	20	23	29	11
12	19	31	9	57	00	54	12	25	20	32	23	29	12
13	19	17	9	35	1	18	12	45	20	44	23	28	13
14	19	3	9	13	1	41	13	5	20	55	23	27	14
15	18	48	8	51	2	5	13	25	21	6	23	26	15
16	18	33	8	28	2	28	13	44	21	16	23	23	16
17	18	17	8	5	2	52	14	3	21	26	23	20	17
18	18	1	7	43	3	15	14	22	21	36	23	17	18
19	17	45	7	20	3	38	14	41	21	45	23	14	19
20	17	28	6	57	4	2	14	59	21	54	23	11	20
21	17	11	6	34	4	25	15	17	22	3	23	7	21
22	16	54	6	11	4	48	15	35	22	11	23	2	22
23	16	37	5	48	5	11	15	53	22	19	22	57	23
24	16	19	5	24	5	34	16	10	22	26	22	52	24
25	16	1	5	1	5	57	16	27	22	33	22	47	25
26	15	43	4	38	6	20	16	44	22	40	22	41	26
27	15	24	4	14	6	42	17	00	22	46	22	34	27
28	15	5	3	50	7	5	17	17	22	52	22	27	28
29	14	46			7	27	17	33	22	57	22	20	29
30	14	27			7	50	17	49	23	2	22	12	30
31	14	8			8	12			23	6			31

Days	July. N		August. N		September. N*		October. S		November. S		December. S		Days
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	22	4	15	9	4	21	7	16	17	40	23	7	1
2	21	56	14	51	3	58	7	39	17	56	23	11	2
3	21	48	14	33	3	35	8	2	18	12	23	15	3
4	21	49	14	15	3	12	8	24	18	28	23	19	4
5	21	29	13	56	2	49	8	46	18	43	23	22	5
6	21	19	13	37	2	26	9	8	18	58	23	24	6
7	21	9	13	18	2	2	9	30	19	13	23	26	7
8	20	59	12	58	1	39	9	52	19	27	23	28	8
9	20	48	12	39	1	16	10	14	19	41	23	29	9
10	20	37	12	19	0	52	10	36	19	54	23	29	10
11	20	25	11	59	00	29	10	57	20	8	23	29	11
12	20	13	11	39	00	5	11	19	20	21	23	28	12
13	20	1	11	18	S.	18	11	40	20	33	23	27	13
14	19	48	10	58	00	41	12	1	20	45	23	26	14
15	19	35	10	37	1	5	12	21	20	57	23	25	15
16	19	22	10	16	1	28	12	42	21	8	23	22	16
17	19	8	9	55	1	52	13	2	21	19	23	19	17
18	18	54	9	34	2	15	13	23	21	30	23	16	18
19	18	40	9	12	2	39	13	42	21	40	23	13	19
20	18	26	8	51	3	2	14	2	21	50	23	9	20
21	18	11	8	29	3	26	14	22	21	59	23	4	21
22	17	56	8	7	3	49	14	41	22	8	22	59	22
23	17	41	7	45	4	12	15	00	22	16	22	54	23
24	17	25	7	23	4	35	15	19	22	24	22	48	24
25	17	9	7	1	4	59	15	38	22	32	22	42	25
26	16	53	6	39	5	22	15	56	22	39	22	35	26
27	16	36	6	16	5	45	16	14	22	45	22	28	27
28	16	19	5	4	6	8	16	32	22	51	22	20	28
29	16	2	5	1	6	31	16	49	22	57	22	12	29
30	15	45	5	8	6	54	17	6	23	2	22	3	30
31	15	27	4	44			17	23			21	54	31

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A Table of the Sun's Declination for the Year 1712.

Days	January S.		February S		March S*		April N		May N		June N		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	21	45	13	53	3	8	8	50	18	15	23	14	1
2	21	35	13	33	2	45	9	12	18	30	23	17	2
3	21	25	13	13	2	21	9	34	18	45	23	20	3
4	21	14	12	53	1	57	9	55	18	59	23	23	4
5	21	3	12	32	1	34	10	16	19	13	23	25	5
6	20	52	12	11	1	10	10	37	19	57	23	27	6
7	20	40	11	50	0	45	10	58	19	40	23	28	7
8	20	28	11	29	0	23	11	19	19	53	23	28	8
9	20	15	11	7	0	00	11	40	20	6	23	29	9
10	20	2	10	46	N.	24	12	00	20	18	23	29	10
11	19	49	10	24	00	48	12	20	20	30	23	29	11
12	19	35	10	2	1	12	12	40	20	41	23	28	12
13	19	21	9	40	1	36	13	00	20	52	23	27	13
14	19	6	9	18	1	59	13	20	21	3	23	26	14
15	18	51	8	56	2	23	13	39	21	14	23	24	15
16	18	36	8	33	2	46	13	58	21	24	23	21	16
17	18	20	8	11	3	10	14	17	21	34	23	18	17
18	18	5	7	48	3	33	14	36	21	43	23	15	18
19	17	49	7	25	3	56	14	54	21	52	23	11	19
20	17	33	7	2	4	19	15	12	22	1	23	7	20
21	17	16	6	39	4	43	15	30	22	9	23	3	21
22	16	59	6	16	5	6	15	48	22	17	23	58	22
23	16	42	5	53	5	29	16	6	22	25	23	53	23
24	16	24	5	30	5	51	16	23	22	32	22	42	24
25	16	6	5	7	6	14	16	40	22	39	22	42	25
26	15	48	4	44	6	37	16	57	22	45	22	30	26
27	15	29	4	20	6	59	17	13	22	51	22	29	27
28	15	10	3	56	7	22	17	29	22	56	22	22	28
29	14	51	3	32	7	44	17	45	23	1	22	18	29
30	14	32			8	6	18	00	23	6	22	7	30
31	14	13			8	28			23	10			31

Days	July N		August N		September N*		October S		November S		December S		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	21	59	14	56	4	4	7	34	17	52	23	10	1
2	21	50	14	38	3	41	7	57	18	8	23	14	2
3	21	41	14	19	3	18	8	19	18	24	23	18	3
4	21	32	14	00	2	55	8	41	18	39	23	21	4
5	21	22	13	41	2	32	9	3	18	54	23	24	5
6	21	12	13	2	2	8	9	25	19	9	23	26	6
7	21	1	13	23	1	45	9	47	19	24	23	27	7
8	20	50	12	43	1	21	10	9	19	38	23	28	8
9	20	39	12	23	0	58	10	31	19	51	23	29	9
10	20	28	11	3	0	34	10	52	20	4	23	29	10
11	20	16	11	43	00	11	11	13	20	17	23	29	11
12	20	4	11	23	S.	12	11	35	20	30	23	28	12
13	19	51	11	3	00	36	11	56	20	42	23	27	13
14	19	38	10	42	00	59	12	16	20	54	23	25	14
15	19	25	10	21	1	23	12	37	21	5	23	23	15
16	19	12	10	00	2	46	12	57	21	17	23	20	16
17	18	58	9	39	2	10	13	18	22	27	23	17	17
18	18	44	9	18	2	33	13	38	21	37	23	14	18
19	18	30	8	56	2	57	13	57	21	47	23	10	19
20	18	15	8	34	3	20	14	17	21	56	23	5	20
21	18	00	8	12	3	43	14	36	22	5	23	60	21
22	17	45	7	50	4	7	14	56	22	14	22	55	22
23	17	29	7	28	4	30	15	14	22	22	22	49	23
24	17	13	7	6	4	53	15	33	22	30	22	43	24
25	17	57	6	44	5	16	15	51	22	37	22	36	25
26	16	40	6	22	5	39	16	9	22	43	22	29	26
27	16	23	5	59	6	2	16	27	22	49	22	22	27
28	16	6	5	36	6	25	16	45	22	55	22	14	28
29	15	49	5	14	6	48	17	2	23	1	22	5	29
30	15	32	4	51	7	11	17	19	23	6	21	56	30
31	15	14	4	27	7		17	36			21	47	31

A Table of the Sun's Place in the Ecliptick for the Year 1709.

Days	January. ♑		February. ♒		March. ♓		April. ♈		May. ♉		June. ♊		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	22	16	23	44	21	48	22	23	21	29	21	11	1
2	23	17	24	44	22	48	23	22	22	27	22	8	2
3	24	18	25	45	23	48	24	20	23	25	23	6	3
4	25	19	26	45	24	47	25	19	24	22	24	3	4
5	26	21	27	46	25	47	26	17	25	20	25	00	5
6	27	22	28	46	26	46	27	16	26	18	25	57	6
7	28	23	29	47	27	46	28	14	27	15	26	55	7
8	29	24	♓	47	28	45	29	13	28	13	27	52	8
9	♒	25	1	47	29	45	♉	11	29	11	28	49	9
10	1	26	2	48	♈	44	1	10	♊	8	29	46	10
11	2	27	3	48	1	44	2	8	1	6	♋	43	11
12	3	28	4	48	2	43	3	6	2	3	1	41	12
13	4	29	5	48	3	42	4	5	3	1	2	38	13
14	5	30	6	49	4	42	5	3	3	58	3	35	14
15	6	31	7	49	5	41	6	1	4	56	4	32	15
16	7	32	8	49	6	40	6	59	5	53	5	29	16
17	8	33	9	49	7	39	7	58	6	51	6	27	17
18	9	34	10	49	8	38	8	56	7	48	7	24	18
19	10	35	11	49	9	38	9	54	8	46	8	21	19
20	11	35	12	49	10	37	10	52	9	43	9	18	20
21	12	36	13	49	11	36	11	50	10	41	10	15	21
22	13	37	14	49	12	35	12	48	11	38	11	12	22
23	14	38	15	49	13	34	13	46	12	35	12	10	23
24	15	38	16	49	14	33	14	44	13	33	13	7	24
25	16	39	17	49	15	32	15	42	14	30	14	4	25
26	17	40	18	49	16	30	16	40	15	27	15	1	26
27	18	41	19	49	17	29	17	38	16	25	15	58	27
28	19	41	20	48	18	28	18	36	17	22	16	55	28
29	20	42			19	27	19	33	18	19	17	53	29
30	21	43			20	26	20	31	19	16	18	50	30
31	22	43			21	24			20	13			31

Days	July. ♋		August. ♌		September. ♍		October. ♎		November. ♏		December. ♐		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	19	47	19	27	19	27	18	59	20	00	20	26	1
2	20	45	20	25	20	26	19	58	21	1	21	27	2
3	21	42	21	22	21	25	20	58	22	1	22	28	3
4	22	39	22	20	22	23	21	57	23	2	23	29	4
5	23	36	23	18	23	22	22	57	24	3	24	30	5
6	24	34	24	16	24	21	23	57	25	3	25	31	6
7	25	31	25	13	25	19	24	57	26	4	26	32	7
8	26	28	26	11	26	18	25	56	27	5	27	33	8
9	27	25	27	9	27	17	26	56	28	5	28	35	9
10	28	23	28	7	28	16	27	56	29	6	29	36	10
11	29	20	29	5	29	14	28	56	♐	7	♑	37	11
12	♌	17	♍	3	♎	13	29	56	1	7	1	38	12
13	1	14	1	1	1	12	♏	56	2	8	2	39	13
14	2	12	1	59	2	11	1	56	3	9	3	40	14
15	3	9	2	57	3	10	2	56	4	10	4	42	15
16	4	7	3	55	4	9	3	56	5	11	5	43	16
17	5	4	4	53	5	8	4	56	6	12	6	44	17
18	6	1	5	51	6	7	5	56	7	13	7	45	18
19	6	59	6	49	7	6	6	56	8	13	8	46	19
20	7	56	7	47	8	6	7	56	9	14	9	48	20
21	8	54	8	45	9	5	8	56	10	15	10	49	21
22	9	51	9	43	10	4	9	56	11	16	11	50	22
23	10	49	10	42	11	3	10	57	12	17	12	51	23
24	11	46	11	40	12	3	11	57	13	18	13	52	24
25	12	44	12	38	13	2	12	57	14	19	14	53	25
26	13	41	13	37	14	1	13	58	15	20	15	55	26
27	14	39	14	35	15	1	14	58	16	21	16	56	27
28	15	36	15	34	16	00	15	58	17	22	17	57	28
29	16	34	16	32	17	00	16	59	18	24	18	58	29
30	17	32	17	30	17	59	17	59	19	25	19	59	30
31	18	29	18	29			19	00			21	00	31

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A Table of the Sun's Place in the Ecliptick for the Year 1710.

Days	January. ♑		February. ♒		March. ♓		April. ♈		May. ♉		June. ♊		Days
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	22	1	23	29	21	34	22	9	21	15	20	57	1
2	23	2	24	29	22	33	23	7	22	13	21	54	2
3	24	4	25	30	23	33	24	6	23	11	22	52	3
4	25	5	26	31	24	33	25	5	24	8	23	49	4
5	26	6	27	31	25	32	26	3	25	6	24	46	5
6	27	7	28	31	26	32	27	2	26	4	25	44	6
7	28	8	29	32	27	31	28	00	27	1	26	41	7
8	29	9	♓	32	28	31	28	59	27	59	27	38	8
9	♒	10	1	33	29	30	29	57	28	57	28	35	9
10	1	11	2	33	♈	30	♉	55	29	54	29	32	10
11	2	12	3	33	1	29	1	54	♊	52	♋	30	11
12	3	13	4	34	2	28	2	52	1	49	1	26	12
13	4	14	5	34	3	28	3	50	2	57	2	23	13
14	5	15	6	34	4	27	4	49	3	45	3	21	14
15	6	16	7	34	5	26	5	47	4	42	4	18	15
16	7	17	8	34	6	26	6	45	5	40	5	16	16
17	8	18	9	35	7	25	7	43	6	37	6	13	17
18	9	19	10	35	8	24	8	42	7	34	7	10	18
19	10	20	11	35	9	23	9	40	8	32	8	7	19
20	11	20	12	35	10	22	10	38	9	29	9	4	20
21	12	21	13	35	11	21	11	36	10	27	10	1	21
22	13	22	14	35	12	20	12	34	11	24	10	59	22
23	14	23	15	35	13	19	13	32	12	21	11	56	23
24	15	24	16	35	14	18	14	30	13	19	12	53	34
25	16	24	17	35	15	17	15	28	14	16	13	50	25
26	17	25	18	34	16	16	16	26	15	14	14	47	26
27	18	26	19	34	17	15	17	23	16	11	15	45	27
28	19	26	20	34	18	14	18	22	17	8	16	42	28
29	20	27			19	13	19	19	18	5	17	39	29
30	21	27			20	11	20	17	19	3	18	36	30
31	22	28			21	10			20	00			31

Days	July. ♋		August. ♌		September. ♍		October. ♎		November. ♏		December. ♐		Days
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	19	33	19	13	19	13	18	44	19	46	20	11	1
2	20	31	20	11	20	11	19	44	20	46	21	12	2
3	21	28	21	8	21	10	20	43	21	47	22	13	3
4	22	25	22	6	22	9	21	43	22	47	23	14	4
5	23	22	23	4	23	8	22	43	23	48	24	15	5
6	24	20	24	2	24	6	23	42	24	48	25	16	6
7	25	17	24	59	25	5	24	42	25	49	26	17	7
8	26	14	25	57	26	4	25	42	26	50	27	19	8
9	27	11	26	55	27	2	26	42	27	50	28	20	9
10	28	9	27	53	28	1	27	41	28	51	29	21	10
11	29	6	28	51	29	00	28	41	29	52	♑	22	11
12	♌	3	29	49	29	59	29	41	♐	53	1	23	12
13	1	1	♍	47	♎	58	♏	41	1	53	2	24	13
14	1	58	1	45	1	57	1	41	2	54	3	26	14
15	2	55	2	42	2	56	2	41	3	55	4	27	15
16	3	53	3	40	3	55	3	41	4	56	5	28	16
17	4	50	4	38	4	54	4	41	5	57	6	29	17
18	5	48	5	37	5	53	5	41	6	58	7	30	18
19	6	45	6	35	6	52	6	41	7	59	8	31	19
20	7	42	7	33	7	51	7	42	9	00	9	33	20
21	8	40	8	31	8	50	8	42	10	1	10	34	21
22	9	38	9	30	9	50	9	42	11	2	11	35	22
23	10	35	10	28	10	49	10	42	12	3	12	36	23
24	11	32	11	26	11	48	11	42	13	3	13	37	24
25	12	30	12	24	12	48	12	43	14	4	14	38	25
26	13	27	13	23	13	47	13	43	15	6	15	40	26
27	14	25	14	21	14	46	14	43	16	6	16	41	27
28	15	22	15	19	15	46	15	44	17	8	17	42	28
29	16	20	16	18	16	45	16	44	18	9	18	43	29
30	17	18	17	16	17	44	17	44	19	10	19	44	30
31	18	15	18	15			18	45			20	45	31

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A Table of the Sun's Place in the Ecliptick for the Year 1711.

Days	January		February		March		April		May		June		Days
	♑		♒		♓		♈		♉		♊		
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	21	47	23	14	21	19	21	55	21	1	20	43	1
2	22	48	24	15	22	19	22	53	21	59	21	41	2
3	23	49	25	15	23	19	23	52	22	57	22	38	3
4	24	50	26	16	24	18	24	50	23	54	23	35	4
5	25	51	27	16	25	18	25	49	24	52	24	32	5
6	26	52	28	17	26	17	26	47	25	50	25	30	6
7	27	53	29	17	27	17	27	46	26	47	26	27	7
8	28	54	♓	18	28	16	28	44	27	45	27	24	8
9	29	55	1	18	29	16	29	43	28	43	28	21	9
10	♒	56	2	18	♈	15	♉	41	29	40	29	19	10
11	1	57	3	19	1	15	1	40	♊	38	♋	16	11
12	2	58	4	19	2	14	2	38	1	35	1	13	12
13	3	59	5	19	3	14	3	36	2	33	2	10	13
14	5	00	6	19	4	13	4	35	3	31	3	7	14
15	6	1	7	20	5	12	5	33	4	28	4	5	15
16	7	2	8	20	6	11	6	31	5	26	5	2	16
17	8	3	9	20	7	11	7	29	6	23	5	59	17
18	9	4	10	20	8	10	8	27	7	20	6	56	18
19	10	5	11	20	9	9	9	26	8	18	7	53	19
20	11	5	12	20	10	8	10	24	9	15	8	50	20
21	12	6	13	20	11	7	11	22	10	13	9	48	21
22	13	7	14	20	12	6	12	20	11	10	10	45	22
23	14	8	15	20	13	5	13	18	12	8	11	42	23
24	15	9	16	20	14	4	14	16	13	5	12	39	24
25	16	10	17	20	15	3	15	14	14	2	13	36	25
26	17	10	18	20	16	2	16	12	15	00	14	34	26
27	18	11	19	20	17	1	17	10	15	57	15	31	27
28	19	12	20	19	18	00	18	8	16	54	16	28	28
29	20	12			18	58	19	5	17	52	17	25	29
30	21	13			19	57	20	3	18	49	18	22	30
31	22	14			20	56			19	46			31

Days	July		August		September		October		November		December		Days
	♋		♌		♍		♎		♏		♐		
d.	°	'	°	'	°	'	°	'	°	'	°	'	d.
1	19	20	18	59	18	59	18	30	19	31	19	56	1
2	20	17	19	56	19	58	19	29	20	31	20	57	2
3	21	14	20	54	20	56	20	29	21	32	21	58	3
4	22	11	21	52	21	55	21	28	22	33	22	59	4
5	23	8	22	50	22	53	22	28	23	33	24	00	5
6	24	6	23	48	23	52	23	28	24	34	25	1	6
7	25	3	24	45	24	51	24	28	25	35	26	3	7
8	26	00	25	43	25	50	25	27	26	35	27	4	8
9	26	58	26	41	26	48	26	27	27	36	28	5	9
10	27	55	27	39	27	47	27	27	28	36	29	6	10
11	28	52	28	37	28	46	28	27	29	37	♑	7	11
12	29	49	29	35	29	44	29	27	♐	38	1	8	12
13	♌	47	♍	33	♎	44	♏	27	1	39	2	10	13
14	1	44	1	31	1	43	1	27	2	39	3	11	14
15	2	41	2	29	2	42	2	26	3	40	4	12	15
16	3	39	3	27	3	41	3	26	4	41	5	13	16
17	4	36	4	25	4	40	4	27	5	42	6	14	17
18	5	34	5	23	5	39	5	27	6	43	7	15	18
19	6	31	6	21	6	38	6	27	7	44	8	17	19
20	7	28	7	19	7	37	7	27	8	45	9	18	20
21	8	26	8	17	8	36	8	27	9	46	10	19	21
22	9	23	9	15	9	35	9	27	10	47	11	20	22
23	10	21	10	14	10	35	10	28	11	48	12	21	23
24	11	18	11	12	11	34	11	28	12	49	13	22	24
25	12	16	12	10	12	33	12	28	13	50	14	24	25
26	13	13	13	9	13	32	13	28	14	51	15	25	26
27	14	11	14	7	14	32	14	29	15	52	16	26	27
28	15	9	15	5	15	31	15	29	16	53	17	27	28
29	16	6	16	4	16	31	16	30	17	54	18	28	29
30	17	4	17	2	17	30	17	30	18	55	19	30	30
31	18	5	18	1			18	30			20	31	31

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A Table of the Sun's Place in the Ecliptick for the Year 1712.

Days	January ♑		February ♒		March ♓		April ♈		May ♉		June ♊		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	21	32	23	00	22	4	22	39	21	45	21	27	1
2	22	33	24	00	23	4	23	38	22	43	22	24	2
3	23	34	25	1	24	4	24	36	23	40	23	21	3
4	24	35	26	1	25	3	25	35	24	38	24	19	4
5	25	36	27	2	26	3	26	33	25	36	25	16	5
6	26	37	28	2	27	3	27	32	26	33	26	13	6
7	27	38	29	3	28	2	28	30	27	31	27	10	7
8	28	39	♓	3	29	2	29	29	28	29	28	7	8
9	29	40	1	3	30	1	♉	27	29	26	29	5	9
10	♒	41	2	4	♈	00	1	26	♊	24	30	2	10
11	1	42	3	4	2	00	2	24	1	22	♋	59	11
12	2	43	4	4	2	59	3	22	2	19	1	56	12
13	3	44	5	5	3	58	4	20	3	17	2	53	13
14	4	45	6	5	4	58	5	19	4	14	3	50	14
15	5	46	7	5	5	57	6	17	5	12	4	48	15
16	6	47	8	5	6	56	7	15	6	9	5	45	16
17	7	48	9	5	7	55	8	13	7	7	6	42	17
18	8	49	10	6	8	55	9	12	8	4	7	39	18
19	9	50	11	6	9	54	10	10	9	2	8	37	19
20	10	51	12	6	10	53	11	8	9	59	9	34	20
21	11	52	13	6	11	52	12	6	10	56	10	31	21
22	12	53	14	6	12	51	13	4	11	54	11	28	22
23	13	53	15	6	13	50	14	2	12	51	12	25	23
24	14	54	16	6	14	49	15	00	13	48	13	23	24
25	15	55	17	5	15	48	15	58	14	46	14	20	25
26	16	56	18	5	16	46	16	56	15	43	15	17	26
27	17	56	19	5	17	45	17	54	16	40	16	14	27
28	18	57	20	5	18	44	18	51	17	38	17	11	28
29	19	58	21	5	19	43	19	49	18	35	18	8	29
30	20	58			20	42	20	47	19	32	19	6	30
31	21	59			21	40			20	30			31

Days	July ♋		August ♌		September ♍		October ♎		November ♏		December ♐		Days
d.	°	′	°	′	°	′	°	′	°	′	°	′	d.
1	20	3	19	43	19	43	19	15	20	17	20	42	1
2	21	00	20	40	20	42	20	14	21	17	21	43	2
3	21	57	21	38	21	41	21	14	22	18	22	44	3
4	22	54	22	36	22	39	22	14	23	18	23	45	4
5	23	52	23	34	23	38	23	13	24	19	24	47	5
6	24	49	24	31	24	37	24	13	25	20	25	48	6
7	25	46	25	28	25	35	25	13	26	20	26	49	7
8	26	44	26	27	26	34	26	13	27	21	27	50	8
9	27	41	27	25	27	33	27	12	28	22	28	51	9
10	28	38	28	23	28	32	28	12	29	22	29	52	10
11	29	36	29	21	29	30	29	12	♐	23	♑	53	11
12	♌	33	♍	19	♎	29	♏	12	1	24	1	55	12
13	1	30	1	17	1	28	1	12	2	25	2	56	13
14	2	28	2	15	2	27	2	12	3	25	3	57	14
15	3	25	3	13	3	26	3	12	4	26	4	58	15
16	4	22	4	11	4	25	4	12	5	27	5	59	16
17	5	20	5	9	5	24	5	12	6	28	7	00	17
18	6	17	6	7	6	23	6	12	7	29	8	2	18
19	7	15	7	5	7	23	7	12	8	30	9	3	19
20	8	12	8	3	8	22	8	12	9	31	10	4	20
21	9	9	9	1	9	21	9	13	10	32	11	5	21
22	10	7	10	00	10	20	10	13	11	33	12	6	22
23	11	4	10	58	11	19	11	13	12	34	13	8	23
24	12	2	11	56	12	19	12	13	13	35	14	9	24
25	12	59	12	54	13	19	13	14	14	36	15	10	25
26	13	57	13	53	14	17	14	14	15	37	16	11	26
27	14	55	14	51	15	17	15	14	16	38	17	12	27
28	15	52	15	49	16	16	16	15	17	39	18	13	28
29	16	50	16	48	17	16	17	15	18	40	19	15	29
30	17	47	17	46	18	15	18	16	19	41	20	16	30
31	18	45	18	45			19	16			21	17	31

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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.

Stars Names.	Mag.	S.	*Longitude* ° ' "	*Latitude* ° ' "		*Rt. Ascent.* ° ' "	*Declinat.* ° ' "	
The Head of *Andromeda*	2	♈	10 18 51	25 43 12	N.	358 22 12	27 38 5	N.
The bright Foot of *Andromeda*	2	♈	10 13 12	27 47 13	N.	26 34 58	40 56 44	N.
The bright Star of *Aquila*	1	♑	27 41 14	29 21 33	N.	294 8 59	8 9 11	N.
The bright Star of *Aries*	2	♉	3 37 55	9 57 43	N.	27 44 28	22 5 59	N.
The Right Shoulder of *Aquarius*	3	♒	29 20 8	10 43 36	N.	327 43 36	1 10 8	S.
The Left Shoulder of *Aquarius*	3	♒	19 22 53	8 41 50	N.	319 4 51	6 46 29	S.
Capella	1	♊	17 49 6	22 52 9	N.	73 50 4	45 41 25	N.
The Right Shoulder of *Auriga*	2	♊	25 51 49	21 57 38	N.	84 33 59	44 55 52	N.
Arcturus	1	♎	20 11 21	31 1 00	N.	210 39 27	20 45 58	N.
Sirius, or the Dog-Star	1	♋	10 8 44	39 30 5	S.	98 8 48	16 17 4	S.
The Tail of the Great Dog	2	♋	25 32 15	50 36 10	S.	108 10 41	28 42 2	S.
Procyon	1	♋	21 49 32	15 56 11	S.	111 4 5	5 58 4[illegible]	N.
The Northern Horn of ♑	3	♑	29 48 57	7 3 5	N.	300 28 9	13 20 4[illegible]	S.
The bright Star in the Chair of *Cassiopea*	3	♉	1 4 5[illegible]	51 13 35	N.	358 26 51	58 33 8	N.
Mandibula, or the bright Star of the Whale	2	♉	0 17 22	12 37 00	S.	41 48 51	2 56 37	N.
The bright Star in the Northern Crown	2	♏	8 11 7	44 23 20	S.	230 36 53	27 43 41	N.
The Tail of the Swan	2	♓	1 25 5	59 57 23	N.	307 53 52	44 17 41	N.
Castor	2	♋	16 12 34	10 4 23	N.	109 1 22	32 30 33	N.
Pollux	2	♋	19 13 59	6 40 29	N.	111 54 35	28 43 21	N.
The Head of *Hercules*	3	♐	12 6 33	37 22 19	N.	255 23 19	14 46 30	N.
Hydra's Heart	1	♌	23 15 38	22 23 20	S.	138 20 44	7 23 50	S.
Regulus, or the Lyon's Heart	1	♌	25 49 35	0 28 45	N.	148 14 23	13 24 9	N.
The Lyon's Tail	1	♍	17 36 6	12 18 55	N.	173 35 5	16 12 54	N.
The Northern Balance	2	♏	10 2 45	0 26 38	N.	218 45 4	14 45 40	S.
The Southern Balance	2	♏	15 19 43	8 34 47	N.	225 22 42	8 14 33	S.
The bright Star in the Harp	1	♑	11 15 33	61 47 17	N.	276 46 4[illegible]	38 32 49	N.
The Right Shoulder of *Orion*	1	♊	24 43 25	16 3 52	S.	84 53 26	7 20 45	N.
The Left Shoulder of *Orion*	2	♊	16 55 40	16 52 11	S.	77 25 50	6 3 52	N.
Regel, or the bright Foot	1	♊	12 49 41	31 9 26	S.	75 13 3	8 31 58	S.
Marcab Pegasi	2	♓	19 28 27	19 27 37	N.	342 38 9	13 42 3	N.
Scheat Pegasi	2	♓	25 22 15	31 10 21	N.	342 27 9	26 33 32	N.
The Head of *Medusa Algol*	2	♉	22 0 15	22 23 17	N.	22 23 3	39 49 37	N.
The Knot in the Line of the Fisher	3	♈	25 20 45	9 4 18	S.	26 49 1	1 22 29	N.
The Scorpion's Heart	1	♐	5 41 3	4 27 19	S.	242 54 5	25 41 40	S.
The Head of *Serpentarius*	2	♐	18 21 37	35 57 3	N.	260 21 32	12 51 10	N.
The bright Star in the Neck of the Serpent	2	♏	18 1 53	25 35 40	N.	232 32 42	7 3 5	N.
Aldebaran, or the Southern Eye of the Bull	1	♊	5 45 32	5 29 14	S.	64 51 5	15 55 10	N.
The Bull's Northern Horn.	2	♊	18 31 41	5 20 36	N.	77 00 13	28 19 47	N.
The Southern Horn of the Bull	3	♊	20 45 7	2 15 48	S.	80 6 12	20 55 21	N.
The Northern Eye of the Bull	3	♊	4 26 16	2 36 20	S.	62 57 49	18 31 28	N.
Spica Virginis	1	♎	19 47 15	1 59 55	S.	197 29 38	9 36 33	S.
The First in the Great Bear's Tail	2	♍	4 47 55	54 19 00	N.	190 19 58	57 33 13	N.
The Middlemost	2	♍	11 31 36	56 23 17	N.	198 4 7	56 28 33	N.
The Last in the Great Bear's Tail	2	♍	22 47 44	54 25 7	N.	204 3 1	51 18 40	N.
In the Side	2	♌	11 6 13	49 40 23	N.	161 24 25	63 19 40	N.
In the Belly	2	♌	15 19 50	45 7 14	N.	161 3 16	57 57 18	N.
In the *Coxa*	2	♌	26 20 15	47 8 00	N.	174 36 36	55 20 10	N.
In the Back	3	♌	26 55 35	51 38 55	N.	180 15 36	58 39 55	N.
The Pole-Star	2	♊	24 33 37	66 3 00	N.	9 9 8	87 46 15	N.
The First Star of *Aries*	4	♈	29 9 18	7 10 2	N.	24 25 40	17 53 25	N.
The Second Star of *Aries*	3	♈	29 56 42	8 28 45	N.	24 41 20	25 38 1	N.
The bright Star of *Aries*	2	♉	3 37 55	9 57 43	N.	27 44 28	22 5 59	N.
The Southern Horn of *Capricorn*	3	♒	00 00 46	4 41 27	N.	301 10 27	15 36 46	S.

RIGLET

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RIGLET, is any square, flat, thin, Piece of Wood, like those which are designed to make the Frames of small Pictures of; which are so called, before they are *Molded*.

RINÆUS, a Muscle of the Nose, otherwise called *Nasalis*; which see

ROD-*Knights*, alias *Rad-Knights* were anciently certain Servitors, which held their Land by serving 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 Origiual 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, *A. D.* 1206. This Payment was abrogated 25 *H.* 8. 25. But servilely restored again 1 and 2 *Phil.* and *Mary*; and at last utterly abolished, 1 *Eliz.* 1.

ROOT *Binomial*: To raise (easily) a Binomial Root up to any Power assign'd.

Suppose $a + b$. (1.) If it be $\overline{a - b}$ 'tis called a *Residual*; and the Powers of such a *Residual* will be the same with the like Powers raised 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 + and — alternately annexed to every other Term; as will easily appear from multiplying $a - b$ by it self, 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*; as those of b, the *other Names* do after the same Manner encrease.

So that if the Indexes of the Powers of $a + b$ only were required, when that Binomial is to be raised up to the seventh Power, you will easily perceive that it must stand thus.

$$a^7 + a^6 b + a^5 b^2 + a^4 . b^3 + a^3 b^4 + a^2 b^5 + a b^6 + b^7.$$

3. Where 'tis easy to observe that the first and last Term are pure Powers of the single Quantities a and b, and are both of the same Height: As also that the Summ of the Indexes of any two Letters joined together in any of the *Intermediate Terms*, do always make up the Index of the highest Power.

4. The next Work therefore is only to find the *Unciæ*; which may be done by considering,

(1) That the *Uncia* of every single Letter, and of every single Power, how high soever it be, is an Unit, or (1), which neither multiples nor divides. (2) That all the Powers of any Binomial are naturally raised by multiplying the *Preceeding Power* into the *Original Root*: Which in Algebraick Multiplication, is done by only joining each Letter in the Root to the Preceeding Power with its *Unciæ*; and then removing the said *Power*, when 'tis so *joined* to the *second Letter*, one Place forwards, either to the *Right* or *Left*-hand. Thus $a a + 2 a b + b b$, the *Square* or *Second Power* of $a + b$ is found by joining to $a + b$ each Letter of $a + b$, and removing the Powers to the Right or Left-hand thus; a joined to a makes $a a$; a joined to b makes $a b$; and b joined to a makes another $a b$; and b joined to b makes $b b$; and it will stand thus; $a a \begin{smallmatrix} + a b \\ + a b \end{smallmatrix} + b b$ or $a a + 2 a b + b b$. Now from hence it will follow, (3) That the *Unciæ* of 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 *Unciæ* 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 *Unciæ* of the intermediate Terms in the new raised Power, as is plain from the following Table, where the Numbers are so removed without their Letters,

1 1
   1 1 — are the 2 *Unciæ* of $a + b$ and $a + b$. These added in the Order as they stand, produce the next Rank.

1 2 1
   1 2 1 — The *Unciæ* of the Square, and these added again produce the next Rank or *Unciæ* of the Cube, &c.

1 3 3 1
   1 3 3 1 — *Unciæ* of the Cube.

1 4 6 4 1
   1 4 6 4 1 — The *Unciæ* of the Biquadrate.

1 5 10 10 5 1 1
   1 5 10 10 5 1 — The *Unciæ* of the fifth Power.

1 6 15 20 15 6 1
   1 6 15 20 15 6 1 — The *Unciæ* of the sixth Power.

1 7 21 35 35 21 7 1 — The *Unciæ* of the seventh Power,

and so on, as Mr. *Ward* hath well observed in his young Mathematicians Guide, *p.* 157, 158.

If therefore you take the Numbers in the last Row of the Table above, and prefix them to the several and proper Letters in the 7th Power of $a + b$, you will compleat all the Terms with their several *Unciæ*, and it will stand thus;

$$a^7 + 7 a^6 b + 21 a^5 b^2 + 35 a^4 b^3 + 35 a^3 b^4 + 21 a^2 b^5 + 7 a b^6 + b^7$$

And further from observing that the *Unciæ* of the first Term in all the several Powers of a Binomial, are a *Series of Units*, whose Summ is every where the *Unciæ* of the second Term; and that the *Unciæ* of the second Term, are a Series of Numbers in natural Arithmetical Progression;

sion; as 1,2,3,4,5,6,7, *&c.* Whose Summ is every where the *Unciæ* of the next Superior Power in the Third Term, *&c.* He deduces this General Rule for finding the *Unciæ* of any Power of a Binomial, *Viz.*

Multiply the Index of the *First Letter* of any Term into its own *Unciæ*, and divide the Product by the Number of Terms to that Place, and the Question will be the *Unciæ* of the next Subceeding Term, forward. Thus in the last Example,

1. The Index of a^7 (the *First Term*) will be the *Uncia* for $7\ a^6\ b$, 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 *Third Term.*

3. Again, $\frac{21 \times 5}{3} = 35$. The *Uncia* of the *Fourth Term*, and $\frac{35 \times 4}{4} = 35$, will be the *Uncia* of the *Fifth Term*, &c.

4 You may observe here that the *Unciæ* do *increase*, only 'till the *Indeces* of the Two Letters become equal, or *change Places*; and then the Rest of the *Unciæ* do decrease, as the former increased: So that 'tis enough to find the *Unciæ* 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 *Unciæ* of a Binomial, will be understood and admired, *Viz.*

Suppose m the Exponent of any Power: Then will $1 \times \frac{m-0}{1} \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} \times \frac{m-4}{5} \times \frac{m-5}{6} \times \frac{m-6}{7}$, *&c.* be a *Series* for the *Unciæ* of the powers of any Binomial involved infinitely.

As, Suppose you would have the *Unciæ* for the 7th Power of $a+b$. Then $m=7$, and by the Theorem $1 \times \frac{m-0}{1} = 7$ will be the *Uncia*, and that $7 \times \frac{m-1}{2} = 21$ will be the *Uncia* for the Third Term: And again, That $21 \times \frac{m-2}{3} = 35$ will be the *Uncia* for the Fourth Term. Also that $35 \times \frac{m-3}{4} = 35$ will be the *Uncia* of the Fifth Term; and consequently by going backwards (as in Art. 4. above) you will find that the *Unciæ* 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 justly seem in some degree defective, and not *sufficiently 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 respect be solved. The Ancients scarce knew any thing in these Matters, beyond *Quadratick Equations.* And what they writ of the *Geometrick Construction* of solid Problems, by the help of the *Parabola*, *Cissoid*, or any other Curve, were only particular things design'd for some particular Cases. But as to *Numerical Extraction*, there is every where a profound 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 Restorer of the Modern Algebra, *Francis Vieta*, about 100 Years since, shew'd a general Method for extracting the Roots of any Equation, which he publish'd under the Title of, *A Numerical Resolution of Powers*, &c. *Harriot*, *Oughtred*, and others, as well of our own Country, as Foreigners, ought to acknowledge whatsoever they have written upon this Subject, as taken from *Vieta.* But what the Sagacity of Sir *If. 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 Intreaties of his Friends, and suffer those curious Discoveries to see the Light.

Not long since (*viz. A. D.* 1690.) that excellent Person M. *Joseph Raphson*, F. R. S. Publish'd his *Universal 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 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 affected Equations, and that pretty much perplex'd too, and not sufficiently demonstrated. Yet he gives two very compendious Rules for the Approximation of a Cubical Root; one a Rational, and the other an Irrational one. Ex. gr. that the side of the Cube $aaa+b$, is between

$$a + \frac{ab}{3aaa+b}, \ \& \ \sqrt{\tfrac{1}{4}aa + \frac{b}{3a}} + \tfrac{1}{2}a.$$

And the Root of the 5th Power $a^5 + b$, he makes

$$= \tfrac{1}{2}a + \sqrt{\sqrt{\tfrac{1}{4}a^4 + \frac{b}{5a}} - \tfrac{1}{4}aa}$$

(where note, that

that 'tis $\frac{1}{4}aa$, not $\frac{1}{2}aa$, 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 sorts 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 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 consequently, if we suppose aaa the next less Cube, to any given Non-cubick Number, then eee will 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 $\frac{b}{3aa}$ will not much exceed e; so that putting $e=\frac{b}{3aa}$ then the quantity $\frac{b}{3aa+3ae}$ (to which e is nearly equal) will be found $=\frac{b}{3aa+\frac{3ab}{3aa}}$ or $\frac{b}{3aa+\frac{b}{a}}$ that is $\frac{ab}{3aa+b}=e$. And so the side of the Cube $aaa+s$ will be $a+\frac{ab}{3aa+b}$, which is the *Rational Formula* of M. *de Lagney*. But now, if aaa were the next greater Cubick Number to that given, the side of the Cube $aaa-b$, will after the same manner be found to be $a-\frac{ab}{3aa-b}$. And this easy 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 $\frac{b}{3a}=ae+ee$, and so $\sqrt{\frac{1}{4}aa+\frac{b}{3a}}=\frac{1}{2}a+e$, and $\sqrt{\frac{1}{4}aa+\frac{b}{3a}}+\frac{1}{2}a=a+e$, the Root sought. Also the side of the Cube $aaa-b$, after the same manner, will be found to be $\frac{1}{2}a+\sqrt{\frac{1}{4}aa-\frac{b}{3a}}$

And this *Formula* comes something nearer to the Scope, being erroneous in point of *excess*, as the other was in *defect*, and is more accommodated to the Ends of Practice, since the Restitution of the Calculus, is nothing else but the continual Addition or Substraction of the Quantity $\frac{aee}{3a}$ according as the quantity e can be known. So that we should rather write $\sqrt{\frac{1}{4}a+\frac{b-eee}{3a}}+\frac{1}{2}a$, in the former case, and in the latter, $\frac{1}{2}a+\sqrt{\frac{1}{4}aa+\frac{eee-b}{3a}}$. 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 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 side of the double Cube, or $aaa+b=2$. Here $a=1$, and $\frac{b}{3a}=\frac{1}{2}$, and so $\frac{1}{2}+\sqrt{\frac{7}{12}}$, 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 + $\sqrt{\frac{,3969-,0000376}{3,78}}$, or 0, 63 + $\sqrt{,\dot{3}\dot{9}\dot{6}\dot{8}\dot{0}\dot{0}\dot{5}\dot{2}\dot{9}\dot{1}\dot{0}\dot{0}\dot{5}\dot{2}91}$ = 1, 259921049895 —; which in 13 Figures, gives the side of the double Cube, with very little Trouble, *viz.* By one only Division, 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 $\frac{eee}{3a}$, which Correction, 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 sides or a Cube equal to that English Measure commonly call'd a Gallon, which contains 231 solid Ounces. The next less Cube is 216, whose side $6=a$, and the Remainder $15=b$; and so for the first Approximation, we have $3+\sqrt{9+\frac{5}{6}}=$ the Root. And since $\sqrt{9,8333}$... is 3, 1358..., 'tis plain that 6, 358 $=a+e$. Now, let 6, 1358 $=a$; and we shall have then for its

its Cube 231,000853894712, and according to the Rule, $3,0679 + \sqrt{9,41201041 - \frac{,000858394712}{18,4070}}$ 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 Surfolid, 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 compos'd of these Members, $a^5 + 5a^4e + 10a^3e^2 + 10a^2e^3 + 5ae^4 + e^5 = a^5 + b$; from whence $b = 5a^4e + 10a^3e^2 + 10a^2e^3 + 5ae^4$, rejecting e^5 because of its smallness.

Whence $\frac{b}{5a} = a^3e + 2a^2e^2 + 2ae^3 + e^4$, and adding on both sides $\frac{1}{4}a^4$, we shall have $\sqrt{\frac{1}{4}a^4 + \frac{b}{5a}} = \sqrt{\frac{1}{4}a^4 + a^3e + 2a^2e^2 + 2ae^3 + e^4} = \frac{1}{2}aa + ae + ee$. Then substracting $\frac{1}{2}aa$ from both sides, $\frac{1}{2}a + e$ will $= \sqrt{\sqrt{\frac{1}{4}a^4 + \frac{b}{5a}} - \frac{1}{4}aa}$; to which if $\frac{1}{2}a$ be added, then will $a + e = \frac{1}{2}a + \sqrt{\sqrt{\frac{1}{4}a^4 + \frac{b}{5a}} - \frac{1}{4}aa}$ = the Root of the Power $a^5 + b$. But if it had $a^5 - b$ (the quantity of a being too great) the Rule would have been thus, $\frac{1}{2}a + \sqrt{\sqrt{\frac{1}{4}a^4 - \frac{b}{5a}} - \frac{1}{4}aa}$ and this Rule approaches wonderfully, so that there is hardly any need of Restitution.

But while I considered 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.

$$\sqrt{aa + b} = \sqrt{aa + b}, \text{ or } a + \frac{ab}{2aa + \frac{1}{2}b}.$$

$$\sqrt[3]{a^3 + b} = \frac{1}{2}a + \sqrt{\frac{1}{4}aa + \frac{b}{3a}}, \text{ or } a + \frac{ab}{3aaa + b}$$

$$\sqrt[4]{a^4 + b} = \frac{2}{3}a + \sqrt{\frac{1}{3}aa + \frac{b}{6aa}}, \text{ or } a + \frac{ab}{4a^4 + \frac{3}{2}b}$$

$$\sqrt[5]{a^5 + b} = \frac{3}{4}a + \sqrt{\frac{1}{16}aa + \frac{b}{10a^3}}, \text{ or } a + \frac{ab}{5a^5 + 2b}.$$

$$\sqrt[6]{a^6 + b} = \frac{4}{5}a + \sqrt{\frac{1}{25}aa + \frac{b}{15a^4}}, \text{ or } a + \frac{ab}{6a^6 + \frac{5}{2}b}.$$

$$\sqrt[7]{a^7 + b} = \frac{5}{6}a + \sqrt{\frac{1}{36}aa + \frac{b}{21a^5}}, \text{ or } a + \frac{ab}{7a^7 + 3b}.$$

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.*

$$\sqrt{aa - b} = \sqrt{aa - b}, \text{ or } a - \frac{ab}{2aa - \frac{1}{2}b}.$$

$$\sqrt[3]{a^3 - b} = \frac{1}{2} + \sqrt{\frac{1}{4}aa - \frac{b}{3a}}, \text{ or } a - \frac{ab}{3a^3 - b}$$

$$\sqrt[4]{a^4 - b} = \frac{2}{3}a + \sqrt{\frac{1}{3}aa - \frac{b}{6aa}}, \text{ or } a - \frac{ab}{4a^4 - \frac{3}{2}b}$$

$$\sqrt[5]{a^5 - b} = \frac{3}{4}a + \sqrt{\frac{1}{16}aa - \frac{b}{10a^3}}, \text{ or } a - \frac{ab}{5a^5 - 2b}$$

$$\sqrt[6]{a^6 - b} = \frac{4}{5}a + \sqrt{\frac{1}{25}aa - \frac{b}{15a^4}}, \text{ or } a - \frac{ab}{6a^6 - \frac{5}{2}b}.$$

$$\sqrt[7]{a^7 - b} = \frac{5}{6}a + \sqrt{\frac{1}{36}aa - \frac{b}{21a^5}}, \text{ or } a - \frac{ab}{7a^7 - 3b}.$$

Aud within these two Terms, the true Root is ever found, being something nearer to the *Irrational* than the *Rational* Expression. But the qnantity 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 easily by the help of the Logarithms. But when a Root is to be determin'd 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 *Formulæ*, leading me to a certain Universal Rule, for affected Equations

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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 this Diſcovery, which I will do with all the perſpecuity I can, I had given at No. 188 of the *Tranſactions*, a very eaſie and general Conſtruction of all adfected 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 notwithſtanding 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 ſecond Column, to which put $= s$. Laſtly, 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 z ſtand thus

in the *Rational Formula*, viz. $z = a + \dfrac{sb}{ss \pm tb}$;

and thus in the *Irrational Formula*, viz.

$z = a \mp \frac{1}{2}s \pm \dfrac{\sqrt{\frac{1}{4}ss \mp bt}}{t}$; 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 Uſe I may rightly call a *General Analytical Speculum*. The forementioned Powers ariſing 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^3, e^5, e^7 are Negative, and the even Powers, as e^2, e^4, e^6, Affirmative. Alſo let the Summ of the Co-efficients of the ſide e, be $= s$; the Summ of the Co-efficients of the Square $ee = t$, the Summ of the Co-efficient of $e^3 = u$; of $e^4 = w$; of $e^5 = x$; of $e^6 = y$, &c. But now, ſince e is ſuppoſed only a ſmall Part of the Root that is to 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 ſubſtituting $a \pm e = z$, we ſhall have (as was ſaid) $\pm b = \pm se \pm tee$. The following Examples will make this more clear.

Example I.

Let the Equation $z^4 - 3z^2 + 75z = 10000$, be propos'd. For the firſt Hypotheſis, let $a = 10$, and ſo we have this Equation,

$$\begin{array}{lllll}
z^4 = +a^4 & 4a^3e & +6a^2e^2 & 4ae^3 & +e^4, \\
-dz^2 = -da^2 & dae & -de^2 & & \\
+cz = +ca & ce & & & \\
= +10000 & 4000e & +600ee & 40e^3 & +e^4 \\
\quad - 300 & 60e & -3ee & & \\
\quad + 750 & 75e & & & \\
\quad -10000 & & & & \\
\hline
+450- & 4015e & +597ee & -40e^3 & +e^4 = 0 \\
 & s & t & u &
\end{array}$$

The Signs $+$ and $-$ with reſpect to the Quantities e and e^3, are left as doubtful, 'till it be known whether e be Negative or Affirmative; which thing creates ſome Difficulty, ſince 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 *Reſolvend* 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 $= \frac{1}{2}s - \dfrac{\sqrt{\frac{1}{4}ss - bt}}{t}$, when b and t have the ſame Sign,

but when the Signs are different, e is $= \dfrac{\sqrt{\frac{1}{4}ss + bt}}{t} - \frac{1}{2}s$. But after it is found that it will be $- e$, let the Powers e, e^3, and e^5, &c. in the Affirmative 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, $10450 - 4015e + 597ee - 4e^3 + e^4 = 10000$. That is, $450 - 4015e + 597ee = 0$; and ſo $450 = 4015e - 597ee$,

or $b = se - tee$, whoſe Root $e = \frac{1}{2}3 - \dfrac{\sqrt{\frac{1}{4}ss - bt}}{t}$,

or $\dfrac{s}{2t} - \sqrt{\dfrac{ss}{4tt} - \dfrac{b}{t}}$; that is in the preſent caſe,

$e = \dfrac{2007\frac{1}{2} - \sqrt{3761406\frac{1}{4}}}{597}$, from whence we have

the Root ſought, 9, 886, which is near the Truth. But then ſubſtituting this for a ſecond Suppoſition, there comes $a + e = z$, moſt accurately 9, 8862603936495 .... ſcarce exceeding the Truth

by 2 in the laſt Figure, *viz.* when $\dfrac{\sqrt{\frac{1}{4}sss + bt}}{t} - \frac{1}{2}s$

$-\frac{1}{2}s = e$. And this (if need be) may be yet much farther verified, by substracting (if it be $+e$) the quantity $\frac{\frac{1}{2}ue^3+\frac{1}{2}e^4}{\sqrt{\frac{1}{4}ss+tb}}$, 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.* $z = 10{,}26\ldots$ 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,

$$+z^3 = a^3 + 3a^2e + 3ae^2 + e^3$$
$$-dz^2 = da^2 - 2dae - da^2$$
$$+cz = ca + ce$$

$$\begin{array}{lllll} & b & s & t & \\ \text{That is,} & +1000 & +300e & +30e^2 & +e^3 \\ & -1700 & -340e & -17e^2 & \\ & +540 & +54e & & \\ & -350 & & & \end{array}$$

Or, $-510 + 14e + 13ee + e^3 = 0$. Now, since we have -510, it is plain, that a is assumed less than the Truth, and consequently that e is Affirmative. And from (the Equation) $510 = 14e + 13e^2$, comes $e = \frac{\sqrt{bt+\frac{1}{4}ss}-\frac{1}{2}s}{t} = \frac{\sqrt{6679}-7}{13}$. Whence $z = 15{,}7\ldots$, which is too much, because of a taken wide; therefore Secondly, let $a = 15$, and by the like way of Reasoning, we shall find $e = \frac{\frac{1}{2}s-\sqrt{\frac{1}{4}ss-tb}}{t} = \frac{109\frac{1}{2}-\sqrt{11710\frac{1}{4}}}{28}$, and consequently $z = 14{,}954068$. 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 $tb \pm te^3$ instead of tb, or substracting or adding $\frac{\frac{1}{2}e^3}{\sqrt{\frac{1}{4}ss \mp tb}}$ 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 $z^4 - 80z^3 + 1998z^2 - 14937z + 5000 = 0$, 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 $-z^4 + 8z^3 - 20z^2 + 15z = 0{,}5$ (where the quantity z is $\frac{1}{10}$ of z in the Equation proposed) and for the first Snpposition, let $a = 1$. Then $+^1 - 5e - 2e^2 + 4e^3 - e^4 - 0{,}5 = 0$; that is, $1\frac{1}{2} = 5e + 2ee$; hence $e = \frac{\sqrt{\frac{1}{4}ss+bt}-\frac{1}{2}s}{t}$ is $= \frac{\sqrt{37}-5}{4}$, 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

$$\begin{array}{lllll} b & s & t & u & \\ -26014{,}4641 & -8193{,}532e & -967{,}74e^2 & -50{,}8e^3 & -e^4 \\ +163870{,}640 & +38709{,}60e & +3048e^2 & +80e^3 & \\ -322257{,}42 & -50749{,}2e & -1998e^2 & & \\ +189699{,}9 & +14937e & & & \\ -5000. & & & & \end{array}$$

That is, $+298{,}6559 - 5296\,132e + 82{,}26e^2 + 29{,}2e^3 - e^4 = 0$; And so $-298{,}6559 = -5296{,}132e + 82{,}26ee$, whose Root e (according to the Rule) $= \frac{\frac{1}{2}s-\sqrt{\frac{1}{4}ss-bt}}{t}$, comes to $\frac{2648{,}066-\sqrt{6987686{,}106022}}{82{,}26} =$,05644080331 .... $= e$ less than the Truth. But that it may be corrected, 'tis to be consider'd that $\frac{\frac{1}{2}ue^3-\frac{1}{2}e^4}{\sqrt{\frac{1}{4}ss-bt}}$, or $\frac{,0026201\ldots\ldots}{2643{,}423\ldots\ldots}$ is, 00000099, and consequently e corrected, is $=$ 0564470448. And if you desire yet more Figures of the Root, from the e corrected let there be made $tue^3 - te^4 = 0$, 43105602423..., and $\frac{\frac{1}{2}s-\sqrt{\frac{1}{4}ss-bt-tue^3+te^4}}{t}$, or which is all one, $\frac{2648{,}066-\sqrt{6987685{,}67496597577\ldots}}{82{,}26} =$,05644179448074402 $= e$; whence $a + e = z$ the Root is most accurately 12, 75644179448 074402... as Dr. *Wallis* found in the forementioned Place; where it may be observ'd, that

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that the repetition of the *Calculus* does ever triple the true Figures in the assumed a, which the first Correction, or $\frac{\frac{1}{2}ue^3 - \frac{1}{2}e^4}{\sqrt{\frac{1}{4}ss - bt}}$, 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 said concerning the Number of Places rightly taken in the Root, I would have it understood so, that when a is but $\frac{1}{2}$ part distant from the true Root, then the first Figure is rightly assumed; if it be within $\frac{1}{100}$ part, then the two first Figures are rightly assumed; if within $\frac{1}{1000}$ 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 something concerning our *Rational Formula*, viz. $e = \frac{sb}{ss \pm tb}$ which seems expeditious enough, and is not much inferior to the former, since it will triple the given Number of Places. Now having formed an Equation from $a + e = z$, as before, it will presently appear, whether a be taken greater or less than the Truth; since se ought always to have a Sign contrary to the Sign of the Difference of the *Resolvend*, 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 same Signs; but it is $ss + bt$, when they have different ones. But it seems most commodious for Practice, to write the Theorem thus, $e = \frac{b}{s} \pm \frac{tb}{s}$ since this way the thing is done by one Multiplication 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) 12, 7 . . . . , where

$$\underset{+b}{298,6559} \underset{-s}{- 5296,132}\,e \underset{+t}{+ 82,26}\,ee \underset{+u}{+ 29,2}\,e^3 - e^4 = o,$$

and so $\frac{b}{s} - \frac{tb}{s} = e$; that is, let it be as s to t, so b to $\frac{tb}{s} =$ 5296, 132). 298, 6559 into 82, 26 (4, 63875 . . . wherefore the Divisor is $s - \frac{tb}{s} =$ 5291, 49325 . . . . .) 298, 6559 (0, 056441 . . . . . $= e$, that is, to five true Figures, added to the Root that was taken. But this *Formula* cannot be corrected, as the foregoing *Irrational* one was; and so if more Figures of the Root are desired, '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*

1. *Fibrous*, which send 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
1. *Broad and Swelling*.
2. *Long and Slender*, which commonly are more hard and woody.

The *Broad and Swelling* are
1. *Bulbous*, which consist but of one Globe or Head, and send 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 either
   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 *Geniculatæ*, *Knotty*, or *Jointy*, as *Couch-Grass*, *Mints*, (&c.
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. Transf. 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* Abscissa *multiplied by the Circular Base:* and he gives this Instance: Suppose the *Ratio* of a Square to the Circle inscribed be as $\frac{n}{1}$: the Equation, expressing the Nature

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Nature or Property of any Circle, whose Diameter is d; is $yy = dx - xx$. Theref. $\frac{4d x \dot{x} - xx\dot{x}}{n}$ is the Fluxion of a Portion of the Sphere; and consequently the Portion it self $4\,\frac{1}{2}\,dxx - \frac{1}{3}\,xxx$, And the Circumscribed Cylinder is $\frac{4dxx - x^3}{n}$ Therefore the Portion of the Sphere is to the Circumscribed Cylinder, as $\frac{1}{2}d - \frac{1}{3}x$ 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-silver, *&c.* Bubbles of Air under Water or some such Liquor, melted Oil, *&c.* do generally put on, seems 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 seems 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 from a Drop of Water falling upon small Sand, or Dust, which will strait produce an 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 rest their Arms as the *Rounds* pass, and to let no one come near them. When the *Round* is near the *Corps de garde*, 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-Sense, 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 Ship ought to make with her Keel, in order to *Stay* or *Bear up*, the soonest that is possible: And he saith the Tiller of a Rudder ought to make with 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 between the Keel and Cleat may be of this Number of Degrees; and that the Tiller of the Rudder 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 Instrument 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 Advantages 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 *Artificial 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, are 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 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 small 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, besides Inches and Foot-Measure, is a large Scale of Equal Parts, with a *Meridian Line* placed by, to graduate Sea-Charts, *&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, *&c.* there all is easie.

1. Know then that every Line of Numbers is a Line of Geometrick Proportion, divided first into 9 Unequal Parts, which may be called *Primes*; these are marked with the 9 Digits, 1, 2, 3, 4, 5, *&c.* Each of these *Primes* is subdivided into ten other Parts

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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-parts.

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, ſo 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 diſtinguiſhed, are all Arbitrary Points; and may each of them repreſent ſo many entire Units, Tens, Hundreds, Thouſands, *&c.* or ſo many Tenths, Hundredths, Thouſandths, or Ten Thouſandth Parts of an Unit.

2. Wherefore in Whole Numbers, if 1, at the beginning of the Line D ſignifie an *Unit*: Then 2, 3, 4, and 5, *&c.* will alſo ſignifie or ſtand for ſo many *Units*, and the *Tenths*, and *Centeſms*, both be accordingly *Decimal*, or *Centeſimal* Parts. If 1, then repreſent Ten Units, then the Primes 2, 3, 4, *&c.* will ſignifie 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.*

3. 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, *&c.* Part of an Unit.

To explain this a little further, draw out the Sliding-piece B: Till 1, at the beginning of B, ſtand 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, ſtand for 1, or Unity. Then will the next 1, in the Middle of the Line A, ſtand for 10, and 10 at the End of A, or beginniug of B, will repreſent 100, (1) in the Middle of B, will be 1000; and 10 at its Eud 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 .1 (one Tenth,) in the *Third* Radius 'twill be .01; as the *Second* .001, and in the *Firſt*, .0001 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.

4. All which being well underſtood, and conſidered, which a little Practice will render eaſie: 'twill be eaſie to diſtinguiſh that Point on the Line where any Number given, *Integer*, or *Decimal Part*, is repreſented. Thus you will find that the Point *a g*, on the Line D, repreſents 1895 Units; and the Point *w g*, 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.

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 ſo many Thouſandth-parts.

Of the Uſes of the Sliding-Rule.

1. *To multiply one Number by another; As, ſuppoſe 68 by 26.*

As 1. 26 : : 68. 1768.

Set 1, on the Line A, againſt 26, on B, and then againſt 68 on A, you will find the Product 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 multiplying 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 1 : 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 ſetting of the Rule, you do both Multiply and Divide.

As ſuppoſe 25 a Multiplicator; ſet 1, on B, againſt 25, on A; and then againſt any Multiplicand 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, *&c.* and ſo you may go on either forward or backward, as far as you pleaſe.

5. *To*

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5. *To reduce Vulgar Fractions to Decimals:* As, suppose $\frac{63}{84}$.

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 Left-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 1 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.

If .7625 were the Decimal of an Ale Barrel, Set 32 (the Gallons in a Barrel of Ale) in B, against 1 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.*

If 8 Men can do a Peice of Work in 9 Days, in how many Days would 12 Men dispatch the same 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 sought.

3. If the Question had been in how many Days could 6 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 set 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.

Apply the Lines C and D; so that 10 at the End of C be against 1 in D, and then will the Square 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 1, 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, 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 consists 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 such Inches, Yards, Feet, *&c.*

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 versa.*

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.*

If a Bullet whose Diameter is 4 Inches, weigh 9 *lb.* What will one of the same Matter weigh, whose Diameter is 8?

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

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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 *l.* 5 amount to in 12 Years Time at 6 *per Centum?*

Set 1 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 1 in A; and you will have againſt 15. 5 in A, 26. 66: the Amount in B. And ſo from any 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 1 on B to 6 on A; and then againſt 62 in B will be 3. 72, the Intereſt of 62 *l.* for one Year.

2. Set 1 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 in A.

3. Set 1 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 100 *l.* at the End of the Firſt Year is 106 *l.* 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.

Set 100 on B againſt 106, (or 108, *&c.* according to the Firſt Years Amount at any Rate of Intereſt) and then againſt 106 on B, you will have 112 *l.* 36. the Amount in Two Years; and againſt 112. 36. on B, will be 119 *l.* 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 *l.* 822 on A, which is the whole Amount at the Five Years End.

And from it 'twill be eaſie to anſwer this Queſtion.

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 133 *l.* 822 due Five Years hence, at 6 *per Cent.* Compound Intereſt?

For you need only reverſe the former Practice: Set therefore 106 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 119. 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 100 *l.* 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 *Years, 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 ſought.

19. *What is the Ready Money worth of a Rent or Annuity 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 *l.* 828.

And the preſent Worth of 151 *l.* 828. (by Queſt. 17.) due at the End of Twelve Years, is 75 *l.* 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 ſeek what the Arrears, of 151 *l.* 828 being forborn 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.* to

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to begin Six Years hence, and to continue Twelve Years, is in Ready Money worth but 53 *l.* 185; whereas if it were to commence immediately, 'twere worth 73 *l.* .443.

Purchasing of Annuity.

20. *What Annuity, to continue Twelve Years will* 300 *l. buy; allowing the Buyer* 6 per Centum, *Compound Interest for his Purchase Money?*

By Quest. 19. I find 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 *Worth* or 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 *l.*

21. *What is the Value of a Free-hold Estate of* 75 *l.* per Ann. *allowing the Buyer* 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 .06 on B, set 1 on A; 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.)

The Canon is, As Rad. to Distance run in Miles :: So Co-Sine of the Course to Difference of Latitude in Miles : : And so Sine of the Course to Departure in Miles.

Bring then 90° in the Line of Sines against 108 (the Distance run) in A; and then against 56° 15′ (the Co-Sine of the Course) in the said Line of Sines, you will have 90 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 2*dly*. The Sun's Place in the Ecliptick to be 30° of ♈, and his greatest Declination to be 20° 30′, I require his present Declination.

The Canon is, As Rad. Sine of the Sun's Longitude or Distance from ♈ :: 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 sought.

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 Distance) :: So is the *Sine*, or Co-Sine, of the Latitude, suppose 51° 30′ of the Place, to the Tangent of the Distance sought 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 of the Compass; shewing how many Degrees and Minutes each Point contains.

A Table

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A Table of *RUMBS.*

The Distance of the Rumbs, or Points from the Meridian.						
North	*South*	D.	M.	*South*	*North*	*Point.*
		2	49			
		5	38			
		8	26			
N by *E*	*S* by *E*	11	15	*S* by *W*	*N* by *W*	1
		14	4			
		16	53			
		19	41			
NNE	*SSE*	22	30	*SSW*	*NNW*	2
		25	19			
		28	8			
		30	36			
NE by *N*	*SE* by *S*	33	45	*SW* by *S*	*NW* by *N*	3
		36	34			
		39	23			
		42	11			
NE	*SE*	45	00	*SW*	*NW*	4
		41	49			
		50	37			
		53	16			
NE by *E*	*SE* by *E*	56	15	*SW* by *W*	*NW* by *N*	5
		59	4			
		61	52			
		64	41			
ENE	*ESE*	67	30	*WSW*	*WNW*	6
		70	19			
		73	7			
		75	56			
E by *N*	*E* by *S*	78	45	*W* by *S*	*W* by *N*	7
		81	34			
		84	22			
East		87	11	*West*		
		90	00			

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 Co-sines of both Latitudes::

Or rather for Geometrical Schemes.

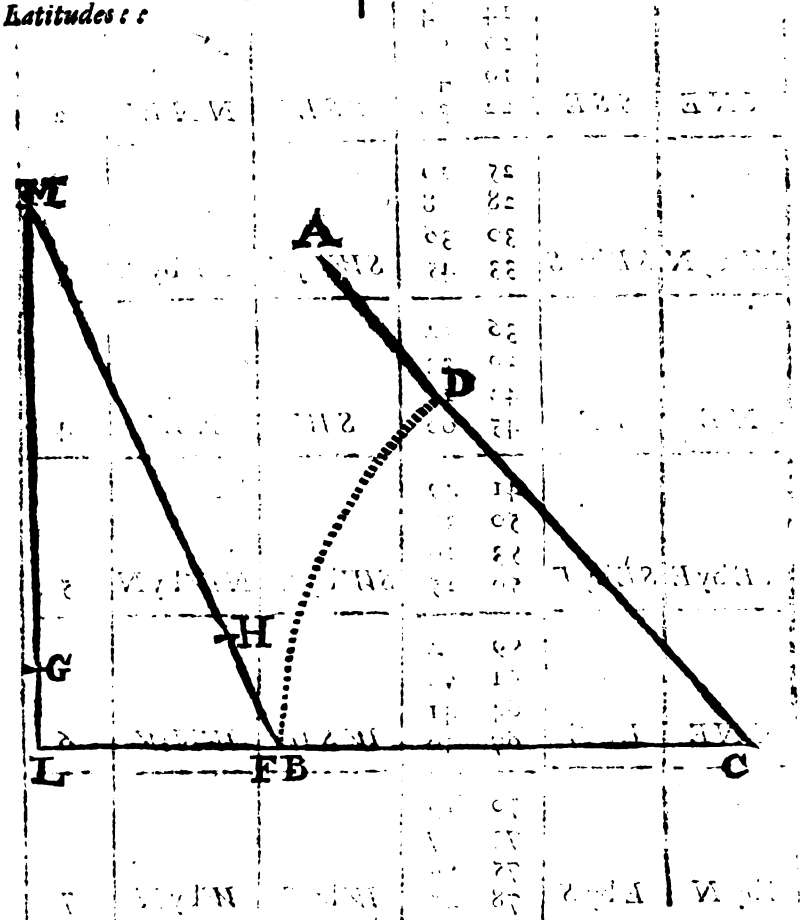
As the Diameter: Is to the Summ of the Co-sines of both Latitudes::
So is the Difference of Longitude: To the Departure from the Meridian, in the Course between the two Places::

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 Finistre*, Latitude 43 Degrees, Longitude 7 Degrees 20 Minutes, and St. *Nicholas Isle*, Latitude 38 Degrees, Longitude 352 Degrees, the Middle Latitude is 40 Degrees 30 Minutes, the Complement is 49 Degrees 30 Minutes, and the Difference of Longitude is 15 Degrees 20 Minutes, or 33 Centesms.



Out of the lesser equal Parts, prick down 15 Deg. 33 Centesms from C to L, and describe the Arch BD with 60 Degrees of the Chords, and make it equal to 49 Degrees 30 Minutes, and draw C D continued further to A, from L take the nearest Distance to A C, ~~which is equal to L M, and~~ 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 L to F, then the Extent M F measured on the said Parts, sheweth the Distance to be 13 Degrees 39 Centesms, which allowing 20 Leagues to a Degree, is almost 268 Leagues; with the Radius C B setting one Foot at M, cross the Rumb Triangle at G and H, which Extent measured on the greater Chord is almost 22 Degrees, the Complement whereof is 68 Degrees, and so much is the Rumb from the Meridian between these two Places, which is 6 Points and about 30 Minutes more, wherefore St. *Michaels Isle* bears from *Cape Finistre* ~~West-South-West, half a~~ Degree more Westwardly.

If the two Places had been both in the Latitude of 40 Degrees 30 Minutes, having the same Difference of Longitude, to wit, 15 Degrees 20 Minutes, then had the Extent L M been their Distance, to wit, 11 Degrees 68 Centesms, at 20 Leagues to a Degree, is 233 Leagues and a half, and thus we supply the want of the Scale of Longitudes,

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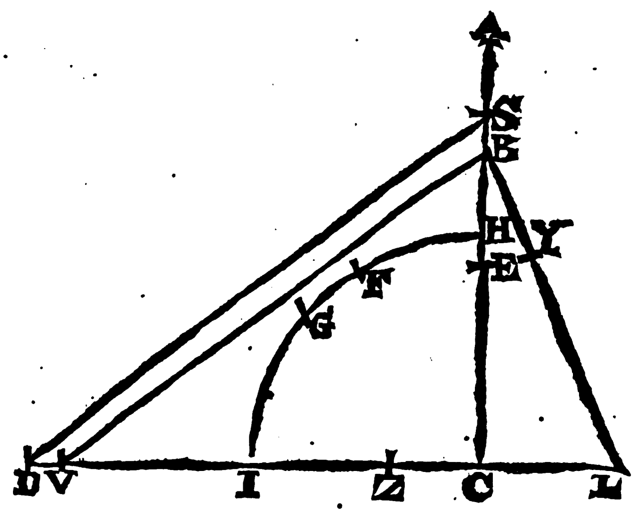
gitudes, in finding the Distance of Places that bear East and West, as those that are in the same Latitude must needs do.

An Example of the latter Proportion.

Let it be required to find the true Rumb and Distance between the *Lizard* and the *Bermudas*. Mr. *Norwood* in his *Sea-man's Practice*, p. 110, maketh the Latitude of the *Lizard* to be 50 Degrees, and of the *Bermudas* 32 Degrees 25 Minutes, or 32 Degrees 41 Centesms, and the Difference of Longitude between these Places to be 55 Degrees.



Draw the Lines A C and C D at Right-angles, now for want of room I use the lesser Chord, and with 60 Degrees thereof I describe the Quadrant H I, and prick the Radius from I to D, so is C D the Diameter, then count both Latitudes from H to F and G, the nearest Distance from F to C I, is the Co-sine 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 to S, so is C S the Summ of both Co-sines; 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 between both Places, then making that one Leg of a Right-angled Triangle, prick down 17 Degrees 59 Centesms, the Difference of Latitude between those Places out of the same Equal Parts from C to L, and draw B L, which 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 Leagues.

Then to find the Course: with 60 Degrees of the Chords, setting one Foot in L, with the other make a Mark at Y and Z, then the Extent Z Y measured on the Chords, sheweth the Rumb to be 66 Degrees 37 Minutes from the Meridian, which is almost 6 Points, and in this Example the Proportion doth not err any thing from the Truth, according to *Mercators Chart*, whereas if you use the former Proportion by the middle Latitude, the Rumb would have been 67 Degrees 2 Minutes from the Meridian, and the Distance 902 Leagues, if you make C A equal to C V, then a Line joining L A should be the Course and Distance according to the same Longitudes and Latitudes laid down on the *Plain Chart*, and thereby the Course should be 72 Degrees 17 Minutes from the Meridian, and the Distance 1155 Leagues; however when two Places are laid down true at first in their Rumb, Distance and Latuides on the *Plain Chart* if you sail home, in, or near the same Rumb, the *Plain Chart* will very well serve to keep the reckoning upon, and to sail by in the greatest Voyage.

What the Nature of this Rumb Line is on the Globe, and how to Delineate it there, and in a Chart Mr. *Collins* shews in the same Book, *page* 55, and 64.

RUMINANT Animals, are such as chew the Cud; and these are Quadrupeds, Hairy and Viviparous, and in general, Mr. *Ray* observes of them, that some have *hallow and perpetual Horns*; others *Deciduous* ones, or such as are shed every Year; and all the Horned Ruminant Animals have four Stomachs. 1. The Κοιλία Μεγάλη of *Aristotle*; the *Venter Magnus*, or what we call the *Paunch* or *Inward*. This receives the Meat slightly chewed, retains it a while, and then delivers it back again into the Mouth, which is what we call the *Cud*, to be re-chewed and rendred more fit to make Chyle, 2. The Κεκρύφαλος, or *Reticulum*, which we call the *Honey-Comb*; from its Internal Coat, being divided

divided so into Cells like Honey-Combs. 3. The 'Εχῖνος, which Er. *Ray* thinks hath been wrong Translated, *Omasus*; and therefore he would have it called the *Echinus*: This is so difficult to clear, that our People throw it away, and call it the *Manifold*. 4. The Ἤνυστρον of *Aristotle*, by *Gaza* called the *Abomasus*. The Stomach in Calves is that which contains the Acid Ferment, which we call the ***Runnet***, and is used to coagulate 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*, Στέαρ, which is much harder and firmer, and less liquifiable in them, than the *Adeps* of other Animals.

RUNCINUS, and *Runcilus*, in Doomsday-Book is used for a Load-Horse: Sumpter-Horse, or Cart-Horse: This Kind of Horse, *Chaucer* in his *Seaman's-Tale*, calls a *Rowney*.

RURAL-*Deans*. There were formerly in the Church, *Arch-Presbyters*, as well as *Arch-Deacons*; and they were called *Rural-Deans*. Our Diocesses are still divided into Deanries, and he who under the Bishop and Arch-Deacon, had the peculiar Care and Inspection of the Clergy and Laity of such a District as is now called a *Deanery*, was the *Rural-Dean*. He had Power to visit and to hear Causes, they had a Seal of their Office, but were removeable at pleasure, but jointly by the Bishop and Arch-Deacon. The Rest of the Clergy within the Deanry were called the *Rural-Dean's Chapter*.

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SAC or *Sacha*, or as some write it, *Saccha* and *Saucha* (according to *Minshew*) was anciently a Royalty or Privilege touching Plea, or Correction of Trespasses of Men within a Mannor: The *Saxon* word, *Sac*, signifying as much as *Causa* in *Latin* (whence our *English Sake*; for whose sake *&c.* but in the Laws of *Edward* the Confessor, it is said, *Sacha est quod si quilibet aliquem nominatim, de aliquo calumniatus fuerit & ille nagaverit, forisfactura Probationis vel Nagationis (si evenerit) sua erit.* From some old Manuscripts, it appears also that *Saka* was a liberty of Holding Pleas, and Imposing Mulcts and Forfeitures on Transgressors in the Court of any Lordship or Mannor; though *Rastal*, and some others will have *Sac* to signifie the Forfeiture it self.

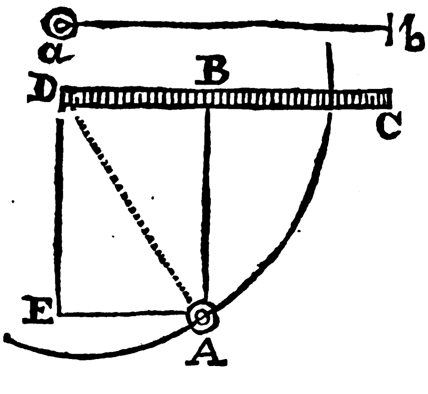
SACCUS *cum Brochia*, was anciently a Service or Tenure of finding a *Sack* and *Broach* for the King for the use of his Army. *Bracton, lib.* 2. *Tract.* 1. *c.* 6.

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 *Scotland* a Sack is 24 Stone, and each Stone contains 16 Pounds.

SAFE *Conduct*, is a Secutity given by the Sovereign 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 assigned.

SAGIBARO, or perhaps *Sachbaro*, anciently signified the same as *Justiciarius*, from *Sac causa*: So that *Sac-baro* is as much as the *Cause-hearer*, or the Man that hears Causes.



SAILS and *Sailing of a Ship*. In order to compute the Force of the Water against a Ships Rudder, 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*, proceeds on this Foundation; 1. He considers all Fluid Bodies, as the *Air* or *Water*, &c. as being composed of little Bodies or Particles, which 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 considers that the Motion of any Body, with regard to a Surface on which it is to strike, must be after one of these three ways, either *Perpendicular*, *Parallel*, or *Oblique*. In the first Case, let the Line *DC*, in Fig. 1. represent a Plain Surface, and let the Line *A B* be Perpendicular to it, describing the direct Impulse of the Body *A* upon it; 'tis plain here that the Body *A* strikes upon it with all its force, and this Force may be called *Absolute*, and may be expressed by the Line *A B*, which the moving Body *A* describes: And this Absolute Force will be *greater* or *less*, according as the Body *A* moves *swifter* or *slower*. (3.) If the Motion of the Body *a* be Parallel to the Surface *D C*, then 'tis plain the Line of Motion *ab* will not affect the Surface at all because it is no way opposed to it; nor can the moving Body strike upon it, or touch it. (4.) If the Line of Motion *A D* be Oblique to the Surface *D C*, so that the Angle of Incidence be *A D C*. then the Motion of the Body in the Line *A D*, 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 *A E*, being Parallel to the Surface *D C*, cannot affect it at all; so that the whole Motion of the Body *A* in that Oblique manner of Striking on the Surface, will be expounded by the Perpendicular Line *A B*. And if *D A* be made the Radius of a Circle, whose Centre is at *D*, B A will be the Sine of the Angle of Incidence *A D C*, and consequently, you may conclude that the Force of a Particle of *Air* or *Water*, as *A*, striking against the Surface *D C*, which may represent either a Sail, or the Rudder of a Ship, in the Oblique Direction *A D*, will be to the Perpendicular Force there, as B A is to D A:: that is, *as the Sine of the Angle of Incidence is to Radius.* And since what is thus true of one Particle *singly* considered, 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 Oblique 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 considered, it will be found that the different Forces then *will be as the Squares of the Velocities of the moving Air or Water*: that is, that a Wind that blows thrice as strong, or moves thrice as swift as another, will have nine times the force upon the Sail: And it being also, saith he, indifferent, whether 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 rest, the Reciprocal Impressions being always the same: So that if a Solid be moved with different Velocities in the same Fluid Matter (as suppose Water) the different Resistances which it will re-

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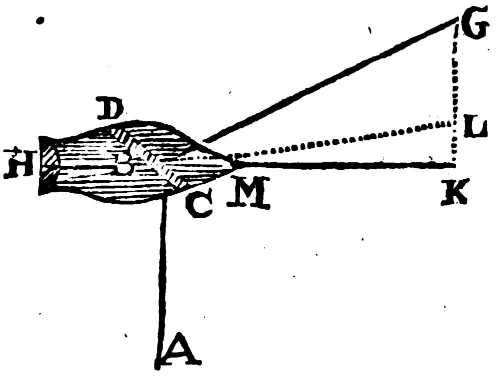
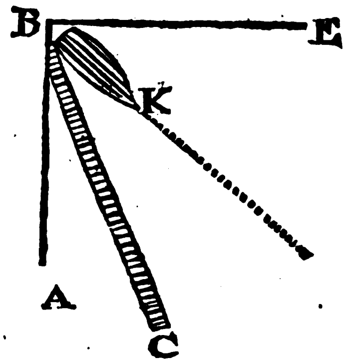
ceive from that Water, will be in the same *Proportion as the Squares of the Velocities of that Body.*



Let H M represent a Ship, *C D* the Position of the Sail, A B the Course of the Wind blowing towards *B*. Draw B G Perpendicular to the Sail *D C*, and G K Perpendicular to the Line of the Keel produced H M K.

By what he hath said above, the Sail *C D* will be driven by the Wind A B, according to the Direction of the Line *B G*: 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 B G. And if H K represent her direct Course, she would have got forward 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 sideways so far as K G, but fall short of it in Proportion to the said Difficulty of dividing the Water with her Side: That is, if the Resistance she finds in passing 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 same 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 *K B L* is her Degrees of *Lee-way*; as the Angle *A B K* expresses 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 Resistances of a Ship's dividing the Water sidewise and lengthwise, we might determine the *Line of a Ships true 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 Lee-way, 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 *B C*, the Wind blowing from A to B, and consequently the Angle of the Winds Incidence on the Sail *A B C*, therefore its Complement will be C B E; then must the Ship be put into the Position *B K*, or more in the Line B K, bissecting the Angle C B E.



And that the Angle which the Sail ought to make with the Wind or the Angle A B C, *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 *Is. 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 dense 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 (saith 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 the Particles of Salt, the most Dense Matter always endeavours to get to the Centre of the Particle. So that a Particle of *Salt* is a kind of *Chaos, 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 small pieces.

If *Salt* in a small quantity be dissolved in a great deal of Water, the Saline Particles, tho' specifically heavier, will not subside, but diffuse themselves 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* one from another, and *endeavour* to expand themselves all manner of ways and to part and separate

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rate as far as the ſpace will permit: And this *Endeavour* ſhews that they have ſome kind of *Repelling Force*, by which they fly from one another, or at leaſt are more ſtrongly *attracted* by *the Parts* of the Water, than by one another. For as all Bodies *aſcend* in Water, which do gravitate leſs towards 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 of Salt, than they are by the Water it ſelf, muſt neceſſarily recede from that Particle, and give place to the Water, which is more forcibly attracted.

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 be ſet to cool, the Salt will ſhoot into Chryſtals, which will be of ſome regular Figure: From whence it appears, that the Saline Particles before their Concretion, were placed in the 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 Diſtances*. For the Suppoſition of ſome ſuch Force will occaſion their being diſpoſed every where into ſuch Orders; but without it they would ramble about and be diſperſed, perfectly irregularly in the Fluid.

In the *French* Memoirs of the Academy of Sciences 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 *Nantwyche* in *Cheſhire*, is thus, (ſaith 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 ſome have one *Lead-walling*, ſome two, three, four, *&c.* A *Lead-walling*, is the Brine of 24 Hours boiling for one Houſe.

Two hundred and ſixteen Lead-wallings, or thereabouts, belong to all the Owners of the Pits. No Tradeſman, 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, *&c.* into it.

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 $\frac{1}{4}$, 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 to Clarifie the Brine, by raiſing the Scum; which they take off juſt upon the boiling of the Pans, otherwiſe it boils in and ſpoils the Salt. The older the Blood is the better, *cæteris paribus*, when the Liquor boils too faſt, they don't put in any Blood, but allay it with Brine that hath been before boiled, and drain'd from its Salt. Crude Brine, they ſay, 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 *Corn*, or Granulate. Then they take a ſmall quantity 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 while before they put in the laſt Ale, they cauſe the Pan to boil as faſt as they can; but after that very gently, till the Salt be almoſt dry, For they do not Evaporate quite, *ad ſiccitaten*, but leave 2, 3, or 4 Quarts of Brine in the Pan, leſt the Salt ſhould burn, and ſtick to its ſides.

The Brine thus ſufficiently Boiled and Evaporated, 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, more or leſs, and then ſet it to dry in the Hot-houſe behind the Furnace.

A Barrow containing 6 Pecks, is ſold 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 called the *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 whereof 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 way.

At *Droitwyche* in *Worceſterſhire*, 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 ſet 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 White of 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*, otherwiſe the Pan would melt. They uſe there neither Blood nor Ale, and the Salt made there is extraordinary fine and white.

In *Lancaſhire* 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 then pouring Water upon it, they make a Lee or *Lixivium*, and the Water draining thro' the Sand,

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carries the Salt with it down into Vessels placed underneath. 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 soon as the Egg begins to sink, they cast the Sand out of the Troughs, and put in new from the Heap.

This Water thus impregnated with Salt, they boil in Leaden-pans, wherein (as above) the Water 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 set 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 *Staffordshire* 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 so great, that probably it would warp Boards, and rust Nails, so that no Timber covering would last long; what Tiles would do, no one yet hath tried there.

The Sweepings of such Salt as is shed and scatter'd about on the Floor, takes up with it a good deal of Dirt, and is called *Grey-Salt*. This sells 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 wettish from the Pans, 'tis molded and made up with some Cummin-seed and Ashes, 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 *Worcestershire*, they use no Blood, but only Whites of Eggs (a quarter of one White to a Gallon of Brine) to Clarify their Brine; and to Granulate it, they use no Ale, nor any thing else; this Salt is much whiter and better than the *Cheshire* Salt, and a *Winchester* Bushel of it weighs 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 *Marishes* the Water is not above an Inch and half deep; 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 they have Stops to hinder the Sea-water from coming into the *Marishes*. But if it rain for 5 or 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 *North-west* Winds are best for that Purpose. The People draw the Salt every day, and each day more than an hundred Pound weight.

SALT-SILVER, was one Penny, formerly paid at the Feast of St. *Martin*, by the Servile Tenants 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 saves or rescues another which was set upon or taken by the Enemy, or by Pirates.

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 Excommunicated, 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 the rest, at St. *John*'s at *Beverly*. How these were taken away by degrees, you 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 sort 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 the *Moat*. When they are got near the foot of the *Glacis*, the Trench is carried on directly forwards, the Workmen covering themselves as well as they can, with *Blinds*, *Wool-packs*, *Sand-bags*, and Mantelets upon Wheels: When they are got to the foot of the *Glacis*, they make *Epaulments*, or *Traverses* on each side 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 sideways; wherefore they lay Planks overhead 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 from the Fire of the opposite Bastion.

SAPHETA, in Architecture, is the Board over the top of a Window, and placed Parallel, and 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 Observations, that *Saturn*, like the other Planets, which

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which have Satellites, revolves round his own Axis; but the contrary seems to be the Case. 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 hath been found in Saturn.

Each Surface of the Ring of Saturn seems to be plain and smooth, without any such 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 elevated some few Degrees above its Plane. 'Tis either Fluid therefore like Water, or Polite, like Ice or Glass. If it be a *Fluid*, it moves round Saturn with a Circular Motion; but if it be of a Solid Substance, it is not yet determined, whether it move round the Planet or not. And since 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 slowly, 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 Apses* 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 Apses in every Revolution of the Satellite, will advance more forward than it recedes backward; and that by the Excess of this Progression, 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 decreasing 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 slower, 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 slower; and in every Revolution of the Satellite, will either be Retrograde or Stationary, be carried backward, or move *in antecedentia*, and in each Revolution will recede fastest, all things considered, 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 *cæteris paribus*, when they are in the Quadratures, *p.* 307.

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 general, as well as its use. But they reckon these several sorts of Saws. 1. *The Pit-saw*, which is 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* is used by Joyners, to cut off such pieces of Stuff as the Hand-Saw will not easily notch thro'. 'Tis drawn by two Men, and the Timber is placed on Trusses in order to be cut. 3. The *Hand-Saw*, which is to be used by a single Man, and usually with one hand. 4. The *Frame-Saw*, or *Bow-Saw*, is a Saw with Cheeks made to it, and with a twisted Chord, and Tongue in the middle to draw the upper ends of the Cheeks closer together, that the lower ends may be farther asunder, and so strain the Saw the straighter. 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 easier 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 single part, than *Concords* in Composition. *The Distances* talk'd of among the *Greeks*, are the Τόνος or Second, the Δίτονος or third, the Διατεσσάρων or fourth, the Διαπέντε or fifth, and Διαπασῶν or eighth. But if these were design'd to denote the Concords, they were in the wrong to place the *fourth*, and more so to place the *second* among them. Or if such were admitted, 'tis a wonder that the *sixth*, 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 *sixth* and *seventh* (being Distances not to be used without better Judgment and Design than those Times would admit of) and made mention of the rest, as being common in their Musick.

The Scale of Musick among the *Greeks*, consisted but of *fifteen Notes*, or the *Distances* of two *Octaves*, viz. The first from their Μεσολαμβανόμενος, (which I suppose was the *Key* of their Musick,) to their Μέση, and the second from their Μέση or *Middle Note* to their Νήτη ὑπερβολαίων, 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 μεταβολὴ κατὰ τόνον. 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 formerly a kind of Toll or Custom, exacted by Her Majesties Sheriffs, &c. of Merchant Strangers for

Wares

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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 Custom, *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 Intrinsick 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 Glossaries, signifying a *Bushel.*

SCENOGRAPHICK *Projection*, or Perspective, is the Transcription of any given Magnitude, into a Plane which intersects the Optick Pyramid at a proper distance: For in Projection, there is to be consider'd, 1. The *Object*, or Foundation, or Ground of the Projection, from whence the *Pyramid*, *Cone*, or *Pencil of Rays* go. (2.) The *Eye* of the Spectator, and 3 the *Plane Table*, or *Diaphanum*, which intersects 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 Perspective* 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 Intersect each other. 3. That a *Plane* or Superficies will be represented where the *Diaphanous Plane* cuts the Optick Pyramid of Rays coming from that Surface. And that Representation of it called its *Image.*

SCHAR-*Penny*, *Scharn-penny*, and sometimes *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 if 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 Elliptical Arch.

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 Imposition, paid to the Sheriff of any County or Shire, for holding the Assizes or County-Courts.

SCREW, } See *Cochlea.*
SCRUE, }

SCRATCH-*work*, in *Italian*, *Sgrafitti*, was a way of Painting in *Fresco*, by preparing of a black Ground, on which was placed a white Plaster; and this White being taken off with an Iron Bodkin, the Black appears thro' the Holes, and serves 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, &c. 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 such Service, to pay a *Scutage* or Composition in Money, which was Levied on every *Scutum Militare*, or Knights Fee, and the Proportional Parts for the King's Use. And the Barons and Knights, which then paid a *Scutage* to the King, had a Power to Levy the same Tax on those Tenants who held from them in Military Service.

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 distinguished into three several Arts, each of which hath its Specifick Difference. For (saith Mr. *Evelin* in his History of *Chalcography*) besides *Sculptura*, as it relates to *Chalcography*, there is both *Sculptura* and *Cælatura*; 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 *Desectores*; 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 lastly 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 Sheriffs turn is now) by the Bishop of the Diocess and the *Ealderman*, *i. e.* in such Shires as had *Ealdermen*) 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 dispersed under their proper Names. Some Problems may properly come in here under the general Word Sector. As 1. *To open the Sector to any given Angle.*

Here must be noted, that 'tis one thing to open the several pairs of Lines thereon drawn to the same Angle; for in *Gunter's* Sector the *Line of Lines* on the one side, and the *Line of Sines* on the other, make an Angle of 2°, when the Edges of the Sector are close shut. So also the *Line of Superficies*,

perficies, and the Lines of Solids make an Angle 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 $\square 8 \times \square 6 = 100$, by 47. è 1. *Eucild.*

The *Line of 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 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.

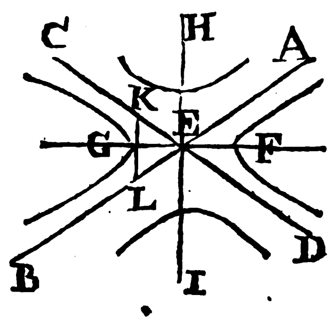
On the contrary, if the Sector be opened to an Angle at a venture, you may find the quantity of that Angle, thus: Take the *Parallel* Chord of 60°. and meaſure it in the *Lateral* Chord, and it ſhall there give the Angle, *i.e.* the Angle that thoſe Lines of Chords are opened to: But that will be different 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 *Curiæ*, is Suit and Service done by Tenants 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 eſſe de hâc Sectâ*, was a Privilege to be exempt from ſuch Cuſtomary Service.

SECTIONS *Conick*, ſee *Conick Sections.*

SECTIONES *Sequentes*, is a Term in Conicks ariſing thus:



Let there be two Right Lines, as A B, C D, 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 partieular Caſe, the Sections G F, and H I, are called *Sectiones Sequentis*, becauſe they are placed following one another in the Contiguous Angles of two Interſecting Right Lines.

And if the determinate Diameter H G, of one of the *Sectiones Sequentes* (which is coincident with the ſuppoſed Indeterminate Diameter of its Oppoſite) be equal to the Vertical Tangent K L, applied betwen the Aſymptotes in the Point G, of the Diameter G F, then *Apollonius* calls ſuch Sections *Conjugate Sections.*

SEGMENTS, on *Gunter*'s Sector there are uſually placed two Lines, called *Lines of Segments*, they are numbred 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 biſſecting 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 exactly, 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 Retinæ*: which Vibrations being communicated, or propagated along the Solid Fibres of the Optick Nerves 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 Denſeſt, the longeſt time, the Vibrations of their Parts are of a laſting nature, and therefore may be propagated along ſolid Fibres of Uniform Denſity to a 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 ſame 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 ſide of both Nerves uniting there, and after Union, going thence into the Brain in the Nerve, which is on the right ſide of the Head; and the Fibres on the left ſide 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 unite in the Brain, in ſuch a manner that their Fibres make but one entire Species or Picture: Half of which, *viz.* that on the right ſide of the *Senſorium*, comes from the right ſide of both Eyes, thro' the ſide of both the Optick Nerves, to the Place where theſe Nerves meet, and from thence on the right ſide of the Head into the Brain: But the other half, *viz.* that on the left ſide of the *Senſorium*, comes in like manner from the left ſide of both Eyes. For the Optick Nerves of ſuch Animals as look the ſame way with both Eyes, (as of Men, Dogs, Sheep, Oxon. &c.) meet before they come into the Brain; but the Optick Nerves of ſuch Animals as do oot look the

ſame

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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 *Retina* by that Stroke?

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, ſometimes 1 Shilling, and ſometimes 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 erected, 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 Demeſne-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 inſide 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 *Cauſa*, is the Proceſs and depending Iſſue 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 ſundry Offices and Callings. A *Sergeant* at Law, or of the Coif, is the greateſt Degree taken in that Profeſſion, as that of a Doctor is in the Civil Law. As theſe are the moſt Learned and Experienced, there is one Court appropriated to Plead in by themſelves, which is the *Common-pleas*, where the Common Law of *England* is moſt ſtrictly obſerved: But tho' 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 Aſſigned. 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 ſits in Judgment on any Traytor, *&c.* 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 ſort of *Sergeants*, are chief Officers executing ſeveral Functions in the King's Houſhold; 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 Mayor.

SERJEANTRY, was a Service formerly done for the holding of Lands, and was either *Grand Serjeantry*, which was ſome Honourable Military Service paid only to the King; as to carry his Banner, bear his Sword, *&c.* Or *Petty-Serjeantry*, which was ſome leſs Noble Service paid to the King, or any other Lord. Some will have *Grand Serjeantry*, 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 Lord of it; and were generally reckoned to be theſe 6. 1. Power of Judicature in Matters of Property. 2. Power of Life and Death in Criminal Cauſes. 3. A Right in Wayfs and Strays. 4. Aſſeſſments. 5. Minting of Money, 6. Aſſize of Bread, Beer, Weights and Meaſures.

SERVICE, (which is ſometimes called *Servage*) is divided into Perſonal and Real, and into Military and Baſe; as alſo into *Intrinſick* and *Extrinſick*. Intrinſick Service 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 *Caſual* or *Accidental*; the former being the *Seiſin* of Rent, and the latter Seiſin of Reliefe.

SERVICE, in a Legal Senſe, is a right by which one thing is ſubject to another thing or Perſon. 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 ſome *Ruſtical* or *Rural*, ſuch as the Right of Riding or Walking, or going with a Carriage thro' another Man's Ground;

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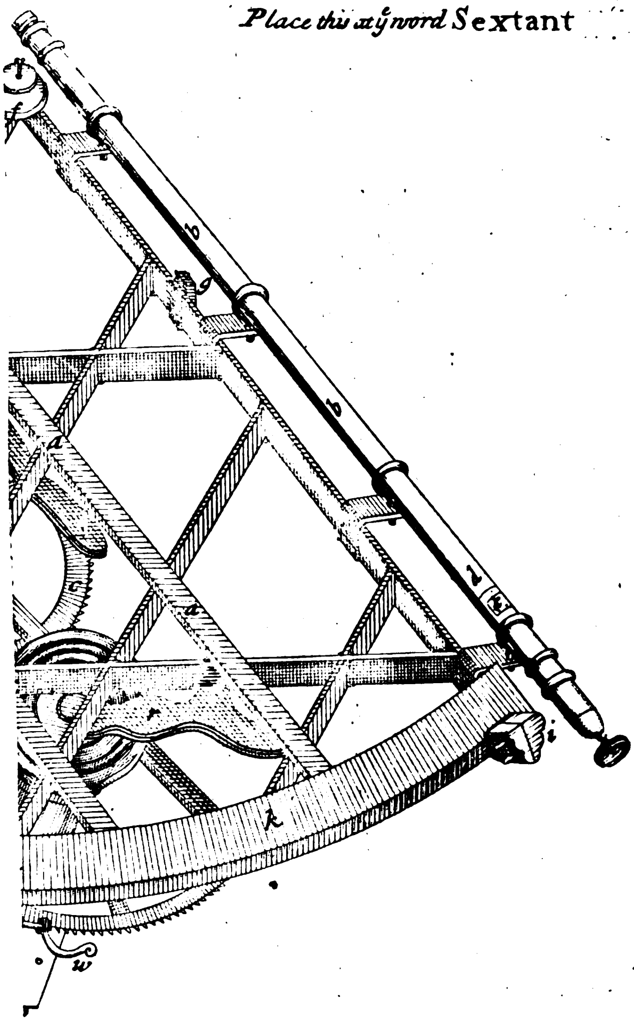

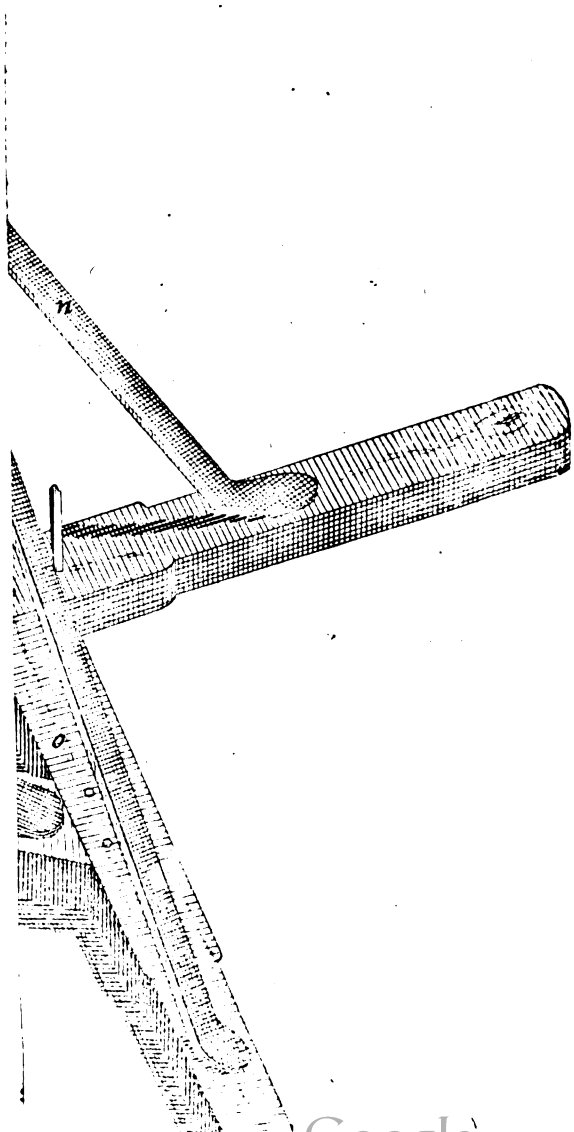

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Ground; the Right of drawing Water, or bringing it thro' his Ground, *&c.* And some Services are called *Urbanæ*, which are the Rights that are preferred to Mens Houses, built contiguous to one another, *&c.*

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. Assize of Bread 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-staves.*

SESAMOIDÆA *Ossa*, the Use of these Bones, which are placed at the Articulations of the Bones of the Fingers and Toes, is that they may serve as so 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. And 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, *&c.* 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 a Iron Bars set edge and flat-ways, composing and framing the Body of the *Sextant*, whose Radius is five Foot.

b b Are two Tellescopes, the one fixt on the right Edge of the *Sextant*, from which the Divisions on the Limb are numbred, and the other moveable with the Index.

c c 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*.

d d 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 Instrument.

e The Revolution-Work, which proves the Index gradually (by the help of a Screw) and sensibly shews its Progress, to the thousandth Part of an Inch.

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 Distances 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 Seconds.

l Is a *Lignum-Vitæ* Axis, upon which the *Sextant* 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.

n n n Three strong Iron Feet, fix'd to an Iron Collar, to hold the aforesaid Axis (*l*.)

o o o 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 (*l*) to its Parallelism with either the Axis of the Equator 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 *sunk* or *dug* to come at the Ore. In the Tin Mines, after this is sunk 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 such 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

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Britannia, describes this Office, and the Antiquity and Authority of this Officer. See *Co. Rep. lib.* 4. And *Spelman*'s Glossary under the word *Vice-Comes*. His Oath is extant in *Reg. Orig. fol.* 331.

SHERIFF-TOOTH, seems anciently to have been a Tenure by the Service or Duty of providing Entertainment for the Sheriff at his County-Turns or Courts. For it appears by *Ryley*'s *Placita Parliament. fol.* 653. that in *Derbyshire* the King's Bayliffs did formerly take 6 Pence of every *Bovate* of Land, in Name of *Sheriff-tooth*.

SHILLING, *Solidus* in the *Latin* is a word of very uncertain Signification, and differs almost in every Nation. But the word *Scylling* or *Shilling* in *England*, never signified any thing but 5*d.* with the *Saxons*, and 12*d.* ever since. When it first went for 12*d.* 'tis hard to find: But there was no 12 Penny Piece of that name Coined in *England* till 1504. and then *Stow* calls them *Groats*: tho' *Fabian* mentions them under the name of *Shillings*. In 34 *H.* 8. there were 12 Penny Pieces struck, 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 Mizzen Chain-wale.*
I *The Chess Tree.*
K *The Entring Port.*
L *The Head.*
M *The Gallery.*
N *The Tafferel.*
O O O *The Three Poop Lanterns.*
P *The Ensign Staff.*
Q *Its Truck.*
R *The Ensign or Antient.*

Z The Mizzen Mast and Rigging.

1 *The Mizzen Mast.*
2 *The Mizzen Yard and Sail.*
3 *The Mizzen Sheet.*
4 *The Mizzen Shrowds and Laniards.*
5 *The Mizzen Bow-lines.*
6 *The Mizzen Brayles.*
7 *The Geer.*
8 *The Mizzen Peek Halliards.*
9 *The Cross Jack-Yard.*
10 *The Lifts.*
11 *The Braces.*
12 *The Mizzen Puttock Shrowds.*
13 *The Mizzen Top.*
14 *The Mizzen Top Armour.*
15 *The Cap.*
16 *Crow-feet.*
17 *The Mizzen Stay and Sail.*
18 *The Halliards.*

Mizzen Top-Mast and Rigging.

19 *Mizzen Top-Mast.*
20 *Its Sails furl'd.*
21 *Its Braces.*
22 *Its Lifts.*
23 *Its Shrowds.*
24 *Its Halliards.*
25 *Its Back-Stay.*
26 *Its Bow-lines.*
27 *Its Sheet.*
28 *The Clew-lines.*
29 *The Stay.*
30 *The Cross-Trees.*
31 *The Cap.*
32 *The Stump.*
33 *Its Stay.*
34 *Its Truck.*
35 *The Spindle.*
36 *The Vane.*
37 *The Slings of the Cross Jack-Yard.*

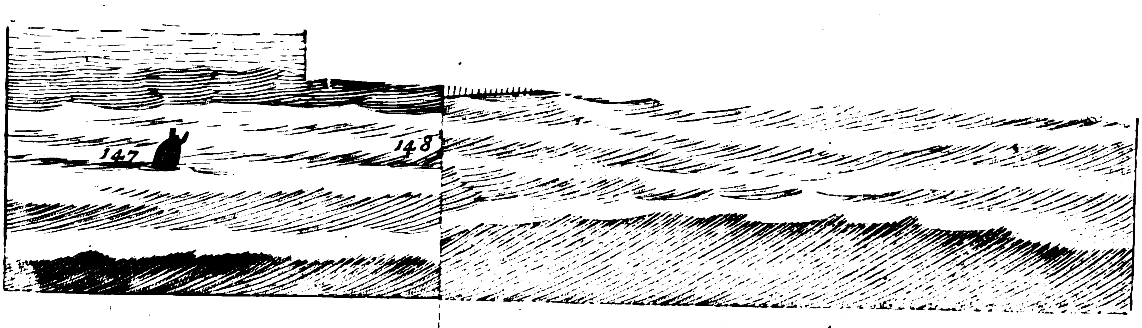
M The Main Mast and its Rigging.

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 Yard 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 Yard Tackles.*

Main Top-Mast and Rigging.

60 *The Main Top-mast.*
61 61 *Tackles.*
62 *The Main Top-mast Shrouds.*
63 *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-sail Sheets.*
71 71 *The Main Top-sail Clew-lines.*
72 72 *The Main Top-sail Lifts.*
73 *The Runner.*
74 *The Bunt-lines.*
75 *The Cross Tree.*
76 *The Cap.*
77 *The Stump.*

Place this, and the other Plate of ye Section of a Ship at the word Ship .



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78 *The Stay.*
79 *The Truck.*
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 87 *The Fore-Sheets.*
88 88 *The Fore-Tacks.*
89 89 *The Fore-Braces.*
90 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-ſail Halliards.*
107 *Stay and Sail.*
108 *The Halliards.*
109 *The Fore-Top maſt Yard and Sail.*
110 *The Runner.*
111 111 *The Fore-Top-ſail Lifts.*
112 112 *The Fore-Top-ſail Braces.*
113 *The Fore-Top-ſail Bow-lines.*
114 114 *The Fore-Top-ſail Sheets.*
115 *The Fore-Top-ſail Clew-lines.*
116 *The Fore-Top-ſail Bunt-lines.*
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-Yard and Sail.*
127 *The Sprit-ſail Lifts.*
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.*
134 *The Sprit-ſail Top-maſt.*
135 *The Sprit-ſail Shrouds.*
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 Lifts.*
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 ſuch 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, Main-ſail, 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 ſight and uſe of 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 Chaſer 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 looſes 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 *Weigh*, he looſes his *Fore-top-ſail*, 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 Stern-moſt Ship is to weigh firſt.

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 *Fore-top-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 Mizen-top-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 Pendant

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dant on the Ensign-staff, and fires a Gun: And then the Leeward-most and Stern-most Ships are to *Wear* first, and bring on the other Tack and lie by, or go on with an easie Sail till he comes a Head. Every Flag is to answer with the same Signal.

6. If they are lying by, or Sailing by a Wind, and the Admiral would have them *bear 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 for the 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 hawl down the Jack before he fires the Gun to wear, and keep it down till the Fleet is before the Wind.

7. 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 Gun.

8. When any Ship discovers Land, he is to hoist 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 hawl down his Ensign.

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 Danger.

10. When any sees a Ship or Ships more than the Fleet, he is to put abroad his Ensign, and there keep it, till the Admiral's or Commander's is out, and then to lower it as often as he sees Ships, and to stand in with them, that so the Admiral may know which way they are, and how many: But if he be at such a distance that the Ensign can't well be discovered, he is then to lay his Head towards the Ship or Ships so descryed, and to *brail* up his low Sails, and continue hoisting 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 send out Ships to Chase, he hoists a Flag, Striped White and Red, on the Flag-staff, at the Fore-top-mast-head, and fires a Gun. But if he would have the Rear-Admiral do so, he then hoists the same Signal on the Flag-staff at the Mizen-top-mast-head, and fires a Gun.

12. When the Admiral would have any Ship to chase *to Windward*, he makes a Signal for speaking with the Captain, and hoists a *Red Flag* in the Mizen-shrouds, and fires a Gun.

But if to chase *to Leeward*, a *Blue* Flag; and the same Signal is made by the Flag in whose Division that Ship is. When he would have them give over Chase, he hoists a White Flag on his Flag-staff at the Fore-top-mast-head, and fires a Gun: Which Signal is to be made also by that Flag Ship, which is nearest the Ship that gives Chase, till the Chasing Ship sees the Signal.

13. In Case of Springing a Leak, or any other Disaster 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 firing one Gun.

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 same Signal.

16. If he would have the Fleet *Moor*, he hoists 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 looses both his Top-sails, and fires two Guns; and then the Leeward Ships are to cut or slip first, to give room to the Weather-most to come to Sail.

So if he would have any particular Ship to cut or slip, and to *Chase to Windward*, he makes the Signal for speaking with that Ship, hoists a *Red* Flag in the Mizen-shrouds, 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 Ensign-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 Anchor, in Weighing, Anchoring and Sailing.

1. When the Admiral would have the Fleet to *Unmoor* and *Ride short*, he hangs out 3 Lights one over another in the Main-top-mast-shrouds, over the constant Light in the Main-top, and fires two Guns, which are to be answered by the Flag-Ships; and each private Ship hangs out a Light in the Mizen-shrouds.

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 a Light in the Main-top-mast-shrouds, and fires a Gun, which is to be answered by all the Flags; and every private Ship must hang out a Light in his Mizen-shroud.

3. When he would have them *Tack*, he hoists 2 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 every private Ship is to hang out a Light extraordinary, which is not to be taken in till the Admiral takes in his.

After the Signal is made, the Leeward-most and Stern-most Ships must Tack as fast as they can; and 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 *Head-sails 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 1 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 1 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 1 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.

10. 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.

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 Ensign-staff, and fires one Gun; which is to be answered by the Flag-ships, and every private Ship must shew 1 Light. And when he would have them *Hoist* their Yards and Top-mast, he puts out 2 Lights, one under the other, in the Mizen-top-mast-shrouds, and fires a Gun; which is to be answered by the Flag-ships, and each private Ship must shew 1 Light in the Mizen-shrouds.

14. If any strange Ship be 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 if 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.

2. 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, expecting 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; if 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 same Sail set that he had before it grew foggy, 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 disovers 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 *Weft* made with the Ensign, then the *Lieutenant* of each Ship is to come on Board.

2. If

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2. If an Ensign be put Aboard in the same Place, all the Masters of the Ships of War are to come on Board the Admiral.

3 If a Standard on the Flag-staff be hoisted at the Mizen-top-mast-head, and a Gun fired, then 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. If 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 Weft with the Ensign, a *Lieutenant* of each Ship must go on Board.

5. If he hoists a *White* Flag as before, then the Vice-Admiral, or he that Commands in the second 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 Weft 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 his own Division, he will hoist a Pendant in the Mizen-peek, and fire a Gun; and if with the Lieutenants, a Weft 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 *Yellow* 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 *Weft* with his *Jack*.

9. If all the Pinnaces and Barges are to come on Board, Manned and Armed, the Signal is a Pendant on the Flag-staff, hoisted on the Fore-top-mast-head, and a Gun; and if 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-staff at the Mizen-top-mast-head, 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 aforesaid, 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 1 Gun; but if he would have them Chase, he hoists his Pendants, as before, and fires 2 Guns.

11. When the Admiral would speak with the Victualler, or his Agent, he puts an *English* Ensign 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 a Line of Battle, one Ship a head of another, 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-mast-head, 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.

3. If he would have the Vice-Admiral of the Red do so, he spreads a Red Flag from the Cap on the Fore-top-mast-head, downward on the Back-stay: 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; if 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-top-sails 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-top-mast-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-peek, and fires a Gun, and all the Flag-ships must do the same.

10. If he would have him that Commands in the second Post of his Squadron to make more Sail (tho' he himself shorten Sail) he hoists a white Flag on the Ensign-staff: But if he that Commands in the third Post be to do so, he hoists

a Blue

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a Blue Flag at the ſame places, and fires a Gun, and all the Flag-ſhips muſt make the ſame Signal.

11. When ever he hoiſts a Red Flag on the Flag-ſtaff 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 Mizen-peek, and fires a Gun, then all the ſmall Frigats of his Squadron that are not of the Line of Battle, 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-top-maſt-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 ſpreads 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, and fires a Gun, and all the Flag-ſhips in the 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 Main-top-maſt-head, and fires a Gun; which Signal the Flag-ſhips are 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 himſelf, 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 with, and Board the Enemy.

18. When he would have the Chaſe given over, he hoiſts a white Flag at the Fore-top-maſt-head, and fires a Gun.

19. If he would have the Red Squadron draw into a Line of Battle, *one a 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 ſecond 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 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. 1. From Mr. *Ray*, at the end of his Catalogue of *Engliſh* Words about the Silver Mines in *Cardiganſhire* 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 ſlit 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 Refining 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, (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 ſubſiding to the bottom of the Teſt.

As ſoon 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 Cake of Silver after it grows cold, *ſprings or riſes up into Branches* (ſaith Mr. *Ray*, but I queſtion 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 *Litharge* 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 or pounded with Charcoal only.

The

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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 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 Metal 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 again.

They have alſo an *Aſſay Furnace*, wherewith they try the Value of the Metal, of what Proportion 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 Silver. 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 little, that it will not quit coſt to Refine it.

At the firſt Smelting they mingle ſeveral ſorts of Ore together, ſome Richer, ſome Poorer, elſe they will not melt ſo kindly. The Silver made here is exceeding good and fine. Theſe ſix Mountains in *Cardiganſhire*, not far from one another, afford Silver Ore; *Talabout*, *Geginnon*, *Comſomlack*, *Gedarren*, *Bromeſloid* and *Cummer*. But when Mr. *Ray* was there, they digg'd only at *Talabout*.

Their Way of Digging and Collecting the Ore, was thus: They ſink 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 ſlopes 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 *Schemnitz* in *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 kept open with Under-work at a great Expence. Much of this Mine being 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 *Marchaſite*; 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 *Cinnaber*; 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 ſometimes yields but half an Ounce, or an Ounce of Silver; ſometimes 2, 3, 4, 5 and 20 Ounces.

There is an Officer in the Works, whom they call the *Probeirer* or *Eſſayer*, who proves the Richneſs of the Ore, thus: Of all ſorts 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 ſort 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 ſinking always to the bottom with the Silver in the *Waſh-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 elſe remains mixt with the Silver is *driven* 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*.

When Silver is generated (as 'tis in ſome Places of *America*, and perhaps elſewhere) in Rockey Stones, abounding with Bituminous Mixtures, ſo as that it can't be forced from its Impurities

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 thus:

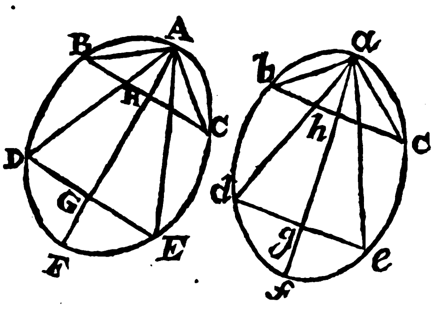
They Calcine the Ore, firſt broken into ſmall pieces, in a Reverberatory Oven; but with a moderate Fire for fear of Fuſion, and driving away into the Air part of the Metal. This Calcination frees the Mineral from ſuch Mixtures as would hinder the Power of the Quickſilver upon it, and alſo renders the 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 ſifted, they divide it into ſeveral heaps, and then by leſſer Eſſays 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 ſeveral times, ſtirring 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 Quickſilver, are often ſtirred about, the better to incorporate the Mercury and Silver. They ſeem to have only Conjectural Signs to know when the Quickſilver hath done its Office in ſeparating the Silver from theſe Heterogeneal Subſtances; which occaſions by its uncertainty great Loſſes, eſpecially when they Work this way on Gold. But when by the Colour of the Mercury, Coagulated by the Silver in clear Maſſy Lumps, they conjecture the Work done, they waſh it by means of *three Veſſels*, ſtanding in order, one under another: So that the Matter in the firſt and higheſt, being worked and ſtirred about with a *Molinet*, all the 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 Quickſilver 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. *Philoſ. Tranſ.* No. 41.

SIMILAR *Light*, according to Sir *Iſ. Newton*, is ſuch, whoſe Rays are all equally Refrangible; and this he calls alſo Simple and Homogeneal.



SIMILAR *Sections* in Conicks, are ſuch whoſe Diameters make equal Angles with their Ordinates; and alſo where the Triangles A D E, A B C, are Similar to the Triangles *a d e*, a b c, and the Baſes D E to B C; as d e, b c. Their Diameters alſo, as *A F*, 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 under an Obligation to do it, whenever a Church 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 ſuch Benefices are rather *Depopulations* than *Sine-cures*, and 'twill be proper for the new Incumbent to read the 39 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 no Parſonage which hath a Vicar Endowed, ſhall be comprehended, &c. So that here no Diſpenſation is neceſſary to hold this *Sine-cure* 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*

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Rectoriam sive Portionem Rectoriæ 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 Uses; 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 90 and 90 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 Distance between 60, 30, 45, *&c.* will give the Sines of 60°, 30°. 45°. *&c.* And *vice versâ*, from the Sine given you may find the Radius, by fitting the Sine into the Sector Parallel-wise, between the Numbers expressing its Degrees. For then the Parallel Distance between 90 and 90, will be the Radius sought.

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 side; and the Degrees and Minutes where it fits, shall give you the Sine it represents.

SINUS, in the *Dura Mater*, is that strong 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 Laterales*; and 4 *Sines Vertebralis.* (*Keil*, *p.* 133.)

SI *Recognoscant*, is a Writ that 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 *Dressing* the Tin Ore, after it comes from the *Launder* of the Stamping-mill; which is by sifting it thro' an Hair-Sieve, casting back the remainder in the Sieve into the *Tails*, to be *Trambled* over again. See *Buddle* and *Tin*.

SKIN. As soon as the *Cuticula* or Scarf-skin is separated from the *Cutis* or true Skin of a humane Body, there are these three parts appear first, an infinite number of *Papillæ Pyramidales*, which are the ends of all the Nerves of the Skin, each of which are enclosed in two or three Covers of a Pyramidal Figure. Between these *Papillæ* 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, serving to support and moisten the *Papillæ Pyramidales*. 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 Duct*; which last passes thro' the other two Parts to the *Cuticula*, in order to moisten it and the *Papillæ Pyramidales*, lest they should be so dry as to hinder the Sense of Feeling; and also to discharge 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 Glands of 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 Anatomy.*

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 Duct* of the *Miliary-Glands* of the *Cutis*, or thick Skin, open. *Lewenhoeck* reckons, that round about one Cuticular 500 such 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 secern the Sweat, and what goes off by insensible Perspiration: And they must be very many in number, since, as *Sanctorius* observes, 15 Ounces of a Fluid Matter passes in 24 hours time. Next under the Scarf-Skin lie the *Papillæ Pyramidales*, which also are prodigiously numerous, being the Extremities of all the Nerves of the Skin, and do more immediately serve for the Sense of Feeling, and to convey 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 *Papillæ Pyramidales*; and then under these the Miliary Glands are placed, protruding their *Secretory Ducts* up to the Surface of the Scarf-skin; on which there are many Parallel Lines, and these intersected by others, and in each Intersection there is an Hair usually placed. The *Scales* of the Scarf-

Scarf-skin defend the Orifices of the Excretory Ducts of the *Miliary Glands*, and hinder Objects from making too exquisite and painful an Impression upon the Nerves, and so to save them from External Injuries. The Skin itself is designed to enwrap the whole Body, and to sustain the *Papillæ Pyramidales* in their Places, and the Miliary 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 see.

SLEDGE; is a large Smith's Hammer to be used with both Hands: Of this there are two sorts, *The Uphand Sledge*, which is used by under Workmen, when the Work is not of the largest sort: This is used with both the Hands before, and 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.

SLOOP, is a Vessel of the Shallop-kind. In 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.

SMOKE-*farthings*, the Pentecostals, or Customary Oblations offered by the Inhabitants within any Diocess, when they made their Processions to the Mother or Cathedral Church, and came by degrees into an annual standing Rent, called *Smoke-farthings*.

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 side, 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 the Lines of Solids may be made out of the Line of Lines, (or rather out of a Diagonal Scale, equal to it in length) by a Table of Cubick Roots, and this is the readiest way; for the Roots taken out of the Scale 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 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 of the Sides of the greater or greatest Solid, and open 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 them parallel to the former, till the Feet of the Compasses stay in like Points; the Numbers belonging 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 Diminish 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 side of a Solid similar to the former, and in the *Ratio* required.

3. *To Add or Substract one Solid to, or from another.*

Find the Ratio between them (by Prob. 1.) and then Add or Substract those Proportions, and accordingly augment or diminish (by the precedent.) Thus, if *A* and *B* be the sides of 2 Cubes to be *added* or substracted; I first find the Proportion of *A* to *B* to be, suppose, as 100 to 40, or as 5 to 2; 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*, in Substraction.

4. *To find 2 Mean Proportionals between 2 given 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 Angle, take the Distance between 8 and 8, and that shall give you *B*, suppose the former of the 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 sought.

5. *To find 2 Mean Proportionals between 2 Numbers given*: Suppose between 27 and 8.

Reckon 27 and 8 on both sides 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 sought. Apply over then 18 between 27 and 27 in the Line of Solids, and keeping the Sector at that Angle; the Parallel between 8 and 8 in the same Line, will give a Length to be reckoned, as before on the Line of Lines from the Centre, which will be 12, the latter Mean Proportional required.

6. *To find the Cubick Root of a Number given, or the Cube of a Number assigned.*

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 such Points over the Cube Number given. Wherefore if the Number be under 1000, the Root can consist but of one Figure. If less than 1000000, it can consist but of 2 Places; and if less than 1000000000, it will have but 3 Places in the Root, *&c.* Wherefore the Line of Solids is divided first into 1000 unequal Parts: And therefore, 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 the Line of Numbers. By this means, if the last Point over a Cubick Number, fall on the last Figure

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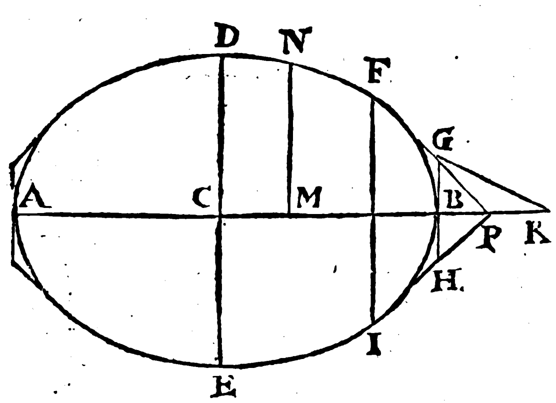
gure to the Left-hand, the Number given ſhall be reckoned on the Line of Solids, from 1 to 10, and the firſt Figure of the Root will be either 1 or 2. But if the Point fall on the laſt Figure but one, the Number given muſt be accounted in the middle of the Line of Solids, between 10 and 100, and the firſt Figure of the Root will be always either 2, 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 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 84900000 — 439
of 849000000 — 947

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

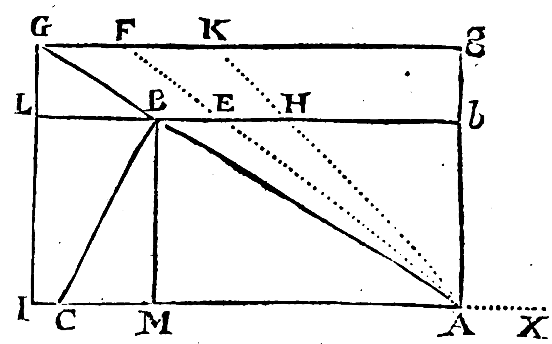


there be a Curve Figure, as DNFB, of ſuch a nature, as that from any Point, as *N*, taken in its Circumference, a Perpendicular be let fall to the Axis, as NM: And if from a given Point, as G, the Right Line GR, be drawn parallel to a Tangent to the Curve in that Point; and alſo if the Axis being produced till GR cut it, it then be, as MN. GR :: GR^3. $\frac{N}{4BR\times}$ GB, 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 whatſoever, deſcribed after the ſame manner, and whoſe Length and Breadth are the ſame.

After this, in the Year 1699, *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 ſuch 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 there is a Solution of this Problem, of finding the *Solid of leaſt Reſiſtance.* (See *Philoſ. Tranſ.* N°. 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 IA, from I towards X.



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 $= \frac{CM^2}{BC}$ 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 ſay, that the Reſiſtance of the △ AIG, is to the Reſiſtance of the Rectangle AIG, as the Area of the Triangle AIG, is to the Area of △ AFg, and the Reſiſtance 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. 324.

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×bH. bg×bE (by the preceeding *Lemma*) wherefore e. E :: bH. bE. (that is) e. E :: $\frac{CM^2}{BC}$. BC. (by the Conſtruction of that Lemma) wherefore e. E :: CM^2. BC^2. But CM^2. BC^2 :: GL^2. GB^2, (from the ſimilar Triangles BMC, GLB) wherefore e. E :: GL^2. GG^2. Q.E.D.

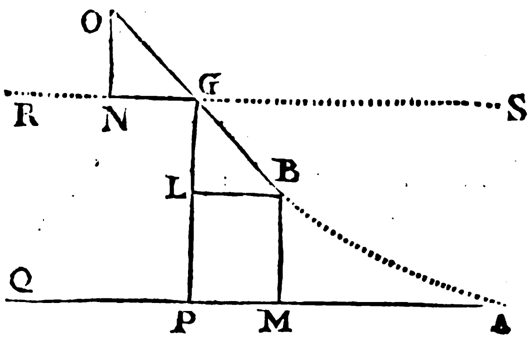
Cor. 2. *The Reſiſtance againſt the infinitely ſmall part GB, is equal to the Cube of the Line GL, divided by the Square of the Line GB.* For if all the infinitely ſmall Parts of the Line Ag, (as bg, &c.) be ſuppoſed equal; then the Reſiſtance in *bg* might be expreſſed by bg: that is, E=bg, and therefore E=GL. Wherefore, by Cor. 1. e. GL :: GL^2. GB^2. wherefore e $= \frac{GL^3}{GB^2}$. Q.E.D.

Cor.

Cor. 3. Let r be Radius, and c the Circumference 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 Resistance 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 e. 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 $\frac{c \times BM}{r} \times \frac{GL^3}{BG^2}$ Q. E. D.

Then follows the Problem proposed, which is this:

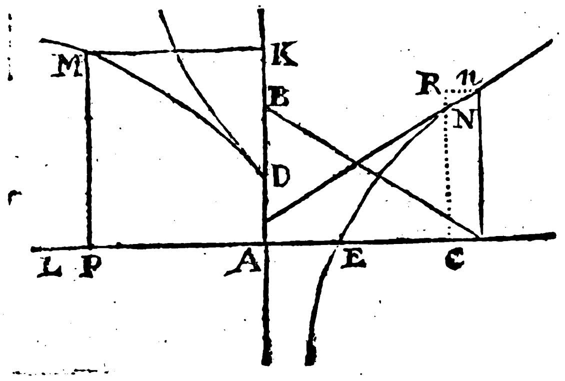
Problem, To find the Curve, by whose Rotation round an Axis, a round Solid shall be produced, which, supposing to be moved in a Fluid, according to the Direction of the said Axis, shall suffer the least possible Resistance in that Medium.

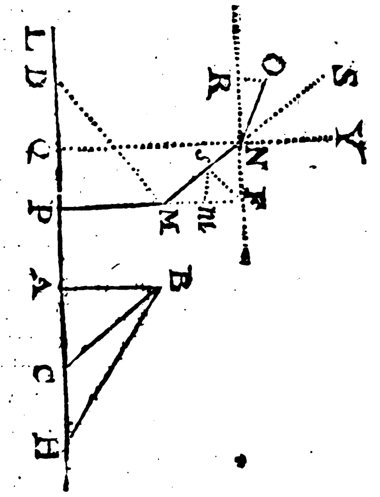


Suppose O G, G B, two infinitely small Parts in the Curve required, by whose Rotation round the Axis A Q, the Solid of least Resistance is generated. Let B M, G B be drawn at Right Angles to A Q, and draw B L parallel to A Q, and O N parallel to B M. 'Tis then plain, that $\frac{c \times BM \times GL^3}{r \times GB^2}$ is the Resistance against the Surface generated by the Rotation of the *Lineola* GB, about the Axis A Q; and that $\frac{c \times GP \times ON^3}{r \times OG^2}$ is the Resistance against that generated in like manner by O G, from Cor. 3. of the preceding Lemma. Now both these Resistances taken together, must be the least possible: Wherefore $\frac{c \times BM \times GL}{r \times GB^2} + \frac{c \times GP \times ON^3}{r \times OG^2} =$ 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 ON = GL) the Point G is to be Investigated, where this will happen. And supposing *O* and *B* fixed Points, this will easily be found by the Method *de Maximis & Minimis*. And producing the *Calculus*, it will come at last to stand thus; $\frac{BM \times BL}{BG^4} = \frac{GP \times NG}{OG^2}$. Wherefore 'tis plain, that $\frac{BM \times BL}{BG^4}$ is an invariable Quantity. So that if the Abscissa *A M*, be called x, and the Ordinate B M $= y$, then B L will be $= \dot{x}$ and G L $= \dot{y}$ (which in this whole *Calculus*, I suppose *invariable*) whereof B G$^2 = \dot{x}\dot{x} \times \dot{y}\dot{y}$. Wherefore $\frac{y\dot{x}}{\dot{x}\dot{x} \times \dot{y}\dot{y}^2}$ will be an invariable Quantity. Let then a be an invariable Line, and then, according to the Laws of Homogeneals, it will be $\frac{y\dot{x}}{\dot{x}\dot{x} \times \dot{y}\dot{y}^2} = \frac{a}{y}$ 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. Philos. Mathem. l.* 2. *Sect.* 7. gives us, in Prop. 35. and Schol. of Lib. 2. the Property of a *Curve*, as D M; which being supposed to revolve about its Axis *A L*, shall generate a *Solid*, whose Resistance, 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 A L, 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 following Solution.





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 constitutes the Curve required: Draw MP, NQ Ordinates to the Axis AL, and draw RNF Parallel to the same 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 towards L (and with the same Velocity.) On the said Lines MN, MF, being quiescent, draw FS perpendicular 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 Force 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 :: $\overline{DM}^2 : \overline{DP}^2 :: \overline{MN}^2 : \overline{FM}^2$. 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 found thus: If FN represent the Force of the Particle against QNv in the Direction from A towards L, then FS will represent the Force of the same Particle against MNs 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 FNq is 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 $a \times MF \times MP$, whence to find (from A towards Q) the Force of the Fluid on the Surface MN; say, $\overline{MN}^2 : \overline{FM}^2 :: a \times MF \times MP : \frac{a \times \overline{MF}^2 \times MP}{\overline{MN}^2} =$ to the Force (in the Direction of AL from A towards L) of the Fluid on the Oblique Surface described by the Rotation of MN about the Axis AL; or, which is the same thing, the Quantity $\frac{a \times \overline{MF}^2 \times MP}{\overline{MN}^2}$, expressing the Resistance which 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 $\frac{a \times \overline{OR}^2 \times NQ}{\overline{NO}^2}$.

Now if we suppose the Points MO, and the right Line RF, to be given by Position, and that they are in the same Plane with the Axis AL; it remains only to determine the Point N in the Line RF, so that the Surface generated by the right Lines MN, NO revolving about the Axis AL shall suffer the least Resistance.

Let the invariable Quantities MF be $=m$, MP$=r$, OR$=n$, NQ$=q$; and the variable Quantities FN$=v$, and NR$=z$; then $\overline{MN}^2 = mm + vv$, and $\overline{NO}^2 = nn \times zz$; therefore the Resistance which the Surface described by the Line MN meets with, *viz.* $\frac{a \times \overline{MF}^2 \times MP}{\overline{MN}^2}$ is $= \frac{a + m^2 \times r}{mm + vv}$, and that which the Surface described by NO (revolving about the Axis AL) *viz.*

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viz. $\frac{a\times\overline{OR}^3\times NQ}{\overline{NO}^2}$ is $=\frac{a\times n^3\times q}{nn+zz}$, whence it is evident (from the Nature of the Question) that the Quantity $\frac{a\times m^3\times r}{mm+vv}+\frac{a\times n^3\times q}{nn+zz}$ ought to be a *minimum*, and (*Art.* 198.) consequently the Fluxions thereof must be $=0$. Whence $\frac{2m^3r\times v\dot v}{\overline{mm+vv}^2}=\frac{-2n^3q\times z\dot z}{\overline{nn+zz}^2}$. Now because $vz+$ is $=$ R F an Invariable Quantity, therefore $\dot v=-\dot z$, and consequently $\frac{m^3\times r\times v}{\overline{mm+vv}^2}=\frac{n^3\times q\times z}{\overline{nn+zz}^2}$. 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, N O, it will be $4\overline{AB}^2\times AC:\overline{BC}^3::BC:MP$; and in like manner $4\overline{AB}^2\times AH:\overline{BH}^3::BH:NQ$; for because the Triangles M F N, B A C are Similar, therefore $AC=\frac{au}{m}$, and $BC=\frac{a\times\overline{mm+vv}|^{\frac12}}{m}$, whence

$$4AB^2\times AC\left(\frac{4a^3v}{m}\right):\overline{BC}^3\left(\frac{a^3\times\overline{mm+vv}^{\frac32}}{m^3}\right)::BC\left(\frac{a\times\overline{mm+vv}^{\frac12}}{m}\right):MP\,(r)$$

and consequently $\frac{rm^3v}{\overline{mm+vv}^2}=\frac14 a$. In like manner, because the Triangles O R N, B A H, are Similar, $AH=\frac{az}{n}$, and $BH=\frac{a\times\overline{nn+zz}^{\frac12}}{n}$. Whence

$$4AB^2\times AH\left(\frac{4a^3z}{n}\right):BH^3\left(\frac{a^3\times\overline{n^2+z^2}^{\frac32}}{n^3}\right)::\overline{BH}\left(\frac{a\times\overline{nn+zz}^{\frac12}}{n}\right):NQ=q.$$

Whence $\frac{qn^3z}{\overline{nn+zz}^2}=\frac14 a$; and consequently, $\frac{m^3\times r\times v}{\overline{mm+vv}^2}=\frac{n^3\times q\times z}{\overline{nn+zz}^2}$. Which is the very same Equation that we first found.

Whence 'tis manifest; that the Nature of the Curve M D (which being revolved about its Axis A L, generates the Solid of least Resistance) is such, 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 $4\overline{AB}^2\times AC:\overline{BC}^3::BC:MP$ the Ordinate passing thro' the Point M, which is the Property of the Curve that generates the Solid of least Resistance, discover'd by Sir *Isaac Newton*.

And having thus discovered the Property of the Curve M D, *it may be Constructed by help of the Logarithmetical Line in this manner:*

In the Perpendicular A K assume A B $=a$, and in the Axis A L produc'd, take A E $=\sqrt{\frac14 aa}$, and through the Point E describe the Logarithmetical Line E N, and let A K be the Assymptote, and $\frac14 a$ the Sub-tangent; then take A C at pleasure, 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 $=\frac{aa}{4z}+\frac{z}{2}+\frac{z^3}{4aa}$, and $AP=\frac{zz}{4a}+\frac{3z^4}{16a^3}-\frac{Sa}{48}+CN$ (*viz.* $+$ C N when A C > A E and $-$ C N when A C < A E) and compleat the Parallelogram P K, I say, the Angle M, or the Point wherein K M intersects P M will be in the Curve requir'd.

For A C being $=z$, if A P $=x$, and P M $=y$, then by the Property of the Curve A K or P M $=y$ is $=\frac{a^4+2aazz+z^4}{4aaz}$, and consequently, $\dot y=\frac12\dot z+\frac{3zz\dot z}{4aa}-\frac{aa\dot z}{4zz}$, and because B C is parallel to the Tangent in M, therefore the Triangle A B C is Similar to the little Triangle at M, and consequently $a:z::\dot y:\frac{z\dot y}{a}=\dot x=\frac{z\dot z}{2a}-\frac{3z^3\dot z}{4a^3}-\frac{a\dot z}{4z}$, and the flowing Quantity or A P (x) is $=\frac{zz}{4a}+\frac{3z}{16a^3}-S\frac{a\dot z}{4z}$, but by the Property of the Logarithmetical Line $z:\frac14 a::\dot z\,(Rn):\frac{a\dot z}{4z}=$ R N, whence $S\frac{a\dot z}{4z}=$ C N, therefore A P (x) is $=\frac{zz}{4a}+\frac{3z4}{16a^3}-$ C N $+$ an Invariable Quantity $\frac{Sa}{48}$, and consequently, when C N 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. I.

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, consists 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 be 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 Interposition 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

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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 ſenſible Vibration of the ſonorous Body; but by inſenſible Vibrations of the little Parts, always helped, and ſometimes occaſioned 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 *Acute*, flows from the greater or leſſer Spring of each Part, and from the more or leſs quickneſs 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 *Weakneſs* of Sound, that renders it *flat* or *ſharp*: *ſtrong Sound* ariſes from *great Vibrations* in the Air, 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 greater or leſſer *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*, N° 313. hath obliged the World with ſome very curious and careful Obſervations and Experiments about the Motion of Sound; being furniſhed with very good 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 *Iſ. Newton*, in *Princip. Lib.* 2. *Prop.* 50. allows but 968 Feet for the Progreſs of Sound in a Second of Time.

The Hon. Mr. *Fr. Roberts*, *Phil. Tranſ.* N° 207. 1300 Feet.

Mr. *Boyle*, in his *Eſſay* on *Languid* and *Unheeded Motion*, 1200 Feet.

Dr. *Walker*, in *Phil. Tranſ.* N° 247. 1338 Feet.

Merſennus in *Baliſtic. Prop.* 39. 1474 Feet.

Flamſtead and *Halley*, 1142 Feet.

The *Florentine Academy*, 1148 Feet.

The *French Obſerv. Hiſt. Acad. Regiæ*, 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 ſuch 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. And, (3.) From there being no regard had to the *Winds*, of which more below. And he judges, that the little difference there is between the three laſt Numbers of 1142, 1148, and 1172, ariſes 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 *ſooner*, than when its *Muzzle* is *from* the Obſerver?
3. Whether Sounds move in the ſame Time, the ſame Spaces, in all States of the Atmoſphere, and Heights of the Barometer?
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 ſtill, then in windy and turbulent Weather?
7. Whether a ſtrong tranſverſe Wind accelerates or retards the Motion of Sound?
8. Whether Sounds have the ſame 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 ſame Velocity?
11. Whether the Sound of a Gun move equally ſwift at all the Elevations of the Gun?
12. Whether different Strengths of Gun-powder change the Motion of the Sound of the Report?
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* Poſition?
15. Whether all kinds of Sounds, as of Guns, Bells, Beetles, &c. have the ſame Velocity?
16. Whether Sounds be ſwifteſt in the beginning 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 ſwift 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. *Derham* was at the trouble of getting, and had the advantage of hearing and ſeeing from the Tower of his Pariſh-Church at *Upminſter* in *Eſſex*, 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 tho' 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 ſort 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, he got leave to have two *Sakers* (ſee that word in Vol.

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Vol. 1.) to be placed one by another on the Heath, but with their Muzzles quite contrary ways; and on the 15th of *Feb.* 170½ to be discharged continually every half Hour, from 6 in the Evening, till 12 at Night: There was a small Gale of Wind blowing directly against the Sound.

The Interval between the Flash and the Report of each Gun, he always found to be about 120, or 122 half Seconds of Time. He mentions both these Numbers, because the Sound of the Report always came double; the first within 120 half Seconds; the second (which he takes to be an Echo from the Wind-Mill, or adjacent Houses on *Black-Heath*) within 122.

He observed no difference in the Time of the Sound's Progress, when the *Saker* was fired *towards* him, or from him, which answers his second Question.

Nor did he find that any *different Elevation* of the several Muskets made any alteration in the Motion of the Sound; which is an Answer to his 11th *Problem*. And to solve the 12th Query, he found that different *Quantities* or *Strengths* of Powder, made no alteration in the *Velocity* of the Sound's Motion; tho' it manifestly did so in the *Strength* of the Noise. Nor did he find that there was any Variety in the Time of the Motion of the Sound, either by Night or Day; whether it were clear or cloudy; whether it rained or snowed, whether the Barometer were high or low, and whether it were Summer or Winter; which solves his 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.

And the same he found, as to intense or strong, and languid or weak Sounds; which answers his 10th Question.

By repeated and very accurate Observations, he also found the Motion and Time of the Progression of Sound to be in all respects *equable*; which solves the 17th Problem: that is, that *Sound* moves just an *English* Mile in 9¼, or 9, 25 half Seconds; two Miles in 18½, three Miles in 27¾, &c. and so on uniformly.

As to his last, or 19th Question, he is confirmed, that Sound moves the nearest way, and that it doth not creep along the Earth's curved Surface: And he believes (in answer to the 14th Query) that the Velocity of the Sound is the same in *Acclivites* and *Declivites*; tho' he hath not had opportunity of making Experiments *enough* to determine 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 the Motion of Sounds; which is an Answer to his 18th Question.

He found that very thick cloudy and snowy Weather, did always lessen and dull the Noise made by the Discharge of Guns, &c. whereas in frosty and clear Weather, they were much more audible, clear, and distinct, than at any other times.

By many repeated and accurately made Experiments, he discovered, that contrary Winds do always retard the Motion of Sounds, and that in proportion to their Strength; which is what the *Florentine Virtuosi*, and many others have formerly been entirely mistaken in; asserting, that Contrariety of Winds occasion no Retardation of the Motion of Sound.

By Observations and Experiments, made with proper Instruments, about the Velocity of the Motion of Wind, he concludes, that in the greatest and most rapid Storms that ever blew, the Wind moves not above 60 Miles an Hour, and perhaps not above 50; whereas Sounds may go above 700 Miles in the same time: and consequently they cannot be the same Particles of the Air or Atmosphere, which carry both; at least they can't be moved after the same manner. He concludes, as abovesaid, that the Velocity of Sound is such, that it ordinarily moves 5280 Feet, or an *English* Mile, in 9¼ half Seconds: And that it moves 571 in a half, and 1142 Feet in a whole Second of Time. But that the Winds may so affect it, by conspiring with its Motion, as to carry it 600 Feet in half a Second; or, by being contrary to it, to retard it so, that it may not move more than 560 Feet in a half Second of Time.

He concludes with shewing the Uses that may be made of this Knowledge of the Velocity of the Motion of Sound, in measuring the Distances of Ships at Sea from one another, or of a Ship from Shore; of Forts and Batteries one from another, or of any Places at Land within the hearing of the Report of a Gun; of the Distances of Thunder, Clouds, &c.

In *Philosophical Transactions*, N°. 156, you have an Account of the Doctrine of Sounds, by *Narcissus* Bishop of *Ferns* and *Leighlin*; and in N°. 247, of the Swiftness of Sounds, and their Reflections by Echoes.

In the History of the Royal *French* Academy for *A.D.* 1700, they say it hath been experienced, that a Sound moves 180 of their Toises in a Second, or 283 middle *French* Leagues in an Hour. (1.) Therefore they conclude, that the Air must be moved or struck at first with a very great Smartness or Swiftness. (2.) All Conjectures and Physical Reasons persuade us, that this Motion or Stroke on the Air, must be impressed by very brisk Vibrations of the small Parts of the sonorous Body, in order that they may exert their Spring or elastick Force (3.) In *Philosophical Transactions*, N°. 297, you have an account of some Experiments of Mr. *Hawksbee*'s, whereby it appears plainly, that as exhausting the common Air out of a Receiver, doth very much lessen the Noise made by the Bell there hung and struck, so crouding or conveying more Air into a Vessel, made on purpose for such Condensations of Air, did very sensibly augment the Sound of the included Bell.

SOVERAIGN, was a Piece of Gold Coin, Currrent at 22 Shillings and Sixpence, in 1 *H.* 8. when, by Indenture of the Mint, a Pound Weight of Gold of the old Standard was to be coined 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 at 24 Shillings a-piece, and in 6 *E.* 6. at 30 Shillings; and also in 2 *Eliz.*

SOWNE, is a Term of Art used in the *Exchequer*, and seems a Corruption from the *French Souvenu*, i. e. *remembred:* For the Stat. 4 *H.* 5. *c.* 7. in the Original *French*, hath *Des Estreats oriens Souvenu*. And such Estreats and Casualties as are not to be remembred, run not in Demand, *i. e.* are not leviable. So now in the *Exchequer* they say, such Estreats as the Sheriff by his Industry cannot get, are *Estreats that Sowne not*; and *Estreats that Sowne*, are such as he may gather.

SPHERE,

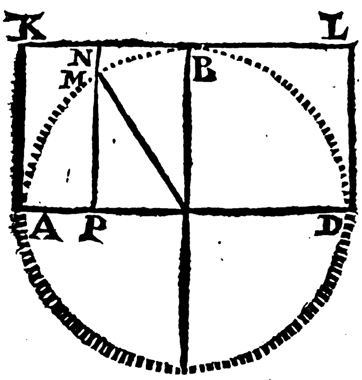
SPHERE: 1. The Surface of a Sphere is equal to the Periphery of a great Circle, multiplied by its Diameter; *Hayes*, p. 73.

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 Proportion. $2r . x :: 2rc . cx.$

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 the Angle of Inclination of the Planes of those 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 corresponding Sphere.

4. The Convex Area of a Cylinder Circumscribing a Sphere of the same Diameter with its own Altitude (which in this Notation will be $2rc$) is Quadruple of the Area of the Base; and consequently $=$ 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 Circles.



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 assigned, and thro' it P N be drawn Normal to A D; I say, the Surface or Ring described by K N, will be equal to the Segment described by the Ark A M. For the Ring described by K N, will be to the whole Cylindrick Surface 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.* N°. 26[illegible]. *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 *Du Fresne* recite, without interpreting it. But it seems to be taken from the *Saxon*, *Sparrau*, which signifies to *shut 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; such as those of his Visitations, Institutions, Ordinations, &c.

SPIRAL *Line*. See on this Subject further, *Stephano de Angelis de Infinitis Spiralibus inversis*, &c. *Petavii*.

Il. Bullialdi Demonstrationes Novæ de Spiralibus.

SPLEEN. The Vessel which in Beasts they call the *Milt*, is situated in the left *Hypochondrium*, under the *Diaphragm*, between the Ribs and the Stomach, above the left Kidney; it is tied to the *Peritonæum*, to the Diaphragm, and to the *Omentum*. 'Tis of a blueish or leaden Colour, of an oblong Figure, thick at the edges, and not thin as the *Liver*: It hath two Membranes, the External comes from the *Peritonæum*; 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 seem to be, but they come from innumerable Points, as *Radii* from so many Centres; and the Fibres of one Point are regularly woven with the Fibres of the Points surrounding it. It receives Veins, Nerves and Arteries from those that enter the Spleen.

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 inserted 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 *Cœliaca*, whose Capillary Branches make frequent Inosculations upon the Membranes of the Cells. Its 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 considerable, from the *Plexus Splenicus*, are equally distributed thro' the whole Substance of the Spleen, being all included in a *common Capsula*. There are likewise a few Lymphatick Vessels which arise from the Spleen, and discharge themselves into the *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 considering that the most of the Blood in the Liver comes immediately from the Spleen and *Omentum*, they think that one furnishes the Oleaginous, the other the Spirituous part of the Bile.

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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 *Nebulæ* or Clouds; in some others *Faculæ* 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 Motion. 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.* in the middle between the Nodes, both Plains passing thro' the Centre of the Sun, that is, about the beginning of *March* and *September*. Whence he 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 side the Sun's Equator towards the Poles, in which these *Maculæ*, *Nebulæ* and *Faculæ*, do appear most. Whereas, without these Limits, or 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, the strength of the Army, and as occasion serves. Usually a Squadron consists of 3 Troops, each of 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 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.

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 distance 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 *hollow 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*, *Back-bear*, and *Bloody-hand*. This *Stable-stand* is, when a Man is in *Stabili Statione*, at his *Standing* in the Forest with a *Cross-bow*, or *Long-bow*, ready to shoot at a *Deer*; or else when he is *standing* close up by a Tree, &c. with Grey-hounds in a Leash ready to slip.

STAKE, is the Name of a small *Anvil* used by Smiths; sometimes 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 said Stalls. In *Scotland* they call it *Stallenge*; the *Romans* called it *Siliquaticum* from *Siliqua*, which was their first and least Weight, a kind of *Caract* 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 *Tin*.

STANDARD for *Gold-Coin* in *England*, is 22 Caracts of fine Gold, and 2 Caracts of Copper; and the *French* and *Spanish* Gold are nearly of the same Standard. See *Caract*.

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 such Silver is called *Sterling*. When either Gold or Silver is finer than 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 *assay* it; that is, weigh it very exactly, and then melt it in a Crucible with a strong Fire, so long

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till the Copper, or other *Allay* mixed with it, be burnt away. When cold, they weigh it again accurately; and if it hath lost nothing of the first Weight, they call it *fine Gold*; if it hath lost $\frac{1}{24}$ part of its Weight, they call it Gold of 24 Caracts, or one Caract better than Standard; if it have lost $\frac{2}{24}$ parts, then 'tis 22 Caracts fine, or Standard; if it hath lost $\frac{3}{24}$ parts, 'tis called 21 Caracts fine, or 1 Caract *worse* than Standard, &c. And so they assay Silver, only they compute its 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 Laws about, and Liberties granted to the *Stannary Courts* in several Acts of Parliament; as in the time of *Edw.* 1. and afterwards, as abridg'd by *Edw.* 3. and in 17 *Car.* 1. *c.* 15.

STAPLE, signifies this or that Town, City or Place where the Merchants of *England* were, by Act of Parliament, to carry their Wool, Cloth, Lead and Tin, &c. and such like *Staple* or *Standing* Commodities of this Land, in order to their being sold by the Great. These Places you will find in several Statutes, appointed and altered by the Kings of *England*, from the second Year of *Edw.* 3. to the fifth of *Edw.* 6. and what Officers these *Staples* had belonging to them, you may see 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' some will allow only the first five.

STAR. All Deeds, Obligations, Contracts, Releases, &c. of the *Jews*, were antiently called *Stars*, from the *Hebrew Shetar*, a Deed or Contract. These were sometimes written in *Hebrew* and *Latin*, 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, ordered by several Statutes, that the Chancellor, assisted by others there named, (*vid.* 3 *H.* 7. *c.* 1. and 21 *H.* 8. *c.* 2.) should have Power to punish *Routs*, *Riots*, *Forgeries*, *Embraceries*, *Perjuries*, and such other Misdemeanors, as were not sufficiently provided for by the Common-Law; and for which the inferior Judges are not so proper to give Correction. But this Court, by 17 *Car.* 1. *c.* 10. was entirely dissolved and determined, and so continues 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.

STELLIONATE, in the Civil Law, is all kind of Cozenage, and Knavish Practice in Bargaining; and all sorts 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 it signifies that Coin or Money, which for Metal and Value, was to be a common Standard of all Current Money. And this is the more probable, because such Money, at the coming in of the *Normans*, was called *Sterilensis*. As *Orderic. Vital. sub Anno* 1082. *Porrigam quindecem Sterilensium*, Dr. *Kennet's Glossary*. *Esterling* in *Stow* is used for a Penny-weight, signifying a Penny of fine Silver, such as we now call *Standard*. But the word *Sterling*, as being a Piece of Money, generally, if not always, signifies a *Penny*. And as for a good while together there was no other Coin but Pennys; and that *Denarius* signifies, in many Authors, the same as *Nummus*; all good *Standard* Silver 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 bottom to the top in any Wainscot, are by the Workmen called *Stiles*.

STILOBATUM, is, in Architecture, the Body of the Pedestal of any Column.

STIPULATION, in the Civil Law, is a Contract made by Words, and not in Writing, by asking a Question, and receiving presently a proper Answer: And in this Contract the Obligation is only upon one side, *i. e.* on the side of the *Promiser*, who was called *Reus Debendi*, or *Promittendi*; as the *Stipulator*, or *Creditor*, to whom the Promise is made, was called *Reus Credendi*, or *Stipulandi*. This was the old Sense, but now with us the Word *Stipulation* is commonly used for the Act of the Person obliged; and some say that the Word *Stipulator* is common both to Debtor and Creditor.

STOMACH, see *Ventriculus*. Monsieur *Chirac*, Professor of Medicine at *Montpellier*, hath by an easy Experiment shewn, that the Force of the Stomach alone (in Vomiting) without taking into consideration 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 six *Felloes*, which serve for the Round of the Wheel of a Gun-carriage, 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.

STRIÆ, are the Lists or Rays which run between the *Flutes*, *Channels* or *Striges*, in Fluted Pillars. These are 20 in the Dorick, and 24 in the Ionick Order.

STRIGES, in Architecture, are the hollow Channels in the Shaft of a Column, called by our Workmen *Flutings* and *Grooves*. They more properly belong to the Ionick Order, tho' they are found sometimes in the Dorick, and often in the Corinthian and Composite. They are generally at right Angles with the Plane of the Base, but are sometimes found winding about the Pillar. Sometimes the *Striges* are filled up with a swelling a third part from the Base, lying in the hollow like a Stick shot of a round form: These Mr. *Evelyn* thinks 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 that *Brace*, which is framed into the *King-Piece* and the *principal Rafters*.

STUDDING-SAILS, in a Ship, are Bolts of Canvas, or any Cloth that will hold Wind, extended in a fair Gale of Wind along the side of the Main-sail, and boomed out with a Boom; they are sometimes also used to the Clew of the Main-sail, Fore-sail and Sprit-sail, when the Ship goes either before the Wind, or Quartering.

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STYLO-*Chondrohyoideus*, vel *Stylo-Hyoides alter*, is a Muscle of the *Os Hyoides*, which arises fleshy and tendinous from the *Styloid Process*, near the Origin of the *Stylo Pharyngeus*, and runs under the *Cerato-Glossus*. It is inserted into the Cartilaginous Appendix of the *Os Hyoides*; and its Use is to assist the *Stylo-Hyoideus*, in putting the *Os Hyoides* upwards and laterally. Dr. *Douglass*.

STYLO-*Hyoideus*, is a Muscle of the *Os Hyoides*, arising by a round Tendon from near the middle of the *Processus Styliformis*, and is inserted tendinous into the Basis of the *Os Hyoides*, near its *Cornu*; to which also it often adheres fleshy. Its Use is to put the Bone of the Tongue on one side, and a little upwards, when both act in Concert.

SUBNORMAL; is a Line, determining in any Curve, the Intersection of the Perpendicular to the Tangent in the Point of Contact, with the Axis. And this Subnormal, in the common or *Apollonian* Parabola, is a determinate invariable Quantity; for 'tis always equal to half the *Parameter* of the *Axis*.

SUBROGATION, in the Civil Law, is putting another Person into the Place and Right of him, that, in any Case, is the proper *Creditor*. This is also called *Cession*.

SUBSTITUTION, is, in Algebra or Fluxions, the putting in the room of any Quantity in an Equation, some other Quantity which is really *equal* to it, but express'd after another manner; and this is done, in order to find, at least, such a proper Expression in the Equation, as shall solve the Problem, or Question proposed. And in the Knack of doing this readily, consists the chiefest Business of the Operations in Fluxions.

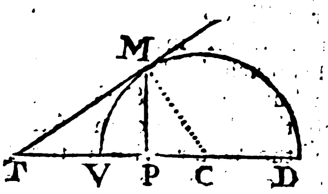
SUB-TANGENT, in any Curve, is the Line which determines the Intersection of the Tangent in the Axis. And in any Equation if the value of the Sub-tangent come out *Positive*, 'tis a sign that the Point of Intersection of the Tangent and Axis, falls on that side of the Ordinate where the Vertex of the Curve lies; as in the *Parabola* and *Paraboloids*. But if it come out *Negative*, the Point of Intersection will fall on the contrary side of the Ordinate, in respect to the Vertex or beginning of the Abscissa; as in the *Hyperbola*, and *Hyperboliform Figures*.

And universally, in all *Paraboliform* and *Hyperboliform Figures*, the *Sub-tangent is equal to the Exponent of the Power of the Ordinate multiplied into the Abscissa*.

Thus, in the common Parabola, whose Property is $px = yy$, the Sub-tangent is in length equal to x the Abscissa multiplied by 2, the Exponent of the Power of yy, the Square of the Ordinate; that is, 'tis equal to twice the Abscissa: and by the former Rule for Paraboliform Figures, it must be taken above the Ordinate in the Axis produced. Thus also in one of the cubical Paraboloids, where $pxx = yyy$, the length of the Sub-tangent will be $\frac{2}{3}$ of the Abscissa.

Thus, in the Figure annexed, you will see that the

SUB-TANGENT, in any Curve, is a Line which determines the Intersection of the Tangent



in the Axis. Thus, if T M be a Tangent in the Point M, and P M an Ordinate to the Axis, the T P is the Sub-tangent, because it determines the Point T, where the Tangent cuts the Axis produced beyond the Vertex of the Curve V. And the Line P C, which determines the Intersection of the Perpendicular *M C* (to the Tangent in the Point of Contact M) in the Axis V D, is called the *Subnormal*.

SUBURBICARIÆ *Regiones*, called also *Suburbanæ*, *Urbicariæ vicinæ*; were such Regions or Cities of the Roman Empire, as lay within an hundred Miles of *Rome*, and were under the Jurisdiction of the Præfect of that City: Wherefore they are sometimes called *Regiones Solitæ*, because in these the Governour of *Rome* was wont to exercise his solemn Jurisdiction. This also was the antient Extent of the Power and Charge of the Bishops of *Rome*, before the Papal Usurpation.

SUCTION; there are many Effects vulgarly attributed to *Suction*, which, in reality, have very different Causes. As when any one *sucks* Water, or any other Liquor up thro' a Pipe, 'tis commonly thought, that by that Action the Person *draws* the Air up into his Mouth, and that the Water, which is contiguous to it, follows it by a kind of *Attraction*, as if the Air and Water hung together: And others fancy that the Air moves into the Mouth of the *Sucker*, and the Water moves up after the Air, to prevent a *Vacuum*, which they say, *Nature abhors*. Whereas the true Cause of this Phænomenon, is only that the Air and Atmosphere presses with its whole weight, uniformly on the Surface of the Liquor in the Vessel, and consequently prevents any one part of the Water to rise 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 Pipe to the same height as without, and indeed a little higher, because the Pressure of the Air within the Pipe is a little taken off by bearing against the sides of the Pipe. Now when any one applies his Mouth to the upper end of the Pipe and sucks, his Lips so strongly enclose the Pipe, that no Air can get between them and it; and by the voluntary Motion of the Spirits in the Muscles, the Cavity of his *Thorax*, or Breast, is opened and enlarged; by which means the Air included there, hath now a much larger Space to dilate itself in, and consequently cannot press so strongly against the upper end of the Pipe, as it did before the Cavity of the *Thorax* was so enlarged, and when the Weight of the whole Atmosphere kept its Spring bent. And that Weight or Pressure being now taken off by the Lips of the Man that sucks, the Æquilibrium is destroyed, the Air gravitates on the Surface of the Water, but cannot do so on the upper Orifice of the Pipe, because the Juncture of the Lips takes it off; and the Spring of the Air included in the Thorax, being weakened

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by the Dilatation of its Cavity, it cannot press so hard against the upper Orifice of the Pipe, as the Water will do against the lower, and consequently the Water must be forced up into the Pipe. 'Tis much the same thing in the Suction of a common Pump: The Sucker being tight, takes off entirely the Pressure of the Atmosphere on the Surface of the Water within the Barrel of the Pump; and consequently the Atmosphere by its weight must force the Water up to make the Æquilibrium. See *Hydrostaticks.*

SUFFRAGAN; is a titular Bishop appointed to aid and assist 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 *Is. 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 that they will both sublime together; for by dissolving Flowers of Sulphur in Oil of Turpentine, and then distilling the Dissolution, 'tis found, that Sulphur consists of a thick, volatile and inflammable Oil, or of a *fat Bitumen*, an *acid Salt*, and a very fixed Earth, with a little Metal. The three first of which are found there in nearly an equal Quantity; but there is only a very small Proportion of the last. The *acid Salt* being dissolved in Water, is the same with the *Oleum Sulphuris per Campanam.*

SUMMATORY *Calculus*, according to some, is the same with the *Calculus Differentialis* of *Leibnitz:* but more properly *Summatory Arithmetick*, is the Art of finding the flowing Quantity, 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, renders truly and compleatly happy. The Schools distinguish this chief Good of Man, into that which is simply and adequately so, and beyond which there can be no other; and into a lesser and subordinate one, which is in some measure attainable in this imperfect State; and this last they call *Fœlicitas Viatorum*, and the former *Fœlicitas Comprehensorum.*

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 about our Earth; yet in comparison of the vast Diameter of the Solar Body, becomes wholly invisible to us, tho' assisted by the best Telescopes: He supposes it also to look as bright as the Body of the Sun it self, and that it is really the Shell of this Atmosphere, and not the very Body of the Sun that shines. And from hence he saith, that all the Phænomena of the *Maculæ* and *Faculæ* of the Sun will be solved; and that they are only Clouds or Smoaks in this Atmosphere.

The Sun it self, within this Atmosphere, he concludes to be a Solid and Opacous Body, (*p.* 91.) from these Reasons. (1.) The Constancy of its Rotation. (2.) The Fixedness of its Axis. (3.) The Power of its Gravitation or Attraction towards its Centre. These prove its Solidity; and its Opacity, he concludes, from the disappearing of the Solar Spots in the Limb, and their not returning backwards, as they would seem to do if the Body were transparent as the Atmosphere is, or the Flame of a Candle, or the Radiation or hazy Light about the *Nucleus* of a Comet, thro' which, as well as thro' its Beard, the small fixed Stars may be seen.

He thinks the superficial Parts of the Sun, to consist of Bodies similar 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 he*) 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, supposing we had Observations Astronomical of 4000 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 it is now; yet could it not be thence concluded, that the Sun did not lose a Mile in Diameter every Year, and consequently be now 4000 Miles less in Diameter than it was then. For since his Diameter is near 87 times greater than that of the Earth; which latter he supposes 8000 Miles, then the Sun's must be 696000 Miles. Now 4000 is but a 174th part of that Diameter, and consequently would have diminished it but $\frac{1}{6}$ 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 approached as much nearer us as that Diminution amounts to; and for which, *he saith*, 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 conserved 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 Systems) much after the manner as Iron, when heated to such a degree as to be just going into Fusion by the vibrating Motion of its Parts, emits with Force and Violence, copious Streams of Liquid Fire all around: Great Bodies must preserve their Heat longest; and that, perhaps, in the Proportion of their Diameters.

Sir *Is. Newton* hath made it probable, that the great Comet in the Year 1680, in its *Perihelion*, went so near the Sun, as that it acquired a Heat 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 Matter, like the Planets, but heated to a very intense degree, they may be many Millions of Years without losing any considerable part of their Heat.

Accord

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According to *Cassini*, the Sun's distance from the Earth is 172,800,000 Miles *English*.

The Phænomena 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 these:

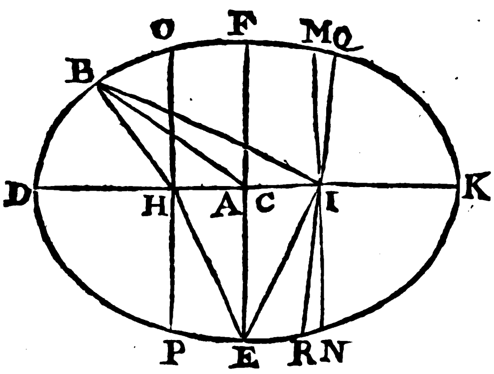
1. *That the Centre of the Sun's Body moves annually in the same Plane of the Ecliptick, and never deviates from the Line so called.*

Which apparent Motion of the Sun doth in reality 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; since here none of those *disturbing Forces* have any Place, which render the Motion of the Moon so irregular. Of which 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, he 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 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 F D E K 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; K D its great Axis, or the *Linea Apsidum*; and D the Aphelion; and K the Perihelion of the Earth. F E is the lesser Axis, I C, or C H is the *Eccentricity*, or the distance between the Centre and the *Foci*. Let M N, or O P, be the *Latus Rectum* of the Ellipsis, and let the right Line A B bisect the Angle H B I: Now since 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 describe equal Areas in equal Times. But seeing the Line B I grows *longer* towards and at the Aphelion, 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 always be in a reciprocal Ratio of her distance from the Sun; so that if the distance between D and I be double to that between K and I, she will move twice as fast in the Perihelion as in the Aphelion.

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 Solstice, as is found by Observation. And this difference in his apparent Diameter, shews also that the Earth moves not in a Circle, but an Ellipsis round the Sun.

4. Those Places in the Ecliptick, in which these greatest Differences of the apparent Motions and Diameters of the Sun happen, in process of time are *changeable*, and do move forward (or *in consequentia*) equally. For tho' 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.

5. If you suppose the Ecliptick to be bisected in the Equinoxial Points, the Sun appears to stay 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, Q R is not much different from N M 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 process 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 Orbit, 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 same, *viz.* 23, 30.

8. The Sun's Diurnal Parallax is almost insensible, and his Menstrual Parallax is scarce 15 Minutes 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 the Distances nor Magnitudes of the Sun or Planets, can be obtained to any tolerable Certainty.

There have been three Ways made use of by Astronomers, to find the Sun's Horizontal Parallax.

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 considerable quantity: but all that we can accurately conclude from it, is, that it is not so; and consequently that the Distance of the Sun is vastly great. See Mr.

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Mr. *Whiston's Prælect. Astron.* p. 61. where there is a short account of this Method.

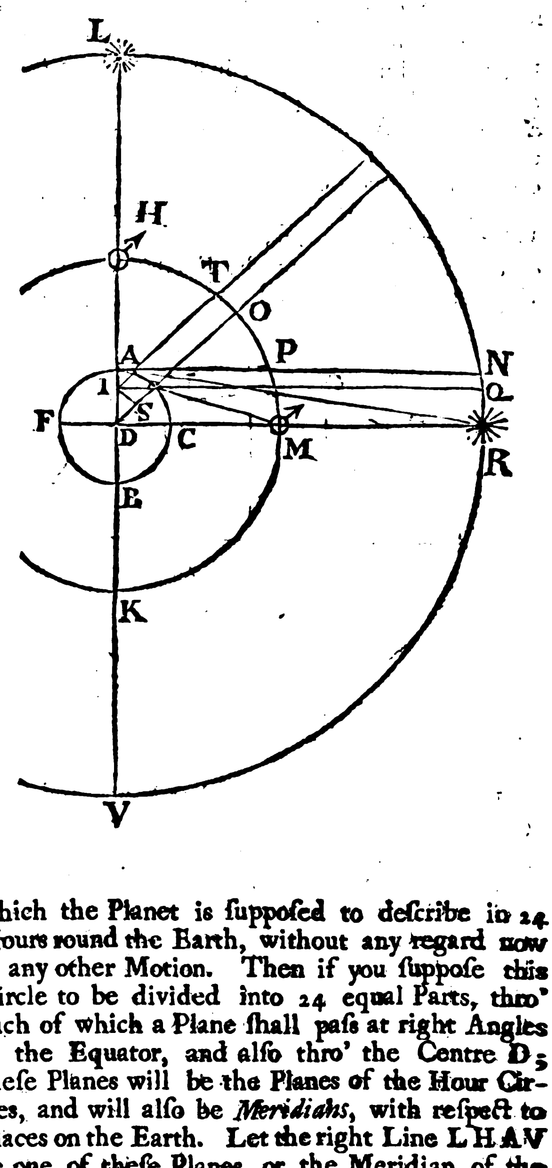
2. The second way of finding the Sun's Horizontal Parallax, is that which 'tis said *Aristarchus Samius* first used, and hath been followed by *Kepler*, *Vendeline*, and more especially by *Ricciolus*. This supposes that you have the exact Moment of the Time of the *Half-Moon*, or the *Dichotomization*, or *Bisection* of her Disk, by the Light and Shadow; and some other things, as difficult to obtain as what you seek for: And therefore I shall say no more of it, than only to refer you to Mr. *Whiston's* Book, p. 66. where you have a good account of this Method; because I must give you an account of

3. A third way of finding this Horizontal Parallax of the Sun; which tho' it be not so direct, is yet more accurate and exact than either of the former.

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 *Copernican* 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 such 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 Parallax. And the Conjunctions of *Venus* and the Sun are so 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 such times, when he is in opposition to the Sun, very conspicuous and fit for Observation, is much the most fit 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 Centre, and to a Point on its Surface, when the Planet is exactly in the Observer's Horizon; that is, you must suppose two Observers, one with his Eye at the Earth's Centre, and the other Eye at the Earth's Horizon, at the other Extremity of a Semidiameter of the Earth, whose Position is normal to that Line which connects the Earth's Centre, and that of *Mars*, the latter being accurately in the Horizon of that Observer, who is supposed at the Surface. And thus, for instance, the Moon's Parallax may be obtained by the Observations of two Astronomers at the same Minute of Time, if she be *Vertical* to one of them, and *Horizontal* to the other; because the Moon's Place to the Vertical Observer will be the same as if he had seen her from the Centre of the Earth. And this Method, with good Instruments, will do for any other Planet or fixed Star. But the Method of *Cassini* for finding the Parallax of *Mars* (*v. gr.*) hath this great Advantage in it, That it may be performed by the Observation of but one Astronomer furnished with a good Telescope and Micrometer; since the Part of the other may be supplied by means of the fixed Stars: Of which now take *Blanchinus's* Account, in the *Leipsick Acts of* October, 1685, with some few Explications and Corollaries. Let the Circle A F B C represent the Earth's Equator, H K M the Diurnal Ark of *Mars*, when he moves in the Equator; L V R, as the Equinoctial in the Heavens, extended infinitely in the Region of the fixed Stars. Let *Mars* be in A, in the Plane of the Equator; then his Diurnal Revolution will be truly represented by the Motion of the Line D H, round D as a Centre, in the Plane of the Equinoctial, so as to form the Circle H M K,



which the Planet is supposed to describe in 24 Hours round the Earth, without any regard now to any other Motion. Then if you suppose this Circle to be divided into 24 equal Parts, thro' each of which a Plane shall pass at right Angles to the Equator, and also thro' the Centre D; these Planes will be the Planes of the Hour Circles, and will also be *Meridians*, with respect to Places on the Earth. Let the right Line L H A V be one of these Planes, or the Meridian of the Place A in the Earth's Equator, where an Observer sees the Planet *Mars*, and the fixed Star L in one and the same right Line. Now if the Star and the Planet had only the same Diurnal Motion, they would be both together again at the same Place, or in the same right Line, at the end of 24 Hours;

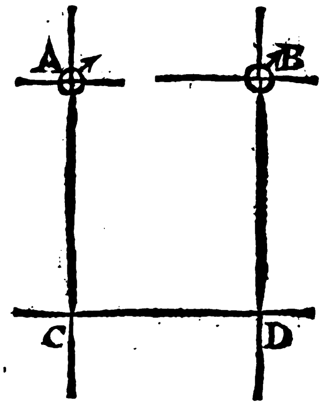
Hours; and if the Diurnal Motion be suppoſed equable, in ſix Hours the Planet and Star would be in the right Line F D M R, at right Angles with the Meridian L H D, or in the Aſtronomical Hour-Circle of 6. Wherefore an Eye placed at the Earth's Centre, would always ſee the Planet and the Star in one and 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 A H L, yet in any other Meridian, as ſuppoſe that of D R, (which, in reſpect of the Place at A, may be conſidered as the Hour-Circle of 6) *Mars* will appear to him in the Plane A M, but the fixed Star in the Plane A R. 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 A P N. 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 P M, which *Mars* by his Motion deſcribes. And the Quantity of this Ark is equal to that of the Angle P A M, 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 ſeeking. Wherefore if the Ark P M be juſt one Degree, *Mars* will appear to have paſſed the Plane A P, 4 Minutes of an Hour before the 6 Hours would be expired in his paſſing by the Meridian.

The further *Mars* moves from the Earth, the leſſer 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 *ſenſible* 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 A R D, or its Equal N A R would then come to be ſo very ſmall, as to be ſcarce ſenſible; ſo that when the Star is in the Plane D R, 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 Aſtronomer there could do, is only to aſſure us, that he had ſeen *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 ſince 'tis plain that the Star L, in 6 Hours after it hath paſſed our Meridian, will be in the Plane of the Hour Circle D R, we ſhall know the Star is actually in that Plane, by our Clock's ſhewing us, that the Time is elapſed. And becauſe, with regard to the fixed Stars (whoſe diſtance is ſo immenſe) the Plane of the *ſenſible* Hour Circle of 6 is coincident with that of the *real* one; if, when 6 Hours are paſt from the Star's tranſiting our Meridian, a Plane 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 appear 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 M A N, or AMD, which is the Parallax of the Plane ſought.

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 fine Threads,



or Hairs, interſecting one another at right Angles; and the Teleſcope furniſhed with its *Micrometer*, 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 Angles, will anſwer to the Circles of right Aſcenſion. As in the Figure annexed, where the two parallel Threads A B and C D, have 2 others, A C and B D, placed at right Angles to them, juſt as the Equator and all its Parallels do interſect 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 Motion, 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 the tranſverſe Hair A C; and the exact Difference in Time alſo between the Planets and the Star's coming thither afterwards, muſt be nicely counted, as being the Time of the Horary Parallax of *Mars*: which being turned into Parts of a Degree, as above ſhewed, is the Hori-

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Horizontal Parallax of the Planet required.

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 since 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 the most. 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, so 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 81,000,000 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, so is the Sun's Distance above found to his real or true Diameter, or about 800,000 Miles *English*.

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 such like Consequences:

1. *That it is easier to determine the annual Parallax of the fixed Stars, than the Sun's diurnal one.* For since 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 solar 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.

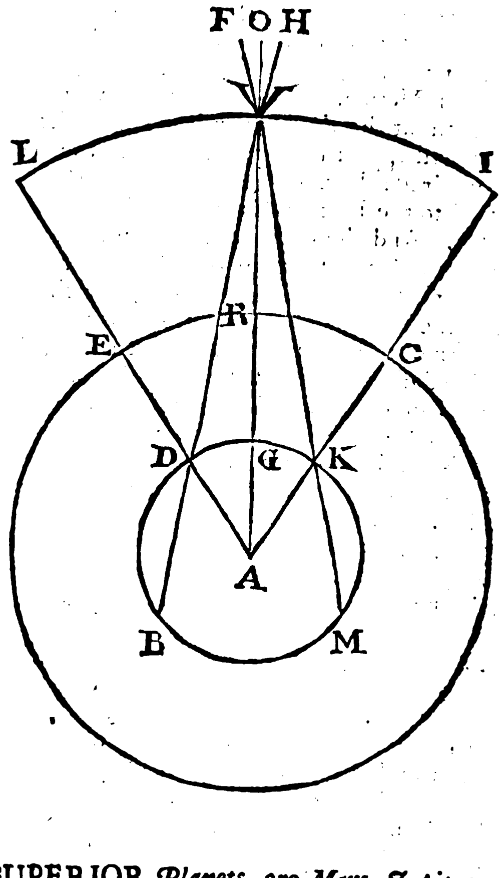
2. *In Astronomical Calculations by the Tables, this Parallax of the Sun may generally and safely be neglected.* For since it doth not arise to above a sixth part of a Minute of Time, it will be scarcely considerable; our present Astronomical Tables not being capable of bringing us to a greater Accuracy and Exactness.

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 Diameters, and the Times of their Periodical Revolution.

Mercury	is distant from the Sun, of *English* Miles	32,000,000
Venus		59,000,000
The Earth		81,000,000
Mars		123,000,000
Jupiter		424,000,000
Saturn		777,000,000

The Diameter in *English* Miles of	*Mercury*	4240
	Venus	7906
	Earth	7935
	Mars	4444
	Jupiter	81155
	Saturn	67870
	Sun	763460

			Days.	Hours.
The Time of the Periodick Revolution of	*Mercury*	is	87	23
	Venus		224	17
	Earth		365	6
	Mars		686	23
	Jupiter		4332	12
	Saturn		10759	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 regard to the Sun, and never can come between the Earth and him. The Theory of the Motions of these superior Planets, to an Eye placed on the Earth, are these:

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 our Earth, appear to move the contrary way from *East* to *West*, which was a great difficulty in the old Astronomy, but may easily be solved by the consideration of the following Diagram; in which let A be the Sun, M G B the Orbit of the Earth, in which it moves annually from M by G, towards B,

B from *West* to *East*; let the Circle QRS be the Orbit of any Superior Planet moving the same way as the Earth. Let the Circle TVX represent the Sphere of the fixed Stars supposed at an 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 Surface of our Earth, the Phænomena will be very different, and the Planets will appear sometimes 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 *CR*, a part of its Orbit round the Sun in A: The Earth, because its Angular Motion is much more swift, will describe the Ark *MG*; so also while *Jupiter* describes the Ark RE, the Earth will move from G to B. Now while the Earth is describing the Ark MK, *Jupiter* will appear to be moving *a little* forward; but whilst the Earth moves thro' the Ark KG, *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 RE. But when the Earth comes towards *B*, then the 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 *D*, the Planet will appear to be Stationary in F or H. So that 'tis obvious to see that the apparent Motion of the Planets will be very irregular and unequal, sometimes swifter, and sometimes slower, 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 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 Parallelism of their Motions at that time, as is clear from the Consideration of the Figure.

SUPERFICIES; they are frequently placed upon a Sector, 2 Lines (one on each Leg) which Mr. *Gunter* calls very properly *Lines of Superficies*. They are made by finding mean Proportionals between the two Homologous Sides, and the hundredth part of such a Side, or by a Table of Square Roots; which Roots may be taken out of the Divisions of the Lines of Lines, and they will give the proper Distances from the Centre, where the 10 (or 100) unequal Divisions must be placed.

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, and put it over from 10 to 100, at the end of the Line of Superficies. Then take the corresponding 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 100.

2. *To augment a Surface, or to diminish it in a given Ratio*, as suppose in the Ratio of 2 to 5.

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 *diminishing*.

3. *To Add together, or to Substract one from another, 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 Problem.

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, whether Ecclesiastical or Civil (or Temporal) so as no Foreign, nor other Power, shall, or ought to bear any Superiority over them. This Supremacy chiefly consists in the following Instances.

1. That the Archbishops of either Province cannot summon their Bishops 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 Governing the Church, without any Authority from the Crown.

2. In that there lies now an Appeal from the Archbishop to the Queen in *Chancery*; and on such an Appeal, a Commission under the Great Seal is to be directed to certain Persons, whereof commonly half are Lay-men, and half Clergymen; which is called the Court of *Delegates*; and which finally determines all Ecclesiastical Causes, by 25 *H.* 8. *c.* 19. tho' sometimes a Review is granted. Before this Statute, the Appeal from the Archbishop's Court lay to the People only.

3. The Queen can grant Commissions for visiting such Places as are exempt from the Jurisdiction of the Bishops and Archbishops, and Appeal lies from thence to the Queen in *Chancery*: Whereas before 25 *H.* 8. the Pope could only visit them, and receive Appeals from those Courts.

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4. Persons in Holy Orders are not, as formerly, exempt from the Queen's Temporal Laws, any 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 Sector; 'tis divided into 100 unequal Parts, and numbred with 1, 2, 3, 4, *&c.* to 10. See *Superficies.*

SWALLET, in the Lead-Mines in *Mendip*, is 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 Bishop at the Time of the annual Synod, by every Parochial Priest. For the Bishops used to hold their Diocesan Synods, and to visit all at 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 and People in the Episcopal Synod. But when they sunk in their Authority, the *Synodical Witnesses* were a sort of impanelled Jury, consisting of a Priest and two or three Laymen for every Parish. And, at last, two for every Diocess were annually chosen, till, at last, this Office came to be devolved upon the Church-wardens. Some think our Questmen, who are assistant to the Church-wardens, were called *Sides-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.

TABERDERS, or *Tabiters*, for so, by Corruption, 'tis now pronounced, are the Batchelor Scholars of the Foundation of *Queen's* in *Oxon*: They were so called from a short Gown, called *Taberd*, or *Tabert*, in those Days, reaching no lower than their Middle-leg; which these Batchelor Scholars were then obliged to wear.

TACTICKS, is the Art of disposing any Number of Men into a proper form of Battle: The *Greeks* were very skilful in this part of the Art Military; having Publick Professors of it, who were called *Tactici*, who were to teach and instruct their Youth in this Matter. *Ælian* hath a particular Book on this Subject; and there is a great deal of it in *Arrian*, in his History of *Alex. M.* and in *Mauritius* and *Leo Imperator.*

TAILLE *Douce*, a Term in Painting, signifying, as Mr. *Evelyn* in Chalcography tells us, the Art of Sculpture or Chalcography it self. In *French* it signifies *sweetly or tenderly cut*; and this, whether done with the *Burin* (or Graver) or with *Aquafortis*, which we call *Etching*. He saith, the *Italians* call it *Intaglia* or *Stamp*, without any Epithet or Adjunct; and also *Bolino*, which he takes to be the more antient and unwarrantable, as implying the use of the *Point* and *Needle*, and of *Etching* with *Aquafortis*; which is sometimes so happily performed, as scarce to be discerned from the finest Stroaks of the *Bolio*, or *Graver* it self.

TALLAGE, was formerly a certain Rate or Proportion, according to which Barons and Knights were tax'd by the King, and inferior Tenants by their Lords. And this latter *Tallage* of the Customary Tenants was sometimes fixed and certain, and sometimes at the arbitrary Pleasure of the Lord; and it was also sometimes compounded for.

TALUS *Superior*, in Fortification, is the Slope on the top of the Parapet; for the top of the Parapet is made sloping, that the Soldiers may defend the Covert-way with small Shot, which they could not do if it were level.

TANGENT; a Plane is said to be a Tangent to a Cone, when 'tis coincident with two Lines, one of which is drawn on the Surface of the Cone, and thro' its Vertex, and the other a Tangent to the Circle of the Base, meeting the former Line in the Point of Contact.

TANGENT *Line*, how the Line of Tangents and half Tangents are made, you'll find under *Scales*; and their Uses in *Projecting* and *Measuring* the Parts of *Right Circles* in Spherical Projection, you have under Spherick Projection. And the Use of the Line of artificial Tangents, in concert with the Line of Sines and Numbers, you have in Plain Trigonometry, *&c.* But there are some other Uses of the Lines of Tangents and half Tangents in *Dialling*, &c. Sometimes on the edge of *Gunter's* Sector you have a *Tangent Line*, in whose end a Pin or Gnomon, equal to Radius, is normally placed; and by that means the Sun's Altitude may be had, by holding the Sector erect, and the Pin parallel to the Horizon; for then the Shadow of the Gnomon, when turned to the Sun, will, in the Divisions of the

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the Tangent shew the Degree of the Sun's height.

This Tangent-Line is used also to draw the Hour-Lines on the Planes of Dials; and is commonly known and shewn in almost all Books of Dialling.

On the Cross-staff there are also Lines of Tangents drawn; one usually of 36 deg. 3 min. and another of 49 deg. 6 min. which, because their middle Points are at 20 and 30, are, by Mr. *Gunter*, called the Tangents of 20 and 30. These Tangents are used in taking of Angles, the Altitude of the Sun or Stars, &c. as you will find under *Cross-staff*.

Dr. *Wallis* gives an Abstract of his two Methods of drawing Tangents to Curves, in *Philosophical Transactions*, N° 81. which are taken from his *Conick Sections*, and other Parts of his Mathematical Works. And Dr. *Barrow*, in his fourth Geometrical Lection, *p.* 40. gives a general Method of determining the Tangents to all *Cycloids*, and all other Curves described, or generated after the manner of a *Cycloid*. In Lect. 9, 10. he shews how to determine Tangents to all manner of *Spiral Curves*, and to many Curves of other kinds. In *Philosophical Transactions*, N° 284. you have a Method of Tangents by Mr. *H. Ditton*, taken from the Theory of *Maxima* and *Minima*, which is very simple and universal.

TARTANE; is a small Vessel, much used in the *Mediterranean*, with but one Mast, and the three-cornered Sail, like a Galley; they fish with them on the Coasts of *Spain*.

TASSELS, in a Building, are those Pieces of Boards that lie under the Ends of the Mantle-trees.

TAXERS; are two Officers chosen in *Cambridge*, to look after the true Gage of all Weights and Measures.

TEETH: Mr. *de la Hire* observes, that the *Bone* of the Tooth doth not grow in Adult Persons, but only the *Periostium*; which is a Substance very different from the Bone every way. 'Tis composed, *he saith*, of an infinite Number of small Threads, which are fastened to the Bone by their Roots, much like the *Horns* and *Nails* of Animals; these little Threads grow as the Nails. When a part of the *Periostium* is broke, and the Bone is laid bare, the Tooth usually perishes.

TELESCOPES: (1.) Sir *Isaac Newton*, in his admirable Treatise of Opticks, *p.* 59. demonstrates, *That the Perfection of Telescopes is impeded by the different Refrangibility of the Rays of Light*; and not, as hath been vulgarly supposed, by the *Spherical Figures* of Glasses: and consequently, they will not be perfected by Glasses of the Figures of the *Conick Section*, i. e. by *Parabolick*, *Hyperbolick* Glasses, &c. For having shewed the Ratio between the less and greater Refractions of the different Rays to be very nearly as 27 to 28, *he saith*, those that are skilled in Opticks, will easily understand, that the least circular Space, into which the Object Glasses of Telescopes can collect all sorts of parallel Rays, is about the $27\frac{1}{2}$ part of half the Aperture of the Glass; or the 55th part of the whole Aperture; and that the *Focus* of the most refrangible 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 Glass, and the *Focus* of the mean refrangible ones.

And if Rays of all sorts, flowing from any one lucid Point in the Axis of any Convex *Lens*, be 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, by a Distance which is to the $27\frac{1}{2}$ part of the Distance of the *Focus* of the mean refrangible Rays from the *Lens*, as the Distance between that *Focus* and the lucid Point from whence the Rays flow, is to the Distance between the lucid Point and the *Lens* very nearly.

After this, he shews, by Experiments, made with very great accuracy, that the Rays of Light, which differ in Refrangibility, do not all converge to the same *Focus*; but if they flow from a lucid Point as far from the *Lens* on the one side, as their *Foci* are on the other, the *Focus* of the most refrangible Rays shall be nearer to the *Lens*, than that of the least refrangible, by above the 14th part of the whole Distance: And if they flow from a lucid Point so very remote from the Glass, that, before their Incidence, they may be accounted parallel; the *Focus* of the most refrangible Rays, shall be nearer to the *Lens*, than the *Focus* of the least refrangible, by a 27th or 28th part of their whole Distance from it. And the Diameter of the Circle in the middle Space between these two *Foci*, which they illuminate when they fall there on any Plane, perpendicular to 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 'tis a wonder that Telescopes do represent Objects so distinctly. But were all the Rays of Light equally refrangible, the Error arising only from the Sphericity of the Figures of Glasses, would be many hundred times less. And expresly by Calculation, *p.* 70. he proves, that the Error arising from the spherical Figure of Glasses, to that arising from the different Refrangibility of the Rays, is as 1 to 8151; and consequently is so little, as deserves not to be considered.

There is another Argument, (saith our excellent Author, *p.* 73.) which proves, that the different Refrangibility of the Rays, is the true Cause of the Imperfection of Telescopes. For the Errors of the Rays arising from the spherical Figures of the Object-Glasses, are as the Cubes of the Apertures of such Object-Glasses: And thence to make Telescopes, of various Lengths, magnify with equal Distinctness, the Apertures of the Object-Glasses, and the *Charges*, or magnifying Powers, ought to be as the Cubes of the square Roots of their Lengths; which doth not answer to Experience. But the Errors of the Rays arising from the different Refrangibility, are as the Apertures of the Object-Glasses: And thence to make Telescopes of various Lengths magnify with equal Distinctness, their *Apertures and Charges ought to be as the Square Roots of their Lengths*: And this answers to Experience, as is well known. For instance; a Telescope of 64 Feet in Length, with an Aperture of $2\frac{2}{3}$ Inches, magnifies about 120 times with as much Distinctness, as one of a Foot in Length, with $\frac{1}{3}$ of an Inch Aperture, magnifies 15 times.

By reason of this different Refrangibility, he concludes that there can scarce be any other means of improving Telescopes by Refractions alone, besides that of *increasing their Lengths*; for which end the late Contrivance of *Hugenius* seems well accommodated. (See *Philosophical Transactions*, N°. 161.) For in his *Aerial* Telescope, the 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 reflecting Telescope; and which, because it appears to be a much better way than in any common Use, I here give the Reader.

I had two round Copper-plates, each of six Inches in Diameter, the one Convex, and the other Concave, and ground very true one to another; on the Concave I ground the Object Metal or Concave, which was to be polished, till it had taken the Figure of the Convex, and was ready for a Polish; then I pitch'd it over thinly, by dropping melted Pitch upon it, and warming it, to keep the Pitch soft, whilst I ground it with the Concave Copper, wetted to make it spread evenly all over the Convex. Thus, by working it well, I made it as thin as a Groat, and after the Convex was cold, I ground it again, to give it as true a Figure as I could. Then I took Putty, which I had made very fine, by washing it from all its gross Particles, and laying a little of this on the Pitch, with the Concave Copper, I ground it upon the Pitch, till it had done making a noise; and then on the Pitch I ground the Object Metal with a brisk Motion, for about two or three Minutes, leaning 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-Metal 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.

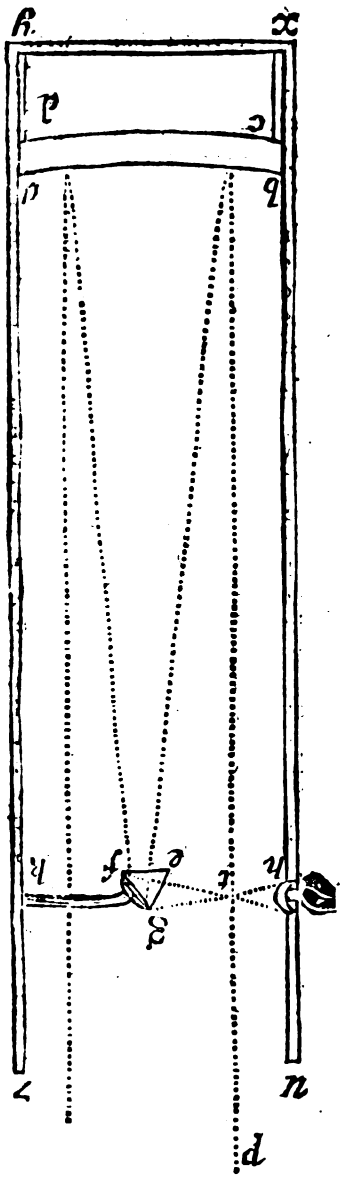
But because Metal is more difficult to polish than Glass, and is afterwards very apt to be spoiled by tarnishing, and besides reflects not so much Light as Glass, Quicksilver'd over, does; I propound, instead of Metal, to use a Glass, ground Concave on the fore-side, and as much Convex on the back-side, and on the back-side well Quicksilver'd over; the Glass also must be exactly all over of the same thickness, otherwise the Object will look coloured and indistinct.

With such a Glass I tried, about five or six 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 Quicksilver'd, the Reflection discover'd innumerable Inequalities all over the Glass: And by reason of these Inequalities, Objects appear'd indistinct in this Instrument. For the Errors of *Reflected Rays*, caused by any Inequality of the Glass, are about six times greater than the Errors of *Refracted Rays*, caused by the like Inequalities. But I however found by this Tryal, that the Reflexion on the concave side 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 Workmen, who can grind and polish Glasses truly spherical. I once mended a common fourteen Foot Object-Glass considerably, by grinding it with Pitch or Putty, and leaning very easily on it in the grinding it, lest the Putty should scratch it: besides, 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 Telescopes, *vid.* his *Opticks*, p. 29.

Let *abde* represent a Glass spherically concave on the Fore-side *ab*, and as much convex on the Back-side *ed*, so that it be every where of an equal thickness; for it must not be thicker on one side than the other, lest it make Objects appear coloured and indistinct: it must also be very well wrought and quicksilver'd over on the Back-side: Place this Glass in the Tube *vxyz*, which must be made very black within. Let *efg* represent a Prism of Glass or Chrystal, placed near the other end of the Tube, in the middle of it, by means of an Handle of Brass or Iron *fgk*, to whose end, made flat, it is cemented. Let this Prism be Right-Angled at *e*, and the other two Angles exactly equal, and consequently each 45 Degrees. Let the Sides *ef* and *ge* be exactly plane and Squares, and by consequence the third Side *fg*, a rectangled Parallelogram, whose Length is to its Breadth in a subduplicate Proportion of 2 to 1.

Let



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 *e f* perpendicularly, and consequently thro' the middle of the side *f g*, at an Angle of 45 deg. And let the side *e f* be turned towards the Speculum, and the Distance of this Prism from the Speculum be such, that the Rays of the Light *p q*, *r s*, &c. which are incident upon the Speculum in Lines parallel to the Axis thereof, may enter the Prism at the side *e f*, and be reflected by the side *f g*, and thence go out of it thro' the side *g e* to the Point *t*, which must be the common *Focus* of the Speculum *a b d c*, and of a Plane Convex Eye-glass *h*, 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 will render the Object distinct; the Plate in which it is made, intercepting all the erroneous Part of the Light which comes from the Verges of the Speculum *a b*.

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 *h*, 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 f g*, must be no bigger than is necessary, and its backside *f g* must not be Quicksilver'd over; for without Quicksilver it will reflect 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 *e f*, and *e g* of the Prism *e f g*, 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 desired 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 Telescope represent the Object erect, Mr. *Molyneux* shews plainly in *Philosophical Transactions*, Nº 183.

Mr. *Auzout* 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 Aperture must be, saith Dr. *Hook*. *ibid.* And Dr. *Hook* also doth there shew a way to make a Plane Convex-Glass of 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 a Telescope in a nocturnal Observation, 'tis a 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 all Money payable to the Queen, by Warrant from the *Auditor of the Receipt*, and make weekly and yearly Books of all Receipts and Payments, which they deliver to the Lord Treasurer.

TEMPORALTIES of Bishops; are such Revenues, Lands, Tenements, or Lay-Fees, which have been laid or annexed to Bishops Sees by our Kings, or other Persons of high Rank in the Kingdom.

TENAILE *of the Foss* or Ditch; is a low Work raised before the Curtain, in the middle of the Foss: It is of three sorts; the first is composed of a Curtain, two Flanks and two Faces: The *Rampart*

part of the *Curtain*, including the *Parapet* and *Talus*, is but five Fathom thick, but the Rampart of the *Flanks* and *Faces* is seven. The Second, which *Vauban* saith he found to be of very good Defence, is composed only of two Faces made on the Lines of Defence, whose *Rampart* and *Faces* are parallel. The Third sort differs from the Second, only that its Rampart is parallel to the Curtain of the Place. All three sorts are good Defences for the Ditch, and lie so low, that they cannot be hurt by the Besiegers Cannon, till they are Masters of the Covert-way, and have planted their Cannon there.

TENON, in Architecture, is the square end of a piece of Timber fitted into a Mortise.

TERRER, or *Terrier*, is a Book or Roll wherein the several Lands, either of a private Person, or of a Town, College, Church, &c. are described; and this should contain the Number of Acres, the Site, Boundaries, Tenants Names, &c.

TERRÆ *Testamentales*; Lands that were held free from *Feodal Services*, in *Allodio*, in Soccage, descendable to all the Sons, and therefore called *Gavel-kind*, were deviseable by Will, and therefore called by this Name, *Terræ Testamentales*.

TESSELATA *Pavimenta*; were the Pavements in the Tents of the Roman Generals, a rich *Mosaick Work*, made of curious small square Marbles, Bricks, or *Tiles*, called *Tessellæ*, from the Form of *Dice*.

TESTONS, or, as we commonly call them, *Testors*, from their having an Head (*Testa*) upon them, were in 34 *H.* 8. coined either *here*, or in *France*; and *Spelman* saith, their value in *France* was 18 *d.* and he doth not know but that they might go for as much here. He saith it was Brass, and cover'd over with Silver, (which perhaps gave rise to the Iniquity of *Plating* Money.) They went with us in *H.* 8th's time for 12 *d.* but in *Edw.* 6th's they sunk down to 9 *d.* and then to 6 *d.* (which still retains the Name of a *Testor.*) In *Anno Dom.* 1559, they fell to 4 *d. ob.* and *Stow* saith, there was a second sort of *Testons*, which in that Year were *Cried down* to 2 *d. q.* and that there was a third sort, 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*, consists of four Shocks; and each Shock contains six Sheaves; but in some Places they reckon but twelve Sheaves to a *Thrave*.

THRIMSA, was an old piece of Money of the 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, but it seems a Mistake.

THUNDER *and Lightning*. The *Phænomena* of this very common, but oftentimes dreadful Meteor, are thus accounted for, and solved by Dr. *Hooke*, *Opera Posth.* p. 169.

The Atmosphere about the Earth abounds with nitrous Particles of a spirituous Nature, which are every where carried along with it; besides which sort of Particles, there are also others raised up into the Air, which may be somewhat of the Nature of Sulphureous, Unctuous, or other combustible Bodies; as we see Spirit of Wine, Spirit of Turpentine, Camphire, and almost all other combustible Bodies, will by Heat be rarefied into the form of Air or Smoak, and be raised up into the Air. All which, if they have a sufficient Degree 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. There are also other sorts of these sulphureous Steams, which arise from subterraneous and mineral Bodies; which, only by their coming to mix with the Nitre of the Air, tho' they have no sensible Heat in them, will so ferment and act one upon another, as to produce an actual Flame: which is a thing that hath been often found in Mines, and more especially if any part of them be kindled, then the whole Train which is mingled with the 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; as I could prove by a multitude of relations from Coal-Mines, and several other Mines. The Accension of which Vapours is so sudden, and with such violence and swiftness runs from one end to the other, as often to kill the Miners, blow up their Props, Turns, Stays, Houses, &c. and produceth as prodigious Effects, as if a vast Quantity of Gun-powder had been fired in the Mine. Now Lightning in the Air seems to be much of the same Nature; for the Air is continually furnished with spirituous nitrous Parts; and the Summer Heat, whenever extraordinary, raises up out of the Earth (and to this the subterraneal Heat also is continually concurring) a great Quantity of sulphureous Vapours, which are of such a nature, as that meeting with the Nitre of the Air, 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 wonderful swiftness fires the whole Train, and so produces the Flash and Noise.

Dr. *Wallis* in *Philos. Transf.* N° 231. *p.* 655. saith, 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 Gun-powder, are Nitre and Sulphur, (the admistion 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 fire, such *Explosion* may well follow with such Noise and Light, as in the firing of Gun-powder; 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 us, will do no mischief, or not considerable; like a parcel of Gun-powder fired in the open Air, where nothing is near enough to be hurt by it. But if the Explosion be near to us, or amongst us, it may

may kill Men or Cattle, tear Trees, fire Gun-powder, break Houses, or the like; as Gun-powder would do in all like Circumstances. This *Nearness*, or *Farness*, may be estimated by the *Distance* of Time between seeing the Flash of Lightning, and hearing the Clap of the Thunder; for tho' in their Generation they be *Simultaneous*, yet Light moving faster than Sound, they come to us successively. I have observed, that commonly the Noise is about seven or eight Seconds after the Flash; but sometimes 'tis much sooner, in a Second or two, or less than that, just after the Flash; and then the Explosion must needs be very near us, and even amongst us. And in such Cases I have more than once presaged the Expectation of Mischief, and it hath proved accordingly.

Now that there is in Lightning a sulphureous Vapour, is manifest from the sulphureous Smell that attends it, and the sultry Heat in the Air, which is commonly a Fore-runner of Lightning soon after. And that there is a *nitrous* Vapour in it, we may reasonably judge, because we do not know of any Body so liable to a sudden and violent Explosion.

As to the kindling of these Materials, in order to such an Explosion, I am told that a Mixture of Sulphur, and Filings of Steel, with the Admistion 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-Waters*, and other hot Springs, where Steel and Sulphur cause a great Effervescence, but no Flame. So that there wants only some *Chalybeate*, or *Vitriolick* Vapour (or somewhat equivalent) to produce the whole Effect, (there being no want of 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 such 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.

THYREO-STAPHILINUS, is a Muscle of the *Uvula*, arising fleshy from the edge of the upper part of the *Cartilago Thyreoides*, between the *Thyreo-pharingæus*, and the *Membrana Faucium*; from thence it ascends straight upwards, being much dilated as it approaches the *Uvula*, on the upper side 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 than the rest; there the Ocean must swell or rise, and the Water will run from other Parts thither.

But from hence only it will not follow, that there should be Tides produced in Rivers and in Land, Seas, Lakes, &c. of little or no breadth; because they are so narrow, that the Moon can't act stronger on one Part than on another: and so there being no difference of Attraction, there is no reason why one part should swell or rise more than another; for, the Attraction being equal, the Water cannot *shift* or move from one Place to another.

TIGE, in Architecture, is the Shaft of a Column from the Astragal to the Capital.

TIN-KILN, is used for the burning of the *Mundick* from the Tin-Ore. See its Description under Tin.

TIN: In *Philosophical Transactions*, N° 69. and N° 138. you have the following Account of the manner of *Finding*, *Digging for*, *Pressing* and *Blowing* of Tin.

The Miners imagine, that, before the Deluge, the uppermost Surface of the *Mineral Veins*, or *Loads*, lay parallel to the upper Surface of the Earth; but that, in the Flood, they were moved, loosed, and torn off; and that by the descending of the Waters into the Valleys, both the Earth or *Grewt*, and those Mineral Stones or Fragments so torn off from the *Loads*, (and which they call *Shoad*) were, together with, and by the Force of the Waters, carried beneath their proper Place, and 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 suspect any Mine to be, they diligently search that Hill and *Country* (as they call the Place where the *Mine* lies) that they may the better know the *Grewt* and the Stones, when they meet them at a distance in the bottom of a neighbouring Valley. They take notice also of the *Frets*, or Openings 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 side of it to search. The Mineral Stones are discovered, either by their Weight, or their Porosity; for most Tin-Stones are Porous, not unlike great Bones, almost throughly Calcined. Yet Tin sometimes lies in very firm Stones; and Dr. *Chr. Merret* saith, 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.* N° 138.

Another Way they have to discover whether the Stones contain any Ore, is, what they call *Vanning*, which is, to powder the Stone, Clay, &c. or whatever is suspected to contain any Metal, and then placing it on a *Vanning 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.

If there be no *Shoad* found in these *Frets*, they trust not to any found in the River, it being uncertain from whence the Water may have brought them. But then they go to the sides of the Hills most suspected, where there is a convenience of bringing a little Stream of Water (the bigger the better) and then they cut a *Leat* or *Gurt*, as they call

call it, that is, a Trench about two Foot over, and 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 sink what they call an *Essay-hatch*, *i.e.* a Hole about six 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' sometimes 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 sink another, as before; and if no *Shoad* appear here, then they go as far on each hand side-ways, and sink there, as before. And so they ascend proportionably 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 that Hill.

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 lessen the first Proportion of twelve Fathom to six, 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, they meet with the *Shoad* of a third. Some Tinners affirm, that the seven *Loads* may lie parallel one to another in the same Hill, but yet only one *Master-Load*; the other six, three on each side, being the lesser 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 quarter of a Mile's distance; but further than that, the *peculiar Grewt* is never found with the *Shoad*.

A Valley may lie so, at the Feet of three several Hills, that they may find three several *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 no other *Load* or Vein, neither doth it send forth any of its own, but is entire of itself, and perhaps will go down into the *Shelf*, five or six Fathom deep, and there terminate.

The Manner of their Digging the Ore, is thus:

When they have found the *Load*, and last *Essay-hatch*, 'tis then called a *Tin-shaft*, or *Tin-hatch*, which is sunk down about a Fathom, and then is left a little long square Place, called a *Shamble*; and so they continue sinking 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 sort 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 every fourteen Days.

2. A *Sledge*, flat-headed, from ten to twenty Pound, will last about seven Years, new ordered once a Quarter. 3. Gadds, or Wedges, of two Pounds, well steeled at the Points, and four-square; these will last three or four Days, or a Week; and then must be new sharpened. 4. Ladders. 5. Wheelbarrows to carry the *Deads* and 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 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 *Winder* with two *Kecbles* or Buckets, one of which comes up as the other goes down.

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 again, and run parallel, as before.

The Breadth of *Master-Loads* is generally from three to seven Feet, seldom larger, unless where several *Loads* unite, and make a Knot, or send forth Springs and Veins: But they do'nt retain the same Breadth in all Places.

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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 many Veins and Joints.

In most Places they meet with Water at some *Feet* deep from the *Load*, at others not at many *Fathoms*; it runs continually thro' the Heart of the *Load*.

When it begins to trouble us, we begin at the Foot of the Hill, a *Drift* scarce half so big as that of the *Load*, and work it on a Level, till we come up to the *Load*. But where they have not this Convenience, or if they pass that Level, then they are forced to draw it up with Winders and Keebles, or force it up with Pumps. Some, but very few Pumps may be dry. They observe, that when they have Water, they never want Air sufficient for Respiration, and for their Candles to burn in; yet sometimes in a soft clayey Country, the Air is so condensed, as to become in a manner a *Damp*, and to require an *Air-Shaft* for a *Vent*: which Damps are sometimes enlarged by working of the *Mundick* with the Ore.

If the *Country* be not strong enough, they underprop their *Drifts* with *Stemples* and *Wall-plates*, placed much like a Carpenter's Square, on the one side, and over-head.

To know which way the *Load* inclines, to bring an *Adit*, or to sink an *Air-shaft* in the desired Place, the Use of the *Dial* is needful; which they call *Plumming* and *Dialling*, and is thus performed. A skilful Person first fastens the end of a long Line at a known Place, and then exactly observes the Point at which the Needle of his *Dial* or *Compass* rests; and at the next Flexure, or Winding, he makes a Mark on the Line, and again notes the *Point* at which the Needle stands at this second Station; and so he proceeds from turning to turning, still marking the Points and his Line, till he comes to the intended Place. Then he repeats above ground what he had done below, and his Dial and Line leads him, till he come exactly over the Place where he ended the *Mine*.

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 brought on Horses to the *Stamping-mill*, whence the Ore is landed at the head of the *Pass*, (*i.e.* two or three Bottom-boards, with two Side-ones, set slopewise) 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, cut in a long Pole, which, with the Ore, falls down into the *Coffer*, (*i.e.* a long Square of the firmest Timber, three Foot-long, and one Foot and half over) wherein are the three usual *Lifters*, placed between two strong broad *Lones*, having two *Braces*, or Thwart-pieces on each side, to keep them steady as a Frame, with *Stamper-heads*, weighing about thirty or forty Pound each of Iron, which serve to break the Ore in the said *Coffer*. These *Lifters*, being about eight Foot long, and half a Foot square, of Heart of Oak, and having as many *Timbers* or *Guiders* between them, are lifted up, in order, by double the number of *Tappets* (fastened to as many *Arms*, passing diametrically to a great Beam, turned by an *Over-shot Water-wheel* on two *Boulsters*) which exactly, but easily meet with the *Tongues* so placed in the *Lifters*, as that they quickly slide from each other, suffering the Lifters to fall with great force on the *Ore*, thereby breaking it into small Sand, which is washed out by the Cock-water, thro' a Brass Grate, holed very thick, and placed within two Bars of Iron at one end of the Coffer, into the *Launder*, *i.e.* a Trench cut out in the Floor, eight Foot long, and ten over, and stopped at the other end with a Turf: so that the Water runs away, and the Ore sinks to the bottom; which, when full, is taken up and emptied with a Shovel.

The *Stamping-Mill* is thus contrived to go two Hours, or more, after they give over attending it. There is a *Tiller*, or long Pole, fastened without at one end to the *Slew* or *Ponder*, *i.e.* that loose and last part of the Trough, that conveys the Stream 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 at both ends, under two little Pins, fastened in the *Lones* for that Purpose: There is another Pin set in one of the *Lifters*, at such an exact height, as that if there be no *Ore* in the Coffer, to keep that *Lifter* high enough, the purposed Pin, in descending, knocks out the Water, carrying it quite over the Mill-wheel; so that when the *Coffer* is emptied, the Mill rests of course. The Launder is divided into three parts, the Fore-head, the Middle, and the Tail. That *Ore* which lies in the *Fore-head*, or within one Foot and a half of the Grate, is the best Tin, and is taken up in a Heap apart; the Middle and Tail is another Heap, which is accounted the worst. This latter Heap is thrown up by the *Trambling Buddle*, that is, a long square *Tye* of Boards, or *Slate*, about four Foot deep, six long, and three over; wherein stands a Man with a *Trambling-shovel* in his Hand, to cast up the *Ore*, about an Inch thick, on a long square Board, just before him, and as high as his Middle, which is called the *Buddle-head*; and with the Edge of his Shovel, he dexterously cuts and divides it long-ways, in respect of himself, about half an Inch asunder; in which little Cuts, the Water coming gently from the edge of an upper plain Board, carries away the Filth, and lighter part of the prepared Ore first, and then the Tin immediately after, all falling down into the *Buddle*; where, with his bare Foot, he smooths it transversely, to make the Surface the plainer, that the Water, and other Heterogeneous Matter, may, without lett, pass away the quicker.

When this Buddle grows full, they take it up; here distinguishing again the Fore-head from the Middle and Tails, which are *trambled* over again: But the Fore-head of *this*, with the Fore-head of the *Launder*, are trambled in a second Buddle, but not different from the first. In like manner, the Fore-head of this being likewise separated from the two other Parts, is carried to a *third*, or the *drawing Buddle*; whose difference from the rest is only this, that it hath no *Tye*, but only a plain sloping Board, whereon 'tis once washed with the *Trambling-shovel*, and so it new names the Ore *Black Tin*, *i.e.* such as is compleatly ready for the *Blowing-house*.

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*.

After the second trambling it, they take that Fore-head in the second *Buddle*, and *dilve* it, (*i. e.* putting it into a Canvas-sieve, in a large Tub of Water, and shaking it lustily) so that the Filth gets over the Rim of the Sieve, leaving the black Tin behind, which is put into Hogsheads, covered and locked, till the next Blowing.

The Tails of both *Buddles*, 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 Tin else may wash away in *Trambling*.

There are commonly three or four of them successively, which contain two sorts of Tin, the one which is too small, the other too great. The latter is new ground in a *Craze-mill* (which is just like a Grist-mill, with two Stones, an upper and an under) and after that, trambled in order. The former, by reason of its exceeding Smallness, is dressed on a *Rack*, or Frame of Boards, about three Foot and a half broad, and six long, and which turns upon two Iron-Pins, fastened in both ends, and the whole placed between two Posts; so that it hangs in an Æquilibrium, and may, like a Cradle, be moved easily either way with the Shovel and Water.

Blowing of Tin.

When they perceive much *Mundick* in their Tin, 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 Moor-stone about six Foot long, and four broad; in the middle of which is a square Hole of about half a Foot in Diameter: About a Foot beneath this Stone, is placed another, which is not so long by half a Foot; because it must not reach the innermost, or back part of the Wall, which is the open Place, thro' which the Flame ascends from a lesser Place below that, where a very strong Fire of Furze is constantly made. The Fore-part is like a common Oven; but near the back, on one side, there is another little square Hole. When the Kiln is throughly heated, the *black Tin* that is to be burnt, is laid on the Top-stone, and as much of it is cast down by the square Hole, on the second, or Bottom-stone, as will cover it all over, about three or four Inches thick. Then the Hole at the top is immediately covered with green Turfs, that the Flame may reverberate the stronger; and a Rake-man, with an Iron Coal-Rake, constantly spreads and moves the Tin, that all Parts of the *Mundick* may get uppermost of the Tin, and so be *burned* away; which we certainly know by this, that then the Flame will become *yellow* (as usual) and the *Stench* lessen'd: for whilst the *Mundick* behind burns, the Flame is exceeding blue. Then with the Rake he thrusts it down at the open Place into the open Fire, and receives a new Supply of Tin from above. Now when the Place beneath, where the Fire is made, grows full of Tin, Coals, and Ashes, with the Rake he draws it forth with the Coals at the little square Hole, on the one side, near the back; where the Ore, fiery hot and red, lies in the open Air to cool; which it 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, before 'tis put into the Furnace; which is no other than 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 Peat (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 sometimes remains a different Slug in the bottom of the Float, which they call *Mount-egg*; and this is mostly an Iron Body, tho' of a Tin Colour; 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.

Tho' Tin, for the most part, be made from the Stones, in which it is incorporated, yet 'tis sometimes mixed with a gravelly Earth, sometimes white, but usually red; from whence 'tis easily separated by bare *Washing*. This gravelly Tin is called *Pryan Tin*, and has scarce half the Goodness of the other.

The *Mundick Ore* is usually discovered by its Glittering, yet sad-coloured Brownness, wherewith it will soon discolour their Fingers. This is said to nourish the Tin; and yet they say, where much *Mundick* is found, there is little or no 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 *Mundick* seems to be a kind of *Sulphur*; for Fire only separates it from the Tin, and evaporates it into Smoke.

The *Cornish Diamonds* lie intermixed with the *Tin-Ore*, and sometimes on heaps; they are hard enough to cut Glass; and some of them are of a transparent red, and have the Lustre of a deep Ruby. They seem to be only a fine hard Spar.

The best *Tin Ore* is that which is in Sparks, and next to this, that which hath bright Spar in it. The Furnace where they melt, and from whence they cast their Tin, they call a *Blowing-house*. See also Mr. *Ray*'s Collection of *English* Words.

TIP-STAVES, are the Warden of the *Fleet*'s Officers, attending the Queen's Courts with a painted Staff, for taking into Custody such Persons as are committed by the Court; and to attend such Prisoners as go at large by Licence. By this Name also are the Judges Officers called, who carry a Rod, or Staff, tipped with Silver, and take charge of such Prisoners, as are either committed, or turned over at the Judges Chambers.

TOD *of Wool*, is a Weight mentioned in 12 *Car. cap.* 23. containing 28 Pound, or 2 Stone Weight.

TOFT, *Toftum* in the Law signifies a Messuage, or rather perhaps a Place where a Messuage stood: 'Tis a Word much used in Fines.

TOMICE, the Art of Carving in Wood, or Ivory. The Artist in this Work was called *Deflector*.

TOMPION, is the Stopple of a great Gun or Mortar, being made of Wood, and put into the Mouth, to keep out Rain; also in loading of a Mortar, there is a Tompion of Wood, which is fitted exactly to the Bore of the Piece at the Mouth of

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of the Chamber, and this is drove in hard after the Powder, and the Bomb is placed upon it.

TONGUE *Grafting*, is a way of Grafting in Roots, thus: The Root is cut sloping about an Inch in length, and the Graft as much, both very smooth; then each is cleft an Inch in length also, and then they are made to enter into one another, so that the Sap of the Graft may join to that of the Root as much as can be. Lap the jointed part about with a little Hemp, or Flax Hurds, and set the Root so grafted into the Ground, about ten or twelve Inches deep, so as the Joint may be about four Inches at least covered under the Earth, that it may not be bared at any time, but kept moist by the Earth. The Root you graft on, may be a piece of the Root of an Apple or Pear-tree, about six Inches in length; it should not be less than the Graft, but it may be bigger; but 'tis best when they are both of the same size. *vid. Phil. Transf.* Numb. 95.

About twenty-nine Years ago, saith Mr. *Lewis*, who communicated the Method above, I sowed a Bed of Apple-kernels in *March*, the Spring following I plucked up forty of these Seedlings, grown to the thickness of a fair Graft; I grafted them in this manner of *Tongue Grafting*, and planted them again: they all grew, and four of them bare Fruit to perfection that Year; so that in a Year and a half, from an Apple-kernel I had ripe Fruit. Some of these Trees will now bear two Quarters of Apples upon a Tree, and are bigger than most of those Trees among which they stand, which cost twelve Pence a Tree, when these were Kernels. I conceive, saith he, that Plumbs, Cherries, Apricocks, Peaches, and all sorts of Fruit-Trees, may be thus raised.

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 searching 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 general Propositions about the Transformation of Curves from Mr. *Roberval*; Dr. *David Gregory*, Astronomy Professor in *Oxon*, doth in *Philosophical Transactions*, N° 214. *p.* 233. fully refute that Assertion, by shewing that Mr. *James Gregory*'s Book was published at *Padua*, 1668; and Dr. *Barrow's Lectiones Geometr.* 1674. And therefore 'tis more than probable, that Mr. *Roberval* had seen those Books, since he did not die till *Oct.* 1675; and yet we find not that he makes any such Complaint.

TRANSCENDENTAL *Quantities*, Mr. *Leibnitz*, in the *Act. Erud. Lipsiæ*, for *June* 1686, hath a Dissertation, in which he proposes to shew the Origin and Rise of such kind of Quantities, *viz.* Why some Problems are neither *Plain*, *Solid*, nor *Sur-solid*, nor of any certain Degree, but do transcend all Algebraical Equations: As also to shew how it may be demonstrated without a *Calculus*, that an *Algebraical Quadratrix* for the *Circle* or *Hyperbola* is impossible. For if such a *Quadratrix* could be found, it would follow, that by the help thereof, any *Angle*, *Ratio*, or *Logarithm*, might be divided in the *given* Proportion of one right Line to another; and this by one *universal Construction*. And consequently, the Problem of the *Section of an Angle*, or the *Invention* of any number of mean Proportionals, would be of a *certain Degree*. Whereas the different Numbers of Parts of an Angle, or of mean Proportionals, do necessarily require *different Degrees* of *Algebraical Equations*. And therefore the Problem, understood in general of any Number of Parts of an Angle, or mean Proportionals, is of an *indefinite Degree*, and *transcends* all *Algebraical Equations*.

However, since such Problems as these may really be proposed in Geometry (nay, and ought to be reckoned amongst the most principal) and besides are *determinate*; therefore 'tis necessary that such Lines should also be received into Geometry, as are alone sufficient for the Construction of these Problems.

And further, since they may be described exactly by a *continual Motion* (as is apparent in the *Cycloid*, &c.) they ought not to be accounted *Mechanical*, but *Geometrical Curves*; especially too, since they are of much greater use than all the Lines of the common Geometry (except the right Line and Circle) and have also some very important 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 Geometrical.

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 solved, all that is wished for would be done; since 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) assume *General or Indefinite Equations*, for the Lines sought. *Ex. gr.* putting x and y for the *Abscissa* and *Ordinate*, the Equation I use for a Line sought, is, $a + bx + cy + exy + fxx + gyy$, &c. $= 0$. By the help of which indefinite Equation (which in reality is *finite*; for it may always be determined, how far soever 'tis necessary to raise it) I enquire the Tangent, and that which results comparing with the given Property of Tangents, I find the Value of the assumed Letters, $a, b, c,$ &c. And thus I define the Equation of the Line sought.

In which Equation, sometimes there are some things which remain *arbitrary*, and in that Case innumerable Lines may be found that will satisfy the Problem.

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And this was the Reaſon that a great many, obſerving the Reſult, believed the Problem not to be *ſufficiently determined*, nor indeed *poſſible*. The ſame 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 place.

Now, laſtly, if the *Compariſon* above-mentioned doth not proceed, I pronounce the Line ſought, not to be an *Algebraical*, but a *Tranſcendental 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 *indefinite* and *compounded Enquiries*.

Here therefore, beſides the Symbols x and y, I 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 ſeveral *Tranſcendents* are ſo to be made uſe of, and thoſe of different Natures too from one another; alſo, tho' 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.

Now this Method, applied to the Buſineſs of *Quadratures*, or to the Invention of *Quadratrices*, (in which the Property of the Tangent is always given) 'tis manifeſt, not only how it may be diſcovered, whether the indefinite Quadrature be *algebraically* impoſſible, but alſo how (when this Impoſſibility is diſcovered) a *Tranſcendental Quadratrix* may be found, which is a thing which has not yet been ſhewn. So that it ſeems, I may without vanity aſſert, 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 ſo much admired; and this with ſo much eaſe too, that there is now no more need of their being learned and kept in memory, than for a Man that underſtands Algebra to learn a great many of the Propoſitions of 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; it appears preſently, by my Method, that $p\,dy = x\,dx$, which *Differential Equation*, turned into a *Summatory* one, makes $S p\,dy = S x\,dx$. But, from what I have ſhewn in the Method of Tangents, $d\tfrac{1}{2}xx = x\,dx$, therefore contrarily, $\tfrac{1}{2}xx = S\,dx\,x$, (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, that $S p\,dy = \tfrac{1}{2}xx$. Q. E. D.

In the Notation I had rather make uſe of dx, and ſuch like Symbols, to denote the differential Quantities, than other Letters, becauſe that Expreſſion dx, is a certain Modification of x: And ſo by this means it comes to paſs, that the Letter x 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 $a = \dfrac{S\,dx}{\sqrt{2x - xx}}$, and if the Ordinate of the Cycloid be y, then will

$$y = \sqrt{2x - xx} + \frac{S\,dx}{\sqrt{2x - xx}},$$

which Equation perfectly expreſſes the Relation between the Ordinate y, and the Abſciſſa x; and from it all the Properties of the Cycloid may be demonſtrated.

And thus is the Analytical *Calculus* extended to thoſe Lines which have hitherto been excluded, for no other Cauſe, but that they were thought incapable of it.

Alſo Dr. *Wallis*'s Interpolations, and innumerable other things are derived from hence.

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 of our Age, with reſpect to this kind of Geometry.

Firſt of all, *Galilæus* and *Cavallerius* began to explain the moſt involved Methods of *Conon* and *Archimedes*; but *Cavallerius*'s *Geometry* of Indiviſibles 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 theſe ſtopped within certain (comparatively) narrow Bounds, which the famous Geometers, Mr. *Hugens* and Dr. *Wallis*, went beyond, opening new Ways. For 'tis probable enough, that *Hugens*'s Inventions gave riſe to that of *Heuraet*; as thoſe of *Wallis* might to thoſe of *Neil* and *Wren*, who were

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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. *Is. Barrow*, who wonderfully increased the Science with admirable Theorems of this kind. In the mean time, Mr. *Nicholas Mercator*, a *Holsatian*, and most excellent Mathematician, was the first that I know of, who exhibited any Quadrature by an infinite Series. Which Invention that profound Geometer, Sir *Is. Newton*, did not only reach by himself, but also compleat, by an universal way; and would he make publick the Thoughts he has yet further on this Subject, he would certainly open new ways to us, to the great increase, and yet abridgment, of the Science. As for myself, it happened when I was yet but a *Tyro* in these Studies, that the sight of a certain Demonstration concerning the Magnitude of a spherical Substance, suddenly gave me some Light; for I saw in general, that the Figure made, by applying the Perpendicular to the Curve, as *Ordinates* to the *Axis* (which Perpendiculars in the Circle are the Radii) was proportional to the Surface of the Solid, generated by the Rotation of the Figure about the Axis. With which first Theorem 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 *Characteristick Triangle*, the Sides of which should be *indivisible* (or speaking more properly) *infinitely small* or *differential Quantities*; 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 soon after found my Arithmetical 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 discovered, all those things which I formerly had so much 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 sought, 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, $a = \frac{S\,dx}{\sqrt{2x - xx}}$, a Man should not rashly neglect the dx on this account, that it may be neglected when the x are 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: So that the Progression of the x might be assumed at liberty. Whereas from this one thing alone arise innumerable Transfigurations and Equipollencies 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.

TRANSIRE, 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 *Is. Newton*, at the end of his Book of *Opticks*, *Edit. Lat.* seems to be of opinion, That *Crasse*, or thick *Bodies*, and *Light* may be mutually *converted* and *transmuted* into one another; and that all Bodies receive their *active Force* from the Particles of Light which enter into their Composition. For all fixed Bodies, when well heated, emit Light as long as they continue so: And on the other hand, Light intermingles itself, and inheres in Bodies as often as its Rays fall upon the solid Particles of those Bodies, as he shews before. There is no one Body (saith he) which is less apt to shine than *Water*: But yet *Water*, as Mr. *Boyle* found by repeated Distillations, is capable of being transmuted into a fixed Earth; and that Earth will be capable of bearing Heat enough to be made by that means to emit Light, and shine as well as other Bodies. 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 such Transmutations.

Water, which is a Salt very fluid, volatile, and tasteless, is by Heat changed into *Vapour*, which is a kind of Air; and by Cold, into *Ice*, which is 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 also, and sometimes without it, reverts into dense Bodies again. *Quick-silver* sometimes puts on the form of a fluid 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 sometimes 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*, and sometimes of a *white Precipitate*, and sometimes 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 Insects, &c. as far as Sense can judge, are by little and little evolved, explicated, and encreased in Magnitude, and so turned into Animals: Tadpoles are turned into Frogs; little Worms, or Maggots, into Flies.

All Birds, Beasts, Fishes, Insects, Trees, and Plants, with all their so very different Parts, grow and encrease out of Water, and aqueous and saline Tinctures; and on 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 of Barley, macerated without boiling) in process of Time hath a Sediment and a Spirit, and before Putrefaction, yields Nourishment both for Animals and Plants. Now among all these many various and wonderful Transmutations, why should not Nature turn *Light* into *Bodies*, and *vice versa*?

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The great Objection against the practical Transmuting of a baser Metal into a nobler, seems to be, that the specifick Gravities of Metals cannot be altered: But in Dr. *Hook*'s Life, before his *Opera Posth.* I find, that Dr. *Hook*, in 1679, is said 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 $7\frac{1}{10}$ to 1; and yet that of the Mixture was $8\frac{3}{4}$ 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 subtilly divided (as Metals when dissolved in Acids, &c.) become perfectly *Transparent*; from whence, and from some other Reasons, Sir *Is. Newton*, in his Opticks, concludes, That Water, Salt, Glass, some Stones, &c. and such like Substances, are Transparent, because tho' they may be as full of Pores or Interstices between their Parts, as other Bodies; yet their Parts and Interstices are too *small to cause Reflexions in their common Surfaces*. He shews also, that the least Parts of all natural Bodies are in some measure transparent; and that their Opacity arises from the multitude of Reflexions caused in their internal Parts. 'Tis plain also, as he shews, that opake Substances are rendered transparent, by filling 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 transmitted.

TRANSVERSALIS *Pedis*. Dr. *Douglas*, in his comparative Description of the Muscles, saith that *this* is only part of the *Musculus accelerator Urinæ*, arising from the Knob of the *Ischium*; for it is not inserted into the *Cavum Ovale*, or Bulb of the *Urethra*, but joins in with the *Accelerator*, of which it makes a second beginning.

TRAVERSE, in Fortification, is a Trench with a small Parapet, and sometimes with two, one on each side; 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 enfiladed. It is also a good Defence in a dry Ditch, when the Parapet is made on that side 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 to be put to the Foot of the Wall, Saucissons, Joists, and other pieces of Wood, with Fascines, Stones, Earth, &c. in order to fill up the Ditch, and to carry a Gallery over it. Also a Wall of Stone or Earth, built a-cross a Work which 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 also, 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 Matters.

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 Houshold*, hath Power, with the *Controller and Steward of the Marshalsea*, without Commission, to hear and determine Treasons, Misprisions of Treason, Murder, Homicide, and Bloodshed, committed within the Queen's Palace.

TRENTALS, see *Tricennalia*, were thirty Masses, said in so many Days for the Souls of Persons deceased; and the Offerings which were made, and the Priests for this Service, were also called *Trentals*.

TRICENNALIA, TRIGINTALIA, were *Trentals*, or, as they were called in *English*, a *Months Mind*, because the Service lasted a Month, or thirty Days; in which they said so many Masses.

TRIDENT is a Name given by Sir *Is. Newton* to that kind of *Parabola*, by which *Des Cartes* constructed Equations of six 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*. See *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 necessary Tax, or Imposition, to which all Lands were Subject in the *Saxons* Time, *i. e.* towards the Repairing of Bridges, the maintaining of Castles and Garisons, and Expeditions to repel invading Enemies.

TRINODA *Terræ*, 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, otherwise, 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 from the middle of the Ear, and well dried. Of these

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these, 32 were to make one Penny-weight, 20 Penny-weight an Ounce, and 12 Ounces a Pound; but afterwards, they came to divide the Penny-weight into 24 equal Parts, which have ever since been called Grains. *See Tables of Weight* under *Weights*, in Vol. I. Formerly the *Moneyers* did, and perhaps do still, subdivide the Grain thus: 24 Blanks make a Periot, 20 Periots a Droite, 24 Droites a Mite, and 20 Mites one Grain. *See Ward's Introduct. to Mathemat. p.* 32.

TUBA-*Eustachiana*, is the Canal of Communication between the Mouth and the Barrel of the Ear; 'tis so called by *Antonius Valsalva* from its *Figure*, and its first Discoverer, *Barthol. Eustachius*.

TUMBREL, *Tumbrellum*, *Turbicketum*, is an Engine of Punishment, which ought to be in every Liberty that hath view of Frank-Pledge, for the Correction of Scolds and unquiet Women; and was what we now call a *Cucking-stool*.

TUNICA *Vaginalis*, is the first of the proper Integuments of the *Testes*; 'tis formed by the Dilation of the Productions of the external Membrane of the *Peritonæum*. Its internal Superficies is smooth, its external rough: It contains the *Vasa Deferentia* and *Præparantia*; it embraces loosely the whole Body of the Testicle, adhering to one end of the *Epydidimis*; and on the out-side of it runs the Muscle called *Cremaster*, which see.

TYCHONIAN *System* or *Hypothesis*, is so called from having been advanced to solve the *Phænomena* of Astronomy, by the Noble *Tycho Brahe*. He supposes the Earth *fixed* and *immoveable* in the Centre of the Universe, or of the Sphere of the fixed Stars; so that all the Stars and Planets, are supposed to revolve round the Earth in the space of 24 Hours. The Moon also he supposes to move round the Earth, as the Centre of her menstrual Motion: But the five other Planets, *Saturn*, *Jupiter*, *Mars*, *Venus*, and *Mercury*, he supposes to revolve round the Sun in their several Periods; as the Sun doth round the Earth in a Year's time. But this Hypothesis is so embarass'd and perplex'd, that it hath had few Espousers: And, instead of it, *Longomontanus*, and some few others, have advanced another Hypothesis, that 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 the *Tychonian System*, yet it is still so intricate and confused, and so inconsistent with Observation, and the simple Uniform Laws of Nature, which establish 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 solve it; since all the *Phænomena* of the Heavenly Bodies, are much better accounted for in the other System last mentioned. See *Greg. Astron. Book* I. *Sect.* II.

TYTHES, are of three Sorts. (1.) *Prædial Tythes*, which arise wholly or chiefly from the Earth; as of Corn, Hay, Underwood, Fruits, &c. (2.) *Mixt Tythes*, are such as arise from Beasts, and other Animals pastured or fed with the Fruits of the Earth; as Colts, Calves, Lambs, Wool, Milk, Fowls, &c. (3.) *Personal Tythes*, which are the Profits arising from the Labour, Art, Trade, Negotiation, and Industry of Men. *Great Tythes*, are of the Tenths of Corn, Hay, and Wood only. All others being called *Small Tythes*.

VACUUM: To what hath been said on this Subject, under this Head in Vol. I. may be added by way of Illustration; That since all Bodies do (by what Sir *Isa. Newton* aptly calls the *Vis Inertiæ*) resist as far as they can, any Change or Alteration of their present State, whether of Motion or Rest; and since this Resistance is always the same in the same Body, and in different Bodies is still Proportionable to the Quantity of Matter they contain: And since also of consequence, if two Bodies contain equal Quantities of Matter, and move towards one another with contrary Directions, and equal Velocities; they will necessarily both stop at the Point of Concourse: And *Conversely*, since 'tis certain also that two Bodies moving thus, with contrary Directions and equal Celerities, if at the Point of Concourse they do both rest, must be equally heavy: It plainly follows, that two Bodies, containing each an equal Quantity of Matter, must be equally heavy; wherefore, were there no such thing as Porosity or Vacuity, two Spheres of equal Diameters, must contain equal Quantities of Matter, and be equally heavy; that is, two Spheres of different Matter, suppose one of Wood, and the other of Gold, if they had equal Diameters, must have equal or the same Specifick Gravities. But this being directly contrary to all experience, there is an unavoidable necessity of supposing Vacuities in the Sphere of Wood, to render it lighter bulk for bulk, than that of Gold.

The Planetary Regions in which the Heavenly Bodies move, must needs be almost devoid of all Body or Matter; for otherwise a *Resistance* must accrue to the Planets Motions, which tho' never so small, would in time be sensible, and have an effect in retarding the Motion of the Heavenly Bodies; but no such thing hath ever yet been observed or discovered, but the contrary is certain. And besides, such a thin Vapour as the Tail of a Comet, can move thro' the *Æther*, as some will call it, with incredible swiftness, without being dissipated or drawn from its natural Course; which is in it self a demonstration, that there must be a kind of *Vacuum* in those Celestial Regions. And Dr. *Hook*, who was a *Plenist*, saith, That the vast *Expansum* of the World, must be a Body so exceedingly fluid, (that is, *no Body at all*) as hardly

to

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to hinder the Motion of any Body thro' it. And Sir *Isa. Newton* shows, *p.* 313. *of his Latin Opticks*, That if the Planetary Regions were, as the *Plenists* assert, entirely full of Matter, and without any interspersed Vacuities at all; let their Matter be never so subtile and fluid, they would have a greater Resistance to any Bodies moving in them, than Mercury or Quick-silver hath. *And in such a* Medium *as That, even a perfectly solid Globe must lose half its Motion, 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; wherefore 'tis absolutely necessary for continuing the Motions of the Planets and Comets, that the Places they move in, be almost entirely devoid of all Matter.

The feigned Romantick Subtile Matter, with which the *Cartesians* have filled the Celestial Regions, and all other Parts of the Universe, is by no means useful to explain the Phænomena of Nature: since the Motions of the Planets and Comets, is much better explained by *Gravitation* without it, and the Cause and Nature of Gravity hath not yet been explained by that *Materia Subtilis*, nor I believe ever can be. And if there were any such thing as that *Matter*, it would only serve to do mischief, to disturb and retard the Motions of the Heavenly Bodies, and the Order and Course of Nature. And if there were any such thing within the hidden Pores and *Meatus* of Bodies, it would serve for no good purpose; it would only hinder and stop the *vibrating Motion of their Parts*, in which their *Heat* and all their *active Force* consists.

That Whim therefore of the *Materia Subtilis*, must be entirely banished out of our Philosophical Faith; and then, along with it, will sink all those imaginary Schemes and Hypotheses, for the explaining the Nature of the Phænomena of Light, by the means of *Pressure* or the *Motion* of the *Medium*. See *Pressure*.

VADIARE *Duellum*, was formerly to *wage a Combat*; that is, when any Person challenged another to decide a Controversy by Camp-fight, or Duel, and threw down a Gauntlet, or made some such like sign of Defiance, 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 sides, to the Scupper-holes.

VAPOURS: In order to explain the Circulation of Vapour experimentally, Mr. *Edm. Halley* (See *Philos. Trans.* N° 212.) caused an Experiment of the Quantity of Water, arising simply from the warmth of the Weather, without being exposed to either Sun or Wind, to be made in *Gresham-College*: Which was performed with 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 measured, 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 that the Depth of Water evaporated in one Year amounts to eight Inches. But this is much too little to answer the Experiments of the *French*, who found that it rained 19 Inches of Water in a Year at *Paris*: Or those of Mr. *Townly*, which, by a long continued Series of Observations, hath sufficiently proved, that in *Lancashire*, at the Foot of the Hills, there falls above 40 Inches of Water in a Year; from whence it is very obvious, that the Sun and Wind are much more the Causes of 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 they clothe, as it were, with a Fleece of vaporous Air; which once investing it, the Vapour rises afterwards in much less quantity. And this was shewn by the small Quantity of Water that was lost in 24 Hours time, when the Air was very still from Wind, in proportion to what went away, when there blew a strong Gale; altho' the Experiment was made in a Place as close from the Wind as could be well contrived. For which reason I do not at all doubt (saith he) that had the Experiment been made where the Wind had come freely, it would have carried away at least three times as much more, without the Assistance of the Sun, which might perhaps have doubled it. By the same Experiment it likewise appears, that the Evaporations in *May*, *June*, *July*, and *August*, (which in each Month are nearly equal) are about three times as much as what evaporated in the four Months of *November*, *December*, *January*, *February*, which are likewise nearly equal; *March* and *April* answering nearly also to *September* and *October*.

This *Fleece* of Vapour, in still Weather, hanging on the Surface of the Water, is the occasion of very strange Appearances, by the Refraction of the said Vapours differing from that of the common Air, whereby every thing appears raised; Houses like Steeples, Ships as on Land above the Water, and the Land raised and lifted up, as it were, from the Sea, and many times seeming to over-hang. And this may give a tolerable account of what I have heard of seeing the Cattel at High-water-time, in the Isle of *Dogs*, from *Greenwich*, when none are to be seen at Low-water, (which some have endeavoured to explain, by supposing the Isle of *Dogs* to have been lifted up, by the Tide coming under it.) But the vaporous *Effluvia* 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, pass over, and consequently the Objects seen at the one time, may be conceived to disappear at the other.

Sir *Isa. Newton* in his Opticks, Book 2. p. 60. thinks that the Azure Colour of the Sky, which he takes to be a *Blue*, of what he calls the *first Order*, is caused by the Vapours, when they first begin to condense and coalesce into small Parcels; for then they become first of such a *bigness*, whereby such an Azure may be reflected, before they can constitute Clouds of other Colours: So that this Azure being the first Colour which Vapours begin to reflect, it ought to be the Colour of the finest and most transparent Skies, in which Vapours are not arrived to that *Grossness* requisite to reflect other Colours, as we find it by experience.

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VARIABLE QUANTITIES, in Fluxions, are such as are supposed to be continually increasing 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, signifies 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 such 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 *Glossary*.

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 *Vectis Homodromus*.

VENA PNEUMONICA; is a small Vein which creeps along upon the *Bronchia* of the *Aspera Arteria*, or *Trachæa* 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-side, 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 left 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 Coats. 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 *Nervosa*.

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 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 *Peritonæum*.

The Stomach receives Veins from the *Porta*, *viz.* the *Gastrica*, *Pylorica*, and *Vas Breve*, and Branches from the *Gastroepiplois dextra & sinistra*, which are accompanied with Branches of the *Arteria Cœliaca*, all which lie immediately under the fourth Coat of the Stomach.

The Eighth Pair of Nerves, or *Par Vagum*, gives two considerable 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 one, and the internal do so likewise; both which piercing the Midriff, form, by a great Number of small Twigs, upon the upper Orifice of the Stomach, a *Plexus*: and then the internal Branch spreads it self down to the bottom of the Stomach; and the external Branch spreads it self upon tho inside, about the upper Orifice of the Stomach. This great Number of Nerves which is about the upper Orifice, renders it very sensible, and from them also proceeds the great Sympathy betwixt 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 dissolution 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 Cohæsion of all the little *Moleculæ*, 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 easily enter the Pores of most Bodies, and swelling them, break their most intimate Cohæsions. When the Aliments are thus prepared, their Parts are soon separated from one another, and dissolved 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 *Pitcairne*, demonstrated to be equal to the Pressure of 12951 Pound weight: To which if we add the force of the *Diaphragma*, and Muscles of tho *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 together, till the Water grows pale: Then they

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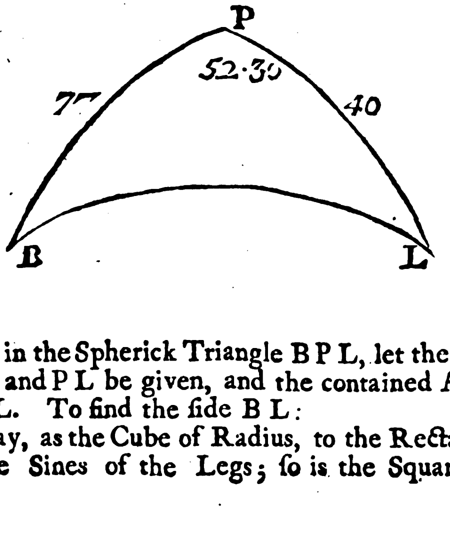
pour that away, and set it by for further use, and pour on more of the green Water, and so continue till the *Verditer* be made; which being taken out, is laid on large Pieces of *Chalk* in the Sun, till it be *dry* for the Market. The Water mentioned to be drawn or poured off from the *Verditer*, (which 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. Transf.* N° 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 80 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 50°: 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 found 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 artificial, 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 Earth'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 found.



As in the Spherick Triangle B P L, let the Legs B P, and P L be given, and the contained Angle B P L. To find the side B L:

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 ½ 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.

EXAMPLE.

The Log. Sine of 40°. -	9.8080675
The Log. Sine of 77°. -	9.9887239
The Log. Sine of 26°. 15 when doubled } -	19.2914116
The natural Sine against	39.0882030 is 1227355
Whose double is — —	2454710
The natural Versed Sine of 37°. the Difference of the Legs, is — }	2013645
Their Sum is — —	4468355

Which is the Versed-Sine of 57 deg. 53 min. the 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.

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 striking upon the small Particles of Bodies, do excite in them such Vibrations, and cause them to grow hot and shine. For all fixed solid 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 some animal or vital Motion. Thus the *Sea-Water shines* 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 putrefied: so shine Vapours arising 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.

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Of the vibrating Motion of the Parts of solid 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 wetted.

Dr. *Hooke* saith, 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 *Rector*, 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 whatsoever, appertaining to that part of her Majesty's Houshold, which is called the *Chamber*, or above Stairs.

VIÆ *primæ*, so the Physicians call the Stomach and Guts, accounting the whole length of the Canal which reaches from the Mouth to the *Sphincter Ani*.

VIGIL; tho' the Civil Day begins from Midnight, yet the Ecclesiastical or Scriptural Day begins at six in the Evening, and holds till six 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-clock the Day before; from which Time the Religious Day was supposed to begin: and this first part of the Holiday, from six 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 Mannors 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 Expression, $ax\sqrt{\overline{ax-oa}}$ the *Vinculum* is the compound Surd $\sqrt{\overline{ox-aa}}$. which is $\times$d into ax.

VIRGATE, or *Yard-Land*, was originally no more than a certain extent or compass of Ground, surrounded with such 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, pursue or avoid, according to the Rules of true Prudence.

VISCOUNT, *Vicecomes*, *Vicount*, signifies 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 below an Earl; and tho' it be an old Name of Office, 'tis a new one in Dignity, being not in use with us till the time of *Hen. 6*. But 'tis of greater Antiquity in other Countries. See *Selden*'s *Titles of Hon. fol.* 761.

VISION: the Physical Cause of Vision seems 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 *solid 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 Fibres 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 such 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 Sensations 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 full 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 Vessel cannot immediately communicate its Motion to the Liquor: But the Liquor perseveres in its state of Rest, whilst the Vessel moves forward, and so seems 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 Inertiæ*; as you will find under *Resistance* in this Vol.

VIS STIMULANS; a Term used by Dr. *Cheyne* in his Book of Fevers, and by some other Physicians, and they understand by it such a Quality in any Fluid, whereby the Particles of it are disposed to make a real Division, or a violent Inflexion of the nervous and membranous Fibres of the

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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 Cordis.*

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 *Essex*, according to Mr. *Ray*'s Account thus: They lay the Copperas Stones (which *Wormius* in his *Mus. c.* 13. *Sect.* 2. saith, are chiefly found in the Isle of *Shepey*; but are indeed gather'd upon the Coasts of *Kent* and *Sussex* in many Places) on a large Bed or Floor prepared in the open Air, underneath which there are Gutters or Troughs, disposed 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 thereby. This Liquor they boil in large Leaden-Pans, putting in a good quantity of old Iron: When 'tis sufficiently 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 reserved to be boiled and evaporated again.

Wormius saith, the Liquor is six or seven Days boiling to a due consistence; and that it can be boiled in nothing but a Leaden Vessel.

Matthiolus describes the way of making Vitriol in *Italy*, to be something different from ours; for, *he saith*, 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 grosser Matter hath subsided, and boil it to a due consistence, 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 his 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 *Guest, 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 he offended against the King's Peace, his Host was to see him forth-coming; and if he could not produce him in a Month and a Day, he was obliged to satisfy for his Offences.

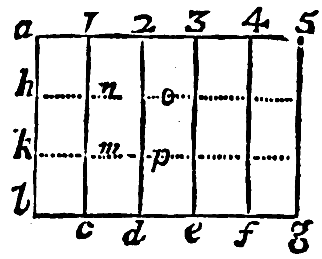
UNDER-*Chamberlain* of the *Exchequer*, is an Officer there that cleaves the Tallies, and reads the same; so that the Clerk of the Pell, and the Controllers thereof, may see that the Entries be true; he also makes searches for all Records in the Treasury, and hath the Custody of the Doomsday-Book. There are two Officers there of this Name.

UNGULA, in Geometry, is the Section of a Cylinder cut off by a Plane, which passes obliquely 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 a c*, *c* 2, 2 *e*, *e* 4, 4 *g*, do truly represent the Spaces described or run thro' with the Velocity *a b*, in the Times *a* 1; 1, 2; 2, 3; 3, 4; 4, 5.

From the bare Consideration 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 *a c*, *a d*, &c. having all the same Altitude, must be as their Bases, *b c*, *c d*, &c.

2. Or if the *Times* be equal, the *Spaces* must be as the *Velocities*; that is, the Parallelograms *a n* to *a m*, will be as *a h* to *a k*, &c.

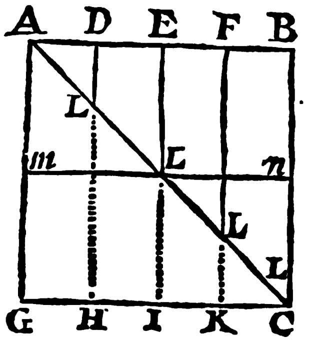
3. And from hence it will follow, that if the *Spaces* are as the *Velocities*, the *Times* will be equal; if as the *Times*, the *Velocities* will be equal.

4. Where the *Spaces* are equal, the *Times* must be *reciprocally* as *Velocities*: for the similar 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 *Velocity*, the Quotient will be the *Time*.

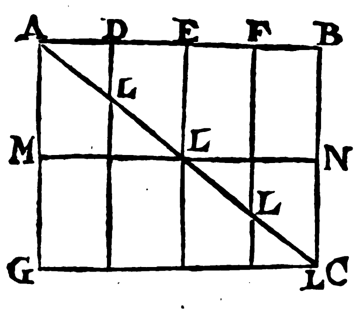
After much the same manner also may the uniform or equable Acceleration or Retardation of any Motion, be expressed very easily and clearly by *Lines*.

As



As suppose the right-lined Triangle A B C, the Side A B denotes the *Time* in which a Body may move from a Point of *Rest*, as in A; and having its Velocity continually encreasing in the uniform *Ratio* of the Lines D L, E L, F L, and B C; or decreasing equally back again in the same *Ratio*, from any determinate degree of it in B C, to none at all in A.

In this Figure then, the Triangles ALD, ALE, A L F, and A B C, will very appositely represent the *Spaces* described in the several Times A D, A E, A F, and A B; and consequently the *Trapezia* D L, D C, &c. will represent the *still aggregated Velocity*, and the *Spaces* corresponding thereunto. And from hence all the Laws and Affections of *equable accelerated Motions* will be easily accounted for; which are such as these, *viz.*

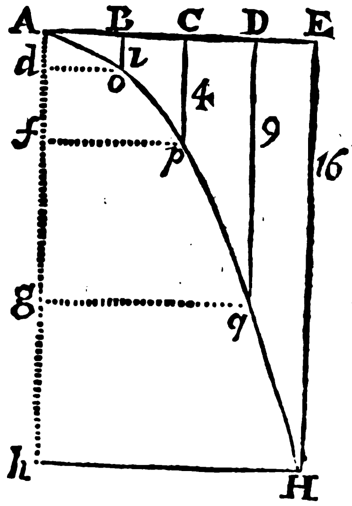


1. That the *Space* described at the end of the accelerated Motion, will be equal to *that* which would have been described by an uniform equal Motion in the same time, and with half the degree of Velocity which the accelerated Body did at last acquire: For the Triangle A C B is equal to the Square M B; each being the half of the Square G B.

2. 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 A D L, A E L, &c. are as the Squares of A D, A E, &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* A E H;



where the vertical Tangent A E, represents the determinate *Time* divided into equal Parts; and the Lines B O, C P, D q, and E H, the several Velocities required in the several Descents. Now the *Spaces* described, A B O, A C P, &c. are as the Squares of the *Times* A B, A C, &c. that is, as the Squares of the *Ordinates do, fp, gq,* &c. which Squares are (by the *Parabola*) as the *Abscissa* A d, A f, 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 consolidating 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 since 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.* N°. 134 tells us, that 'tis not the whole of the unstruck String that trembles, but the several Parts severally, according as they are Unisons 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 easily try, by laying a bit of Paper lightly wrapt about the middle of the second String. See a Solution of this in *Plot's Hist. of Oxfordshire*, by Dr. *Narcissus Marsh*, and of other such 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.*

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VOLVA, the great *Kepler* considering how our Earth will appear to the Inhabitants of the Moon, if there be any such, *viz.* that it will seem 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 easily discovered 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; this being the Phænomenon of the Earth to a Lunar Spectator, (*i. e.* to such as live on that side 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 something 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, *Privolvæ*.

VOMITIVE *Medicines*, see *Emeticks*; where there is an Account of their Operation, in Vol. I. and II.

URBICARIÆ *Regiones.* See *Suburbicariæ*.

USE in the *Civil Law*, is one of the *Personal Services*, and signifies 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 *Usufruct*; for he that hath this Right, cannot take the Profits generally, but only for his daily Use and necessary Subsistence.

USHER, *Ostiarius*, from the *French Huissier*, a Door-keeper of a Court, is an Officer in the Exchequer, of which sort 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 *Ushers* in the Queen's House, as of the Privy-Chamber, &c.

USUFRUCT, is a Personal 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 Octave, is said to be within the *Utas*. The Use of this is in Return of Writs, as appears by 51 *H.* 3. and *Preamble* to 43 *E.* 3.

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 Fee of that Lord.

UVEA, this is reckoned the fifth Coat of the Eye, and seems to be only the Circumference 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 Rays, in order to form the Vision of Objects more distinctly.

WAGA, or VAGA, the same with *Weigh*, which see in this Vol.

WAGE, *Vadiare*, from the *French Gager*, *dare Pignus*, signifies 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 assigned; 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 assign, to avow on their Oaths, that they believe he swears 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 Watch and Ward; it was payable at the Feast of St. *Martin*. This customary Acknowledgment is still paid within the Mannor of *Sutton Colfield*, in *Warwickshire*; and with some Ceremonies that are as singular as surprizing. *Cowel'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 Cart, with six Horses, two Ropes, and two Men in Harness, to watch the *Ward-Staff*, when it is brought to the Town of *Aibridge*.

WARRANTIA *Custodiæ*, is a Writ judicial; and formerly, before the Court of Wards was abolished, lay for him who was challenged, when a Ward to another, in respect of Land said to be holden in Knight-Service; which when it was bought by the Ancestors of the *Ward*, was war-

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warranted, to be free from ſuch Thraldom; and it lay againſt the *Warranter* and his Heirs.

WARRECTUM and *Warrecta Terra*, is Land long neglected and uncultivated; for in old Records you will find, that *Tempus Warrecti* ſignifies the Time that Land lies fallow. *Warrectare* alſo ſignifies to *fallow* Land.

WARREN, is a Franchiſe, or Place privileged, either by Preſcription or Grant from the Crown, to keep *Beaſts and Fowl of Warren*; which are Hares and Conies, Partridges and Pheaſants: 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 *Waſſel-Bowl* ſeems 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 Refectorio habens Vaſtellum*; that is, the Abbot had ſet by him at the upper-end of the Table, the *Waſtell*, or *Waſſel-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 *Waſſailing*, as 'tis ſtill called and uſed in *Suſſex*, and ſome other Places, ſeems to have taken its Name.

WATER. Sir *Iſ. Newton* defines Water (when pure) to be a very fluid Salt, volatile, and void of all Sapor or Taſte, and it ſeems to conſiſt of ſmall ſmooth 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 ſuch a manner, as to be pervious on all ſides. 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 *Poroſity* 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 few Particles of any Fluid, and faſten them to a ſolid Body, or keep them aſunder one from another, and they are no more fluid; for to produce *Fluidity*, a conſiderable number of ſuch 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 ſorts 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 *ſaline* 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, &c.

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 Buſhel. 'Tis now uſed for ſelling of Coals in the Pool, &c.

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 ſort of Ledge left in Stone or Brick-Walls, about 18 or 20 Inches from the Ground, and there the Thickneſs 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 *Conſulares*, *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 *Werlamſtreet*, (ſee *Hoveden*, *Part. prior. Annal. Fol.* 248.) was made from *Dover* to *London*, thence to *St. Albans*, *Dunſtable*, *Towceſter*, *Atherſton*, and the *Severn*; near the *Wrekin* in *Shropſhire*, extending itſelf to *Angleſey* in *Wales*. *Anno* 39 *Eliz.* *c.* 2.

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The second of these Ways is called *Ikemild-ſtreet*, (*ab Icenis*) and reached from *Southampton* over the River *Iſis*, at *Newbridge*; thence by *Cambden* and *Litchfield*, 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' *Devonſhire*, by *Tetbury*, near *Stow* in the *Wold*, and beſides *Coventry* to *Leiceſter*, *Newark*, and ſo to *Lincoln*.

The fourth was called *Ermine*, or *Erminage-ſtreet*, beginning at *St. David's* in *Wales*, and going to *Southampton*. See *Hollingſhed's Chron.* Vol. I. *c.* 19. and *Henry of Huntington*, Book I. at the beginning.

WAVESON, is the Term for ſuch Goods as, after Shipwreck, do appear ſwimming on the Waves.

WEALD, or *Weld*, is a *Saxon* Word, ſignifying the woody part of a Country: As the *Weald* of *Suſſex* and of *Kent*, in the Collect. of Statutes, 14 *Car.* 2. *c.* 6. 'Tis miſ-printed, as 'tis vulgarly pronounced, *The Wild of* Suſſex, *&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 ſail; which they call Weighing Anchor.

WEIGH of Cheeſe, Wool, *&c.* *Waga*, alias *Vaga*, is 256 Pound Weight Averdupois; for by 9 *H.* 6. *c.* 8. a Weigh of Cheeſe ought to contain 32 Cloves, and each Clove 8 Pound; tho' ſome ſay but 7.

WEDBEDRIP, was formerly a cuſtomary Service that inferior Tenants paid to their Lords, in cutting down their Corn, or doing other Harveſt Duties, *&c.*

WEIGHTS, in uſe in *England*, are chiefly of two ſorts: 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 & Menſuris*, 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 ſaith 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 ſuch Ounces made the Pound Troy. See 51 *H.* 3. 31 *Edw.* 1. and 12 *H.* 7.

But in latter Times, it was thought ſufficient to divide the aforeſaid Penny-Weight into 24 equal Parts, which came to be called *Grains*, being the ſmalleſt Weight now in common Uſe; tho' the Moneyers ſubdivide the Grain thus:

24 Blanks	make	1 Periot.
20 Periots		1 Droite.
24 Droits		1 Mite.
20 Mites		1 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 ſlowly, 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 ſaid *Right* or *Left-hand* 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 *Iſ. 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 Colours, but if leſs, to be a Mixture of the Colours of ſeveral Orders: Of the former ſort, he reckons

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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 stronger 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 requisite 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 Ball.

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.* N° 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 50 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 Champagne-Ground, Hilly, and void of Wood; as *Stow* in the *Wold*, and *Cotswold* 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

WRITS *Original*, which are sent out for the summoning 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 Rebellion*.

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.

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YARD-LAND, *Virgata Terræ*, is a Quantity of Land, various according to the Place: At *Wimbleton* in *Surrey* 'tis accounted fifteen Acres; in other Counties 'tis twenty; in ſome twenty-four, in ſome thirty, and in others even four Acres. In a MS. of the Abbacy of *Malmesbury*, a *Virgate of Land* is ſaid to contain twenty-four Acres. This uncertain Quantity in 28 *E.* 1. is called a *Verge of Land.*

YATCHES, are Veſſels with one Deck, carrying from 4 to 12 Guns, with from 20 to 40 Men; and are of Burden from 30 to 160 Tun. They draw little Water, and are uſed for running, and making ſhort Trips, *&c.* They are of ſeveral Makes and Forms.

YEARS-DAY, } See *Annualia*, this Vol.
YEARS-MIND, }

YEOMAN, a Derivative from the *Saxon Geman*, i. e. *Communis*, a Commoner; is our *Engliſh* Word for a Rank next in order below a Gentleman. *Camden* calls them *Ingenuous*; and his Notion of them the Statute confirms 6 *Rich.* 2. *cap.* 4. and 20 *Rich.* 2. *cap.* 2. Sir *Tho. Smith*, (in his *Republ. Anglor. lib.* 1. *cap.* 23.) ſaith, that Yeoman is the ſame with what our Law calls *Legalis Homo*, an *Engliſh* Free-born Man; and who can diſpend of his own Free-Land, in yearly Revenue, the Sum of Forty Shillings *Sterling.*

ZACCO, is the Term ſometimes uſed for the lower part of the Pedeſtal of a Column; and is in the form of a ſquare Brick or Tile.

ZOPERUS, a Term in Architecture, ſignifying the ſame with *Frieze.*

FINIS.

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A TABLE OF

Natural and Artificial *Sines*, *Tangents*, and *Secants*, to every Degree and Minute of the

QUADRANT,

The *Radius* of the Artificial being 10,0000000 and of the Natural 10,000,000.

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0 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	0	10000000	0	Infinit.	10000000	Infinit.	60
1	2909	9999999	2909	343774667	10000000	343774682	59
2	5818	9999998	5818	171887319	10000002	171887348	58
3	8727	9999996	8727	114591530	10000004	114591574	57
4	11636	9999993	11636	85943630	10000007	85943689	56
5	14544	9999989	14544	68754887	10000011	68754960	55
6	17453	9999989	17453	57295721	10000016	57295809	54
7	20362	9999979	20362	49110600	10000021	49110702	53
8	23271	9999973	23271	42971757	10000027	42971873	52
9	26180	9999966	26180	38197099	10000034	38197230	51
10	29089	9999958	29089	34377371	10000042	34377516	50
11	31998	9999949	31998	31252137	10000051	31252297	49
12	34906	9999939	34907	28647773	10000061	28647948	48
13	37815	9999928	37816	26444080	10000072	26444269	47
14	40724	9999917	40725	24555198	10000083	24555402	46
15	43633	9999905	43033	22918166	10000095	22918385	45
16	46542	9999892	46542	21485762	10000108	21485995	44
17	49451	9999878	49451	20221872	10000122	20222122	43
18	52360	9999863	52360	19098419	10000137	19098680	42
19	55268	9999847	55269	18093200	10000153	18093496	41
20	58177	9999831	58178	17188540	10000170	17188831	40
21	61086	9999813	61087	16370019	10000187	16370325	39
22	63995	9999795	63966	15625908	10000205	15626228	38
23	66904	9999776	66905	14946502	10000224	14946837	37
24	69813	9999756	69814	14323712	10000244	14324061	36
25	72721	9999736	72723	13750745	10000265	13751108	35
26	75630	9999714	75632	13221851	10000286	13222229	34
27	78539	9999692	78541	12732134	10000308	12732526	33
28	81448	9999668	81450	12277396	10000331	12277803	32
29	84357	9999644	84360	11854018	10000355	11854440	31
30	87265	9999619	87269	11458865	10000380	11459301	30
31	90174	9999593	90178	11089205	10000406	11089656	29
32	93083	9999566	93087	10742648	10000433	10743114	28
33	95992	9999539	95996	10417094	10000461	10417574	27
34	98900	9999511	98905	10110690	10000489	10111185	26
35	101809	9999482	101814	98217943	10000518	98223033	25
36	104718	9999452	104724	95489475	10000543	95494711	24
37	107627	9999421	107633	92908487	10000579	92913869	23
38	110532	9999389	110542	90463336	10000614	90468863	22
39	113444	9999356	113451	88143572	10000644	88149244	21
40	116353	9999323	116361	85939791	10000677	85945609	20
41	119261	9999289	119270	83843507	10000711	83849470	19
42	122170	9999254	122179	81847041	10000746	81853150	18
43	125079	9999218	125088	79943430	10000782	79949684	17
44	127987	9999181	127998	78126342	10000819	78132742	16
45	130896	9999143	130907	76390009	10000857	76396554	15
46	133805	9999104	133817	74729165	10000896	74735856	14
47	136713	9999065	136726	73138991	10000935	73145827	13
48	139622	9999025	139635	71615070	10000975	71622052	12
49	142530	9998984	142545	70153346	10001016	70160474	11
50	145439	9998942	145454	68750087	10001058	68757360	10
51	148348	9998899	148364	67401854	10001101	67409272	9
52	151256	9998855	151273	66105473	10001145	66113036	8
53	154165	9998811	154183	64858008	10001189	64865716	7
54	157073	9998766	157093	63656741	10001234	63664595	6
55	159982	9998720	160002	62499154	10001280	62507153	5
56	162890	9998673	162912	61382905	10001327	61391050	4
57	165799	9998625	165821	60305820	10001375	60314110	3
58	168707	9998576	168731	59265872	10001424	59274308	2
59	171616	9998527	171641	58261174	10001473	58269755	1
60	174524	9998477	174551	57289962	10001523	57298689	0
	N. Co-Sine.	N. Sine	N. Co Tang.	N. Tangent.	N. Co-Secant	N. Secant.	M

89 DEGREES.

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0 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant.	
0	0	10.0000000	0	Infinit.	10.0000000	Infinit.	60
1	6.4637261	9.9999999	6.4637261	13.5362739	10.0000000	13.5362739	59
2	6.7647561	9.9999999	6.7647562	13.2352438	10.0000001	13.2352439	58
3	6.9408473	9.9999998	6.9408475	13.0591525	10.0000002	13.0591527	57
4	7.0657360	9.9999997	7.0657863	12.9342137	10.0000003	12.9342140	56
5	7.1626960	9.9999995	7.1626964	12.8373036	10.0000005	12.8373040	55
6	7.2418771	9.9999993	7.2418778	12.7581222	10.0000007	12.7581229	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	10.0000015	12.5820319	51
10	7.4637255	9.9999982	7.4637273	12.5362727	10.0000018	12.5362745	50
11	7.5051181	9.9999978	7.5051203	12.4948797	10.0000022	12.4948819	49
12	7.5429065	9.9999974	7.5429091	12.4570909	10.0000026	12.4570935	48
13	7.5776684	9.9999969	7.5776715	12.4223285	10.0000031	12.4223316	47
14	7.6098530	9.9999964	7.6098566	12.3901434	10.0000036	12.3901470	46
15	7.6398160	9.9999959	7.6398201	12.3601799	10.0000041	12.3601840	45
16	7.6678445	9.9999953	7.6678492	12.3321508	10.0000047	12.3321555	44
17	7.6941733	9.9999947	7.6941786	12.3058214	10.0000053	12.3058267	43
18	7.7189966	9.9999940	7.7190026	12.2809974	10.0000060	12.2810034	42
19	7.7424775	9.9999934	7.7424841	12.2575159	10.0000066	12.2575225	41
20	7.7647537	9.9999927	7.7647610	12.2352390	10.0000073	12.2352463	40
21	7.7859427	9.9999919	7.7850508	12.2140492	10.0000081	12.2140173	39
22	7.8061458	9.9999911	7.8061547	12.1938453	10.0000089	12.1938542	38
23	7.8254507	9.9999903	7.8254604	12.1745396	10.0000097	12.1745493	37
24	7.8439338	9.9999894	7.8439444	12.1560556	10.0000106	12.1560662	36
25	7.8616623	9.9999885	7.8616738	12.1383262	10.0000115	12.1383377	35
26	7.8786953	9.9999876	7.8787077	12.1212923	10.0000124	12.1213047	34
27	7.8950854	9.9999866	7.8950988	12.1049012	10.0000134	12.1049146	33
28	7.9108793	9.9999856	7.9108938	12.0891062	10.0000144	12.0891207	32
29	7.9261190	9.9999845	7.9261344	12.0738656	10.0000155	12.0738810	31
30	7.9408419	9.9999835	7.9408584	12.0591416	10.0000165	12.0591581	30
31	7.9550819	9.9999823	7.9550996	12.0449004	10.0000177	12.0449181	29
32	7.9688698	9.9999812	7.9688886	12.0311114	10.0000188	12.0311302	28
33	7.9822334	9.9999800	7.9822534	12.0177466	10.0000200	12.0177066	27
34	7.9951980	9.9999788	7.9952192	12.0047808	10.0000212	12.0048020	26
35	8.0077867	9.9999775	8.0078092	11.9921908	10.0000225	11.9922133	25
36	8.0200207	9.9999762	8.0200445	11.9799555	10.0000238	11.9799793	24
37	8.0319195	9.9999748	8.0319446	11.9680554	10.0000252	11.9680805	23
38	8.0435009	9.9999735	8.0435274	11.9564726	10.0000265	11.9564991	22
39	8.0547814	9.9999721	8.0548094	11.9451906	10.0000279	11.9452186	21
40	8.0657763	9.9999706	8.0658057	11.9341943	10.0000294	11.9342237	20
41	8.0764997	9.9999691	8.0765306	11.9234694	10.0000309	11.9235003	19
42	8.0869646	9.9999676	8.0869970	11.9130030	10.0000324	11.9130354	18
43	8.0971832	9.9999660	8.0972172	11.9027828	10.0000340	11.9028168	17
44	8.1071669	9.9999644	8.1072025	11.8927975	10.0000356	11.8928331	16
45	8.1169262	9.9999628	8.1169634	11.8830366	10.0000372	11.8830738	15
46	8.1264710	9.9999611	8.1265099	11.8734901	10.0000389	11.8735290	14
47	8.1358104	9.9999594	8.1358510	11.8641490	10.0000406	11.8641896	13
48	8.1449532	9.9999577	8.1449956	11.8550044	10.0000423	11.8550468	12
49	8.1539075	9.9999559	8.1539516	11.8460484	10.0000441	11.8460925	11
50	8.1626808	9.9999541	8.1627267	11.8372733	10.0000459	11.8373192	10
51	8.1712804	9.9999522	8.1713282	11.8286718	10.0000478	11.8287196	9
52	8.1797129	9.9999503	8.1797626	11.8202374	10.0000497	11.8202871	8
53	8.1879848	9.9999484	8.1880364	11.8119636	10.0000516	11.8120152	7
54	8.1961020	9.9999464	8.1961556	11.8038444	10.0000536	11.8038980	6
55	8.2040703	9.9999444	8.2041259	11.7958741	10.0000556	11.7959297	5
56	8.2118949	9.9999424	8.2119526	11.7880474	10.0000576	11.7881051	4
57	8.2195811	9.9999403	8.2196408	11.7803592	10.0000597	11.7804189	3
58	8.2271335	9.9999382	8.2271953	11.7728047	10.0000618	11.7728665	2
59	8.2345568	9.9999360	8.2346208	11.7653792	10.0000640	11.7654432	1
60	8.2418553	9.9999338	8.2419215	11.7580785	10.0000662	11.7581447	0
	L. Co Sine.	L. Sine.	L. Co-Tang	L. Tangent	L. Co-Secant	L. Secant.	M.

89 DEGREES.

1 DEGREE

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N. Co-Secant.	
0	174524	9998477	174551	57289962	10001523	57298688	60
1	177432	9998426	177460	56350590	10001574	56359462	59
2	180341	9998374	180370	55441517	10001626	55450534	58
3	183249	9998321	183280	54561300	10001679	54570463	57
4	186158	9998267	186190	53708587	10001733	53717896	56
5	189066	9998212	189100	52882109	10001788	52891564	55
6	191974	9998157	192010	52080673	10001843	52090272	54
7	194883	9998101	194920	51303157	10001899	51312902	53
8	197791	9998044	197830	50548506	10001956	50558396	52
9	200699	9997986	200740	49815726	10002014	49825762	51
10	203608	9997927	203650	49103881	10002073	49114062	50
11	206516	9997867	206560	48412084	10002133	48422411	49
12	209424	9997806	209470	47739501	10002194	47749974	48
13	212332	9997745	212380	47085343	10002255	47095961	47
14	215241	9997682	215291	46448862	10002317	46459625	46
15	218149	9997620	218201	45829351	10002380	45840260	45
16	221057	9997556	221111	45226141	10002444	45237195	44
17	223965	9997491	224021	44638596	10002509	44649795	43
18	226873	9997425	226932	44066113	10002575	44077458	42
19	229781	9997359	229842	43508122	10002641	43519612	41
20	232690	9997292	232752	42964077	10002708	42975713	40
21	235598	9997224	235663	42433464	10002776	42445245	39
22	238506	9997155	238574	41915790	10002845	41927717	38
23	241414	9997085	241484	41410588	10002915	41422660	37
24	244322	9997014	244395	40917412	10002986	40929629	36
25	247230	9996943	247305	40435837	10003058	40448201	35
26	250138	9996871	250216	39965460	10003130	39977969	34
27	253046	9996798	253127	39505895	10003203	39518549	33
28	255954	9996724	256038	39056771	10003277	39069571	32
29	258862	9996649	258948	38617738	10003352	38630683	31
30	261769	9996573	261859	38188459	10003428	38201550	30
31	264677	9996496	264770	37768613	10003505	37781849	29
32	267585	9996419	267681	37357892	10003582	37371273	28
33	270493	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	10003900	35814517	24
37	282124	9996019	282236	35431282	10003982	35445391	23
38	285032	9995936	285148	35069546	10004065	35083800	22
39	287940	9995853	288059	34715115	10004148	34729515	21
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	10004578	33060300	16
45	305385	9995336	305528	32730264	10004667	32745536	15
46	308293	9995247	308439	32421295	10004756	32436713	14
47	311200	9995157	311351	32118099	10004846	32133663	13
48	314108	9995066	314263	31820516	10004937	31836125	12
49	317015	9994974	317174	31528392	10005029	31544246	11
50	319922	9994881	320086	31241577	10005122	31257577	10
51	322830	9994788	322998	30959928	10005215	30976074	9
52	325737	9994694	325910	30683307	10005309	30699598	8
53	328644	9994599	328822	30411580	10005405	30428017	7
54	331552	9994503	331734	30144619	10005501	30161201	6
55	334459	9994406	334646	29882299	10005598	29899026	5
56	337366	9994308	337558	29624499	10005696	29641373	4
57	340273	9994209	340471	29371106	10005795	29388124	3
58	343181	9994109	343383	29122005	10005894	29139169	2
59	346088	9994009	346295	28877089	10005995	28894398	1
60	348995	9993908	349208	28636253	10006095	28653708	0
	N. Co-Sine.	N. Sine	N. Co Tang.	N. Tangent.	N. Co-Secant	N. Secant.	M

88 DEGREES

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1 DEGREE.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	8.2418553	9.9999338	8.2419215	11.7580785	10.0000661	11.7581447	60
1	8.2490332	9.9999316	8.2491015	11.7508985	10.0000684	11.7509668	59
2	8.2560943	9.9999294	8.2561649	11.7438351	10.0000706	11.7439057	58
3	8.2630424	9.9999271	8.2631153	11.7368847	10.0000729	11.7369576	57
4	8.2698810	9.9999247	8.2699563	11.7300437	10.0000753	11.7301890	56
5	8.2766136	9.9999224	8.2766912	11.7233088	10.0000776	11.7233864	55
6	8.2832434	9.9999200	8.2833234	11.7166766	10.0000800	11.7167566	54
7	8.2897734	9.9999175	8.2898559	11.7101441	10.0000825	11.7102266	53
8	8.2962067	9.9999150	8.2962917	11.7037083	10.0000850	11.7037933	52
9	8.3025460	9.9999125	8.3026335	11.6973665	10.0000875	11.6974540	51
10	8.3087941	9.9999100	8.3088842	11.6911158	10.0000900	11.6912059	50
11	8.3149536	9.9999074	8.3150462	11.6849538	10.0000926	11.6850464	49
12	8.3210269	9.9999047	8.3211221	11.6788779	10.0000953	11.6789731	48
13	8.3270163	9.9999021	8.3271143	11.6728857	10.0000979	11.6729837	47
14	8.3329243	9.9998994	8.3330249	11.6669751	10.0001006	11.6670757	46
15	8.3387529	9.9998966	8.3388563	11.6611437	10 0001034	11.6612471	45
16	8.3445043	9.9998939	8.3446105	11.6553895	10.0001061	11.6554957	44
17	8.3501805	9.9998911	8.3502895	11.6497105	10.0001089	11.6498195	43
18	8.3557835	9.9998882	8.3558953	11.6441047	10.0001118	11.6442165	42
19	8.3613150	9.9998853	8.3614297	11.6385703	10.0001147	11.6386850	41
20	8.3667769	9.9998824	8.3668945	11.6331055	10.0001176	11.6332231	40
21	8.3721710	9.9998794	8.3722915	11.6277085	10.0001206	11.6278290	39
22	8.3774988	9.9998764	8.3776223	11.6223777	10.0001236	11.5225012	38
23	8.3827620	9.9998734	8.3828886	11.6171114	10.0001266	11.6172380	37
24	8.3879622	9.9998703	8.3880918	11.6119082	10.0001297	11.6120378	36
25	8.3931008	9.9998672	8.3932336	11.6067664	10.0001328	11.6068992	35
26	8 3981793	9.9998641	8.3983152	11.6016848	10.0001359	11.6018207	34
27	8.4031990	9.9998609	8.4033381	11.5966619	10.0001391	11.5968010	33
28	8.4081614	9.9998577	8.4083037	11.5916963	10.0001423	11.5918386	32
29	8.4130676	9.9998544	8.4132132	11.5867868	10.0001456	11.5869324	31
30	8.4179190	9.9998512	8.4180679	11.5819321	10.0001488	11.5820810	30
31	8.4227168	9.9998478	8.4228690	11.5771310	10.0001522	11.5772832	29
32	8.4274621	9 9998445	8.4276176	11.5723824	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	11.5586056	25
36	8.4459409	9.9998306	8.4461103	11.5538897	10.0001694	11.5540591	24
37	8.4504402	9.9998271	8.4506131	11.5493869	10.0001729	11.5495598	23
38	8.4548934	9 9998235	8.4550699	11.5449301	10.0001765	11.5451066	22
39	8.4593013	9.9998199	8.4594814	11.5405186	10.0001801	11.5406987	21
40	8.4636649	9.9998162	8 4638486	11.5361514	10.0001838	11.5363351	20
41	8.4679850	9.9998125	8.4681725	11.5318275	10.0001875	11.5320150	19
42	8.4722626	9.9998088	8.4724538	11.5275462	10.0001912	11.5277374	18
43	8.4764984	9.9998050	8.4766933	11.5233067	10.0001950	11.5235016	17
44	8.4806932	9.9998012	8.4808920	11.5191080	10.0001980	11.5193068	16
45	8.4848479	9.9997974	8.4850505	11.5149495	10.0002026	11.5151521	15
46	8.4889632	9.9997935	8.4891696	11.5108304	10.0002065	11.5110368	14
47	8.4930398	9.9997896	8.4932502	11.5067498	10.0002104	11.5069602	13
48	8.4970784	9.9997856	8.4972928	11.5027072	10.0002144	11.5029216	12
49	8.5010798	9.9997817	8.5012982	11.4987018	10.0002183	11.4989202	11
50	8.5050447	9.9997776	8.5052672	11.4947329	10.0002224	11.4949553	10
51	8.5089736	9.9997736	8.5092001	11.4907999	10.0002264	11.4910264	9
52	8.5128673	9.9997695	8.5130978	11.4869022	10.0002305	11.4871327	8
53	8.5167264	9.9997653	8.5169610	11.4830387	10.0002347	11.4832736	7
54	8.5205514	9.9997612	8.5207902	11.4792098	10.0002388	11.4794486	6
55	8.5243430	9.9997570	8.5245860	11.4754140	10.0002430	11.4756570	5
56	8.5281017	9.9997527	8.5283490	11.4716510	10.0002473	11.4718983	4
57	8.5318281	9.9997484	8.5320797	11.4679203	10.0002516	11.4681719	3
58	8.5355228	9.9997441	8.5357787	11.4642213	10.0002559	11.4644772	2
59	8.5391863	9.9997398	8.5394466	11.4605534	10.0002602	11.4608137	1
60	8.5428192	9.9997354	8.5430838	11.4569162	10.0002646	11.4571808	0
	L. CoSine.	L. Sine	L. Co.Tang.	L. Tangent.	L Co-Secant.	L. Secant.	M

88 DEGREES.

2 DEGREES.

M	N. Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant.	
0	348995	9993908	349208	28636253	10006095	28653708	60
1	351902	9993805	352120	28399397	10006197	28416997	59
2	354809	9993703	355033	28166422	10006300	28184168	58
3	357716	9993599	357945	27937233	10006404	27955125	57
4	360623	9993495	360858	27711740	10006509	27729777	56
5	363530	9993390	363771	27489853	10006615	27508035	55
6	366437	9993284	366683	27271486	10006721	27289814	54
7	369344	9993177	369596	27056557	10006828	27075030	53
8	372251	9993069	372509	26844984	10006936	26863603	52
9	375158	9992960	375422	26636690	10007045	26655455	51
10	378065	9992851	378335	26431600	10007155	26450510	50
11	380071	9992740	381248	26229638	10007266	26248694	49
12	383878	9992629	384161	26030736	10007377	26049937	48
13	386785	9992517	387074	25834823	10007489	25854169	47
14	389691	9992404	389988	25641832	10007602	25661324	46
15	392598	9992290	392901	25451700	10007716	25471327	45
16	395505	9992175	395814	25264361	10007831	25284144	44
17	398411	9992060	398728	25079757	10007947	25099685	43
18	401318	9991944	401641	24897826	10008063	24917900	42
19	404224	9991827	404555	24718512	10008180	24738731	41
20	407131	9991709	407469	24541758	10008298	24562123	40
21	410037	9991590	410383	24367509	10008417	24388020	39
22	412944	9991440	413296	24195714	10008537	24216370	38
23	415850	9991349	416210	24026320	10008658	24047121	37
24	418757	9991228	419124	23859277	10008780	23880224	36
25	421663	9991106	422038	23694537	10008902	23715630	35
26	424569	9990983	424952	23532052	10009025	23553290	34
27	427475	9990859	427866	23371777	10009149	23393161	33
28	430382	9990734	430781	23213666	10009274	23235196	32
29	433288	9990608	433695	23057677	10009400	23079351	31
30	436194	9990482	436609	22903765	10009527	22925586	30
31	439100	9990355	439524	22751892	10009655	22773857	29
32	442006	9990227	442438	22602015	10009783	22624126	28
33	444912	9990098	445353	22454096	10009912	22476352	27
34	447818	9989968	448268	22308097	10010042	22330499	26
35	450724	9989837	451182	22163980	10010173	22186528	25
36	453630	9989705	454097	22021710	10010305	2204440[illegible]	24
37	456536	9989573	457012	21881251	10010438	21904090	23
38	459442	9989440	459927	21742569	10010571	21765553	22
39	462347	9989306	462842	21605630	10010705	21628755	21
40	465253	9989171	465757	21470401	10010840	21493676	20
41	468159	9989035	468673	21336851	10010976	21360272	19
42	471064	9988898	471588	21204949	10011113	21228515	18
43	473970	9988761	474503	21074664	10011251	21098375	17
44	476876	9988623	477419	20945966	10011390	20969824	16
45	479781	9988484	480334	20818828	10011530	20842830	15
46	482687	9988344	483250	20693220	10011670	20717368	14
47	485592	9988203	486166	20569115	10011811	20593409	13
48	488498	9988061	489082	20446486	10011953	20470925	12
49	491403	9987918	491997	20325307	10012096	203498[illegible]2	11
50	494308	9987775	494913	20205553	10012240	20230284	10
51	497214	9987631	497829	20087199	10012385	20112075	9
52	500119	9987486	500746	19970219	10012530	1999524[illegible]	8
53	503024	9987340	503662	19854591	10012676	19879758	7
54	505929	9987193	506578	19740291	10012823	1976560[illegible]	6
55	508835	9987045	509495	19627296	10012971	1965275[illegible]	5
56	511740	9986897	512411	19515584	10013120	1954118[illegible]	4
57	514645	9986748	515328	19405133	10013270	19430882	3
58	517550	9986598	518244	19295922	10013420	19321816	2
59	520455	9986447	521161	19187930	10013571	1921397[illegible]	1
60	523360	9986295	524078	19081137	10013723	1910732[illegible]	0
	N Co-Sine.	N Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant.	M

87 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
2 DEGREES.							
0	8.5428192	9.9997354	8.5430838	11.4569162	10.0002646	11.4[illegible]	60
1	8.5464218	9.9997309	8.5466909	11.4533091	10.0002691	11.453578[illegible]	59
2	8.5499948	9.9997265	8.5502683	11.4497317	10.0002735	11.4500052	58
3	8.5535386	9.9997220	8.5538166	11.4461834	10.0002780	11.4464614	57
4	8.5570536	9.9997174	8.5573362	11.4426638	10.0002826	11.4429464	56
5	8.5605404	9.9997128	8.5608276	11.4391724	10.0002872	11.4394596	55
6	8.5639994	9.9997082	8.5642912	11.4357088	10.0002918	11.4360006	54
7	8.5674310	9.9997036	8.5677275	11.4322725	10.0002964	11.4325690	53
8	8.5708357	9.9996989	8.5711368	11.4288632	10.0003011	11.4291643	52
9	8.5742139	9.9996942	8.5745197	11.4254803	10.0003058	11.4257861	51
10	8.5775660	9.9996894	8.5778766	11.4221234	10.0003106	11.4224340	50
11	8.5808923	9.9996846	8.5812077	11.4187923	10.0003154	11.4191077	49
12	8.5841933	9.9996798	8.5845136	11.4154864	10.0003202	11.4158067	48
13	8.5874694	9.9996745	8.5877945	11.4122055	10.0003251	11.4125306	47
14	8.5907209	9.9996700	8.5910509	11.4089491	10.0003300	11.4092791	46
15	8.5939483	9.9996650	8.5942832	11.4057168	10.0003350	11.4060517	45
16	8.5971517	9.9996601	8.5974917	11.4025083	10.0003399	11.4028483	44
17	8.6003317	9.9996550	8.6006767	11.3993233	10.0003450	11.3996683	43
18	8.6034886	9.9996500	8.6038386	11.3961614	10.0003500	11.3965114	42
19	8.6066226	9.9996449	8.6069777	11.3930223	10.0003551	11.3933774	41
20	8.6097341	9.9996398	8.6100943	11.3899057	10.0003602	11.3902659	40
21	8.6128235	9.9996346	8.6131889	11.3868111	10.0003654	11.3871765	39
22	8.6158910	9.9996264	8.6162616	11.3837384	10.0003706	11.3841090	38
23	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
25	8.6249653	9.9996136	8.6253518	11.3746482	10.0003864	11.3750347	35
26	8.6279484	9.9996082	8.6283402	11.3716598	10.0003918	11.3720516	34
27	8.6309111	9.9996028	8.6313083	11.3686917	10.0003972	11.3690889	33
28	8.6338537	9.9995974	8.6342563	11.3657437	10.0004026	11.3661463	32
29	8.6367764	9.9995919	8.6371845	11.3628155	10.0004181	11.3632236	31
30	8.6396796	9.9995865	8.6400931	11.3599059	10.0004135	11.3603204	30
31	8.6425634	9.9995809	8.6429825	11.3570175	10.0004191	11.3574366	29
32	8.6454282	9.9995753	8.6458528	11.3541472	10.0004247	11.3545718	28
33	8.6482742	9.9995697	8.6487044	11.3512956	10.0004303	11.3517258	27
34	8.6511016	9.9995641	8.6515375	11.3484625	10.0004359	11.3488984	26
35	8.6539107	9.9995584	8.6543522	11.3456478	10.0004416	11.3460893	25
36	8.6567017	9.9995527	8.6571490	11.3428510	10.0004473	11.3432983	24
37	8.6594748	9.9995469	8.6599279	11.3400721	10.0004530	11.3405252	23
38	8.6622303	9.9995411	8.6626891	11.3373109	10.0004589	11.3377697	22
39	8.6649684	9.9995353	8.6654331	11.3345669	10.0004647	11.3350316	21
40	8.6676893	9.9995295	8.6681598	11.3318402	10.0004705	11.3323107	20
41	8.6703932	9.9995236	8.6708697	11.3291303	10.0004764	11.3296068	19
42	8.6730804	9.9995176	8.6735628	11.3264372	10.0004824	11.3269196	18
43	8.6757510	9.9995116	8.6762393	11.3237607	10.0004884	11.3242490	17
44	8.6784052	9.9995056	8.6788996	11.3211004	10.0004944	11.3215948	16
45	8.6810433	9.9994996	8.6815437	11.3184563	10.0005004	11.3189567	15
46	8.6836654	9.9994935	8.6841719	11.3158281	10.0005065	11.3163346	14
47	8.6862718	9.9994874	8.6867844	11.3132156	10.0005126	11.313728[illegible]	13
48	8.6888625	9.9994812	8.6893813	11.3106187	10.0005188	11.3111375	12
49	8.6914379	9.9994750	8.6919629	11.3080371	10.0005250	11.3085621	11
50	8.6939980	9.9994688	8.6945292	11.3054708	10.0005312	11.3060019	10
51	8.6965431	9.9994625	8.6970806	11.3029194	10.0005375	11.3034569	9
52	8.6990734	9.9994562	8.6996173	11.3003828	10.0005438	11.3009266	8
53	8.7015889	9.9994498	8.7021390	11.2978610	10.0005502	11.2984111	7
54	8.7040899	9.9994435	8.7046465	11.2953535	10.0005565	11.2959101	6
55	8.7065766	9.9994370	8.7071395	11.2928605	10.0005630	11.2934234	5
56	8.7090490	9.9994306	8.7096185	11.2903815	10.0005694	11.2909510	4
57	8.7115075	9.9994241	8.7120834	11.2879166	10.0005759	11.2884925	3
58	8.7139520	9.9994176	8.7145345	11.2854655	10.0005824	11.2860480	2
59	8.7163829	9.9994110	8.7169719	11.2830281	10.0005890	11.2836171	1
60	8.7188002	9.9994044	8.7193958	11.2806042	10.0005956	11.2811998	0
	L. CoSine.	L. Sine	L. Co.Tang.	L. Tangent.	L Co-Secant.	L. Secant.	M
87 DEGREES.							

3 DEGREES

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant.	
0	523360	9986295	524078	19081137	10013723	19107323	60
1	526264	9986142	526995	18975523	10013876	19004854	59
2	529169	9985989	529912	18871053	10014030	18897545	58
3	532074	9985835	532829	18767754	10014185	18794376	57
4	534979	9985680	535746	18665562	10014341	18692330	56
5	537883	9985524	538663	18564473	10014498	18591387	55
6	540788	9985367	541581	18464471	10014655	18491530	54
7	543693	9985209	544498	18365537	10014813	18392742	53
8	546597	9985050	547416	18267654	10014972	18295005	52
9	549502	9984891	550333	18170807	10015132	18198303	51
10	552406	9984731	553251	18074977	10015293	18102619	50
11	555311	9984570	556169	17980150	10015455	18007937	49
12	558215	9984408	559087	17886310	10015617	17914243	48
13	561119	9984245	562005	17793442	10015780	17821520	47
14	564024	9984081	564923	17701529	10015944	17729753	46
15	566928	9983916	567841	17610559	10016109	17638928	45
16	569832	9983751	570759	17520516	10016275	17549030	44
17	572736	9983585	573678	17431385	10016442	17460045	43
18	575640	9983418	576596	17343155	10016610	17371960	42
19	578544	9983250	579515	17255809	10016778	17284761	41
20	581448	9983081	582434	17169337	10016947	17198434	40
21	584352	9982911	585352	17083724	10017117	17112960	39
22	587256	9982741	588271	16998957	10017288	17028346	38
23	590160	9982570	591190	16915025	10017460	16944559	37
24	593064	9982398	594109	16831915	10017633	16861594	36
25	595967	9982225	597029	16749614	10017807	16779439	35
26	598871	9982051	599948	16668112	10017981	16698082	34
27	601775	9981876	602867	16587396	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	10018866	16302873	29
32	616292	9980991	617466	16195225	10019046	16226069	28
33	619196	9980811	620386	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	10019956	15852676	23
38	633711	9979900	634988	15748337	10920141	15780054	22
39	636614	9979715	637908	15676233	10020326	15708096	21
40	639517	9979529	640829	15604784	10020512	15636793	20
41	642420	9979343	643750	15533981	10020699	15566135	19
42	645323	9979156	646671	15463814	10020887	15496114	18
43	648226	9978968	649592	15394276	10021076	15426721	17
44	651129	9978779	652513	15325358	10021266	15357949	16
45	654031	9978589	655435	15257052	10021457	15289788	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	10022228	15023103	11
50	668544	9977627	670043	14924417	10022423	14957882	10
51	671446	9977432	672965	14859615	10022619	14893226	9
52	674348	9977236	675887	14795372	10022816	14829128	8
53	677251	9977039	678809	14731679	10023013	14765580	7
54	680153	9976842	681732	14668529	10023211	14702576	6
55	683055	9976644	684654	14605916	10023410	14640109	5
56	685957	9976445	687577	14543833	10023610	14578171	4
57	688859	9976245	690499	14482273	10023811	14516767	3
58	691761	9976044	693422	14421230	10024013	14455859	2
59	694663	9975842	696345	14360696	10024216	14395471	1
60	697565	9975640	699268	14300666	10024419	14335587	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant.	M

86 DEGREES.

3 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	8.7188002	9.9994044	8.7193958	11.2806042	10.0005956	11.2811998	60
1	8.7212040	9.9993978	8.7218063	11.2781937	10.0006022	11.2787960	59
2	8.7235946	9.9993911	8.7242035	11.2757965	10.0006089	11.2764054	58
3	8.7259721	9.9993844	8.7265877	11.2734123	10.0006156	11.2740279	57
4	8.7283365	9.9993776	8.7289589	11.2710411	10.0006224	11.2716634	56
5	8.7306882	9.9993708	8.7313174	11.2686826	10.0006292	11.2693118	55
6	8.7330272	9.9993640	8.7336631	11.2663369	10.0006360	11.2669728	54
7	8.7353535	9.9993572	8.7359964	11.2640036	10.0006428	11.2646465	53
8	8.7376675	9.9993503	8.7383172	11.2616828	10.0006497	11.2623325	52
9	8.7399691	9.9993433	8.7406258	11.2593742	10.0006567	11.2600309	51
10	8.7422586	9.9993364	8.7429222	11.2570778	10.0006636	11.2577414	50
11	8.7445360	9.9993293	8.7452067	11.2547933	10.0006707	11.2554640	49
12	8.7468015	9.9993223	8.7474792	11.2525208	10.0006777	11.2531985	48
13	8.7490553	9.9993152	8.7497400	11.2502600	10.0006848	11.2509447	47
14	8.7512973	9.9993081	8.7519892	11.2480108	10.0006919	11.2487027	46
15	8.7535278	9.9993009	8.7542269	11.2457731	10.0006991	11.2464722	45
16	8.7557469	9.9992938	8.7564531	11.2435469	10.0007060	11.2442531	44
17	8.7579546	9.9992865	8.7586681	11.2413319	10.0007135	11.2420454	43
18	8.7601512	9.9992793	8.7608719	11.2391282	10.0007207	11.2398488	42
19	8.7623366	9.9992720	8.7630647	11.2369353	10.0007280	11.2376634	41
20	8.7645111	9.9992646	8.7652465	11.2347535	10.0007354	11.2354889	40
21	8.7666747	9.9992572	8.7674175	11.2325825	10.0007428	11.2333253	39
22	8.7688275	9.9992498	8.7695777	11.2304222	10.0007502	11.2311725	38
23	8.7709697	9.9992424	8.7717274	11.2282726	10.0007576	11.2290303	37
24	8.7731014	9.9992349	8.7738665	11.2261335	10.0007651	11.2268986	36
25	8.7752216	9.9992274	8.7759952	11.2240048	10.0007726	11.2247774	35
26	8.7773334	9.9992198	8.7781136	11.2218864	10.0007802	11.2226666	34
27	8.7794340	9.9992122	8.7802218	11.2197782	10.0007878	11.2205660	33
28	8.7815244	9.9992046	8.7823199	11.2176801	10.0007954	11.2184756	32
29	8.7836048	9.9991969	8.7844079	11.2155921	10.0008031	11.2163952	31
30	8.7856753	9.9991892	8.7864861	11.2135139	10.0008108	11.2143247	30
31	8.7877359	9.9991815	8.7885544	11.2114456	10.0008185	11.2122641	29
32	8.7897867	9.9991737	8.7906130	11.2093870	10.0008263	11.2102133	28
33	8.7918278	9.9991659	8.7926620	11.2073380	10.0008341	11.2081722	27
34	8.7938594	9.9991580	8.7947014	11.2052986	10.0008420	11.2061406	26
35	8.7958814	9.9991501	8.7967313	11.2032687	10.0008499	11.2041186	25
36	8.7978941	9.9991422	8.7987519	11.2012481	10.0008578	11.2021059	24
37	8.7998974	9.9991342	8.8007632	11.1992368	10.0008658	11.2001026	23
38	8.8018915	9.9991262	8.8027653	11.1972347	10.0008738	11.1981085	22
39	8.8038764	9.9991182	8.8047583	11.1952417	10.0008818	11.1961236	21
40	8.8058523	9.9991101	8.8067422	11.1932578	10.0008899	11.1941477	20
41	8.8078192	9.9991020	8.8087172	11.1912828	10.0008980	11.1921808	19
42	8.8097772	9.9990938	8.8106834	11.1892166	10.0009062	11.1902228	18
43	8.8117264	9.9990856	8.8126407	11.1873593	10.0009144	11.1882736	17
44	8.8136668	9.9990774	8.8145894	11.1854106	10.0009226	11.1863332	16
45	8.8155985	9.9990691	8.8165294	11.1834706	10.0009309	11.1844015	15
46	8.8175217	9.9990608	8.8184608	11.1815392	10.0009392	11.1824783	14
47	8.8194363	9.9990525	8.8203838	11.1796162	10.0009475	11.1805637	13
48	8.8213425	9.9990441	8.8222984	11.1777016	10.0009559	11.1786575	12
49	8.8232404	9.9990357	8.8242046	11.1757954	10.0009643	11.1767596	11
50	8.8251299	9.9990273	8.8261026	11.1738974	10.0009727	11.1748701	10
51	8.8270112	9.9990188	8.8279924	11.1720076	10.0009812	11.1729888	9
52	8.8288844	9.9990103	8.8298741	11.1701259	10.0009897	11.1711156	8
53	8.8307495	9.9990017	8.8317478	11.1682522	10.0009983	11.1692505	7
54	8.8326066	9.9989931	8.8336134	11.1663866	10.0010069	11.1673934	6
55	8.8344557	9.9989845	8.8354712	11.1645288	10.0010155	11.1655443	5
56	8.8362969	9.9989758	8.8373211	11.1626789	10.0010242	11.1637031	4
57	8.8381304	9.9989671	8.8391633	11.1608367	10.0010329	11.1618696	3
58	8.8399561	9.9989584	8.8409977	11.1590023	10.0010416	11.1600439	2
59	8.8417741	9.9989496	8.8428245	11.1571755	10.0010504	11.1582259	1
60	8.8435845	9.9989408	8.8446437	11.1553563	10.0010592	11.1564155	0
	L. CoSine.	L. Sine	L. Co.Tang.	L. Tangent.	L Co-Secant.	L. Secant.	M

86 DEGREES.

4 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	697565	9975640	699268	14300666	10024419	14335587	60
1	700466	9975437	702191	14241134	10024623	14276200	59
2	703368	9975233	705115	14182092	10024828	14217304	58
3	706270	9975028	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
7	717876	9974199	719733	13894045	10025868	13929985	53
8	720777	9973990	722657	13837827	10026078	13873913	52
9	723678	9973780	725581	13782060	10026289	13818291	51
10	726580	9973569	728505	13726738	10026501	13763115	50
11	729481	9973357	731430	13671856	10026714	13708379	49
12	732382	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	9972286	746053	13403867	10027791	13441118	44
17	746887	9972069	748979	13351518	10028009	13388914	43
18	749787	9971851	751904	13299574	10028228	13337116	42
19	752688	9971632	754829	13248031	10028448	13285719	41
20	755589	9971413	757755	13196883	10028668	13234710	40
21	758489	9971193	760680	13146127	10028889	13184106	39
22	761390	9970972	763606	13095757	10029111	13133882	38
23	764290	9970750	766532	13045769	10029334	13084040	37
24	767190	9970527	769458	12996160	10029558	13034576	36
25	770091	9970303	772384	12946924	10029783	12985486	35
26	772991	9970079	775311	12898058	10030009	12936765	34
27	775891	9969854	778237	12849557	10030236	12888410	33
28	778791	9969628	781164	12801417	10030464	1284[illegible]415	32
29	781691	9969401	784090	12753634	10030692	12792779	31
30	784591	9969173	787017	12706205	10030922	12745495	30
31	787491	9968944	789944	12659125	10031152	12698560	29
32	790391	9968715	792871	12612390	10031382	12651971	28
33	793290	9968485	795798	12565997	10031615	12605724	27
34	796190	9968254	798726	12519942	10031848	12559815	26
35	799090	9968022	801653	12474221	10032081	12514240	25
36	801989	9967789	804581	12428831	10032315	12468995	24
37	804889	9967555	807509	12383768	10032550	12424078	23
38	807788	9967320	810437	12339028	10032786	12379484	22
39	810687	9967085	813365	12294608	10033023	12335210	21
40	813587	9966849	816293	12250[illegible]05	10033261	12291252	20
41	816486	9966612	819221	12206716	10033500	12247608	19
42	819385	9966374	822150	12163236	10033740	12204274	18
43	822284	9966135	825078	12120062	10033980	12161246	17
44	825183	9965895	828007	12077192	10034221	12118522	16
45	828082	9965655	830936	12034622	10034463	12076098	15
46	830981	9965414	833865	11992349	10034706	12033970	14
47	833880	9965172	836794	11950370	10034950	11992137	13
48	836778	9964929	839723	11908682	10035195	11950595	12
49	839677	9964685	842653	11867282	10035441	11909340	11
50	842576	9964440	845583	11826167	10035687	11868370	10
51	845474	9964194	848512	11785333	10035934	11827683	9
52	848373	9963948	851442	11744779	10036182	11787274	8
53	851271	9963701	854372	11704500	10036431	11747141	7
54	854169	9963453	857302	11664495	10036681	11707282	6
55	857067	9963204	860233	11624761	10036932	11667693	5
56	859966	9962954	863163	11585294	10037184	11628372	4
57	862864	9962703	866094	11546093	10037436	11589316	3
58	865762	9962452	869025	11507154	10037689	11550523	2
59	868660	9962200	871956	11468474	10037943	11511990	1
60	871557	9961947	874887	11430052	10038198	11473713	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant.	M

85 DEGREES.

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4 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant.	
0	8.8435845	9.9989408	8.8446437	11.1553563	10.0010592	11.1564155	60
1	8.8453874	9.9989319	8.8464554	11.1535446	10.0010681	11.1546126	59
2	8.8471827	9.9989230	8.8482597	11.1517403	10.0010770	11.1528173	58
3	8.8489707	9.9989141	8.8500566	11.1499434	10.0010859	11.1510293	57
4	8.8507512	9.9989052	8.8518461	11.1481539	10.0010948	11.1492488	56
5	8.8525245	9.9988962	8.8536283	11.1463717	10.0011038	11.1474755	55
6	8.8542905	9.9988871	8.8554034	11.1445966	10.0011129	11.1457095	54
7	8.8560493	9.9988780	8.8571713	11.1428287	10.0011220	11.1439507	53
8	8.8578010	9.9988689	8.8589321	11.1410679	10.0011311	11.1421990	52
9	8.8595457	9.9988598	8.8606859	11.1393141	10.0011402	11.1404543	51
10	8.8612833	9.9988506	8.8624327	11.1375673	10.0011494	11.1387167	50
11	8.8630139	9.9988414	8.8641725	11.1358275	10.0011586	11.1369861	49
12	8.8647376	9.9988321	8.8659055	11.1340945	10.0011679	11.1352624	48
13	8.8664545	9.9988228	8.8676317	11.1323683	10.0011772	11.1335455	47
14	8.8681646	9.9988135	8.8693511	11.1306489	10.0011865	11.1318354	46
15	8.8698680	9.9988041	8.8710638	11.1289362	10.0011959	11.1301320	45
16	8.8715646	9.9987947	8.8727699	11.1272301	10.0012053	11.1284354	44
17	8.8732546	9.9987853	8.8744694	11.1255306	10.0012147	11.1267454	43
18	8.8749381	9.9987758	8.8761623	11.1238377	10.0012242	11.1250619	42
19	8.8766150	9.9987663	8.8778487	11.1221513	10.0012337	11.1233850	41
20	8.8782854	9.9987567	8.8795286	11.1204714	10.0012433	11.1217146	40
21	8.8799493	9.9987471	8.8812022	11.1187978	10.0012529	11.1200507	39
22	8.8816069	9.9987375	8.8828694	11.1171306	10.0012625	11.1183931	38
23	8.8832581	9.9987278	8.8845303	11.1154697	10.0012722	11.1167419	37
24	8.8849031	9.9987181	8.8861850	11.1138150	10.0012819	11.1150969	36
25	8.8865418	9.9987084	8.8878334	11.1121666	10.0012916	11.1134582	35
26	8.8881743	9.9986986	8.8894757	11.1105243	10.0013014	11.1118257	34
27	8.8898007	9.9986888	8.8911119	11.1088881	10.0013112	11.1101993	33
28	8.8914209	9.9986790	8.8927420	11.1072580	10.0013210	11.1085791	32
29	8.8930351	9.9986691	8.8943660	11.1056340	10.0013309	11.1069649	31
30	8.8946433	9.9986591	8.8959842	11.1040158	10.0013409	11.1053567	30
31	8.8962455	9.9986492	8.8975963	11.1024037	10.0013508	11.1037545	29
32	8.8978418	9.9986392	8.8992026	11.1007974	10.0013608	11.1021582	28
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	11.0960134	10.0013910	11.0974045	25
36	8.9041685	9.9985988	8.9055697	11.0944303	10.0014012	11.0958315	24
37	8.9057358	9.9985886	8.9071472	11.0928528	10.0014014	11.0942642	23
38	8.9072975	9.9985784	8.9087190	11.0912810	10.0014216	11.0927025	22
39	8.9088535	9.9985682	8.9102853	11.0897147	10.0014318	11.0911465	21
40	8.9104039	9.9985579	8.9118460	11.0881540	10.0014421	11.0895961	20
41	8.9119487	9.9985475	8.9134012	11.0865988	10.0014525	11.0880513	19
42	8.9134881	9.9985372	8.9149509	11.0850491	10.0014628	11.0865119	18
43	8.9150219	9.9985268	8.9164952	11.0835048	10.0014732	11.0849781	17
44	8.9165504	9.9985163	8.9180340	11.0819660	10.0014837	11.0834496	16
45	8.9180734	9.9985058	8.9195675	11.0804325	10.0014942	11.0819266	15
46	8.9195911	9.9984953	8.9210957	11.0789043	10.0015047	11.0804089	14
47	8.9211034	9.9984848	8.9226186	11.0773814	10.0015152	11.0788966	13
48	8.9226105	9.9984742	8.9241363	11.0758637	10.0015258	11.0773895	12
49	8.9241123	9.9984636	8.9256487	11.0743513	10.0015364	11.0758877	11
50	8.9256089	9.9984529	8.9271560	11.0728440	10.0015471	11.0743911	10
51	8.9271003	9.9984422	8.9286581	11.0713419	10.0015578	11.0728997	9
52	8.9285866	9.9984315	8.9301552	11.0698448	10.0015685	11.0714134	8
53	8.9300678	9.9984207	8.9316471	11.0683529	10.0015793	11.0699522	7
54	8.9315439	9.9984099	8.9331340	11.0668660	10.0015901	11.0684561	6
55	8.9330150	9.9983990	8.9346160	11.0653840	10.0016010	11.0669850	5
56	8.9344811	9.9983881	8.9360929	11.0639071	10.0016119	11.0655189	4
57	8.9359422	9.9983772	8.9375650	11.0624350	10.0016228	11.0640578	3
58	8.9373983	9.9983663	8.9390321	11.0609679	10.0016337	11.0626017	2
59	8.9388496	9.9983553	8.9404944	11.0595056	10.0016447	11.0611504	1
60	8.9402960	9.9983442	8.9419518	11.0580482	10.0016558	11.0597040	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent	L. Co-Secant	L. Secant.	M

85 DEGREES.

5 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	871557	9961947	874887	11430052	10038198	11473713	60
1	874455	9961693	877818	11391885	10038454	11435692	59
2	877353	9961438	880749	11353970	10038711	11397922	58
3	880251	9961182	883681	11316304	10038969	11360402	57
4	883148	9960926	886612	11278885	10039228	11323129	56
5	886046	9960669	889544	11241712	10039487	11286101	55
6	888943	9960411	892476	11204780	10039747	11249316	54
7	891840	9960152	895408	11168089	10040008	11212770	53
8	894738	9959892	898341	11131635	10040270	11176462	52
9	897635	9959631	901273	11095416	10040533	11140389	51
10	900532	9959369	904206	11059431	10040797	11104549	50
11	903429	9959107	907138	11023676	10041051	11068940	49
12	906326	9958844	910071	10988150	10041326	11033560	48
13	909223	9958580	913004	10952850	10041592	10998406	47
14	912119	9958315	915938	10917775	10041859	10963476	46
15	915016	9958049	918871	10882921	10042127	10928763	45
16	917913	9957782	921804	10848288	10042396	10894281	44
17	920809	9957515	924738	10813872	10042666	10860011	43
18	923706	9957247	927672	10779673	10042937	10825957	42
19	926602	9956978	930606	10745687	10043208	10792117	41
20	929499	9956708	933540	10711913	10043480	10788488	40
21	932395	9956437	936474	10678348	10043753	10725070	39
22	935291	9956165	939409	10644992	10044027	10691859	38
23	938187	9955892	942344	10611841	10044302	10658854	37
24	941083	9955619	945278	10578895	10044578	10626054	36
25	943979	9955345	948213	10546151	10044855	10593455	35
26	946875	9955070	951148	10513607	10045133	10561057	34
27	949771	9954794	954084	10481261	10045411	10528857	33
28	952666	9954517	957019	10449112	10045690	10496854	32
29	955562	9954240	959955	10417158	10045970	10465056	31
30	958458	9953962	962890	10385397	10046251	10433430	30
31	961353	9953683	965826	10353827	10046533	10402007	29
32	964248	9953403	968763	10322447	10046816	10370772	28
33	967144	9953122	971699	10291255	10047099	10339726	27
34	970039	9952840	974635	10260249	10047383	10308866	26
35	972934	9952557	977572	10229428	10047668	10278190	25
36	975829	9952274	980509	10198789	10047690	10247954	24
37	978724	9951990	983446	10168332	10048241	10217385	23
38	981619	9951705	986383	10138054	10048529	10187254	22
39	984514	9951419	989320	10107954	10048818	10157300	21
40	987408	9951132	992257	10078031	10049108	10127522	20
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	99600724	10050275	10010147	16
45	1001881	9949685	1006947	99310088	10050569	99812291	15
46	1004775	9949393	1009885	99021125	10050864	99524787	14
47	1007669	9949100	1012824	98733823	10051160	99238943	13
48	1010563	9948806	1015763	98448166	10051457	98954744	12
49	1013457	9948512	1018702	98164140	10051754	98672176	11
50	1016350	9948217	1021641	97881732	10052052	98391227	10
51	1019245	9947921	1024580	97600927	10052351	98111888	9
52	1022138	9947624	1027520	97321713	10052651	97834124	8
53	1025032	9947326	1030460	97044075	10052952	97557944	7
54	1027925	9947037	1033400	96768000	10053254	97283327	6
55	1030819	9946728	1036340	96493475	10053557	97010260	5
56	1033712	9946428	1039280	96220486	10053860	96738730	4
57	1036605	9946127	1042220	95949022	10054164	96468724	3
58	1039499	9945825	1045160	95679068	10054469	96200229	2
59	1042392	9945522	1048101	95410613	10054775	95933233	1
60	1045285	9945218	1051042	95143645	10055082	95667722	0
	N. Co-Sine.	N. Sine	N. Co Tang.	N. Tangent.	N. Co-Secant	N. Secant.	M

84 DEGREES.

5 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant.	
0	8.9402960	9.9983442	8.9419518	11.0580482	10.0016558	11.0597040	60
1	8.9417376	9.9983332	8.9434044	11.0565956	10.0016668	11.0582624	59
2	8.9431743	9.9983220	8.9448523	11.0551477	10.0016780	11.0568257	58
3	8.9446063	9.9983109	8.9462954	11.0537046	10.0016891	11.0553937	57
4	8.9460335	9.9982997	8.9477338	110.522662	10.0017003	11.0539665	56
5	8.9474561	9.9982885	8.9491676	11.0508324	10.0017115	11.0525439	55
6	8.9488739	9.9982772	8.9505967	11.0494033	10.0017228	11.0511261	54
7	8.9502871	9.9982660	8.9520211	11.0479789	10.0017340	11.0497129	53
8	8.9516957	9.9982546	8.9534410	11.0465590	10.0017454	11.0483043	52
9	8.9530996	9.9982433	8.9548564	11.0451436	10.0017567	11.0469004	51
10	8.9544991	9.9982318	8.9562672	11.0437328	10.0017682	11.0455009	50
11	8.9558940	9.9982204	8.9576735	11.0423265	10.0017796	11.0441060	49
12	8.9572843	9.9982089	8.9590754	11.0409246	10.0017911	11.0427157	48
13	8.9586703	9.9981974	8.9604728	11.0395272	10.0018026	11.0413297	47
14	8.9600517	9.9981859	8.9618659	11.0381341	10.0018141	11.0399483	46
15	8.9614288	9.9981743	8.9632545	11.0367455	10.0018257	11.0385712	45
16	8.9628014	9.9981626	8.9646388	11.0353612	10.0018371	11.0371986	44
17	8.9641697	9.9981510	8.9660188	11.0339812	10.0018490	11.0358303	43
18	8.9655337	9.9981393	8.9673944	11.0326056	10.0018607	11.0344663	42
19	8.9668934	9.9981275	8.9687658	11.0312342	10.0018725	11.0331066	41
20	8.9682487	9.9981158	8.9701330	11.0298670	10.0018842	11.0317513	40
21	8.9695999	9.9981040	8.9714959	11.0285041	10.0018960	11.0304001	39
22	8.9709468	9.9980921	8.9728547	11.0271453	10.0019079	11.0290532	38
23	8.9722895	9.9980802	8.9742092	11.0257908	10.0019198	11.0277105	37
24	8.9736280	9.9980683	8.9755597	11.0244403	10.0019317	11.0263720	36
25	8.9749624	9.9980563	8.9769060	11.0230940	10.0019437	11.0250376	35
26	8.9762926	9.9980443	8.9782483	11.0217517	10.0019557	11.0237074	34
27	8.9776188	9.9980323	8.9795865	11.0204135	10.0019677	11.0223812	33
28	8.9789408	9.9980202	8.9809206	11.0190794	10.0019798	11.0210592	32
29	8.9802589	9.9980081	8.9822507	11.0177493	10.0019919	11.0197411	31
30	8.9815729	9.9979960	8.9835769	11.0164231	10.0020040	11.0184271	30
31	8.9828829	9.9979838	8.9848991	11.0151009	10.0020162	11.0171171	29
32	8.9841889	9.9979716	8.9862173	11.0137827	10.0020284	11.0158111	28
33	8.9854910	9.9979593	8.9875317	11.0124683	10.0020407	11.0145090	27
34	8.9867891	9.9979470	8.9888421	11.0111579	10.0020530	11.0132109	26
35	8.9880834	9.9979347	8.9901487	11.0098513	10.0020653	11.0119166	25
36	8.9893737	9.9979223	8.9914514	11.0085486	10.0020777	11.0106263	24
37	8.9906602	9.9979099	8.9927503	11.0072497	10.0020901	11.0093398	23
38	8.9919429	9.9978975	8.9940454	11.0059546	10.0021025	11.0080572	22
39	8.9932217	9.9978850	8.9953367	11.0046633	10.0021150	11.0067783	21
40	8.9944968	9.9978725	8.9966243	11.0033757	10.0021275	11.0055032	20
41	8.9957681	9.9978599	8.9979081	11.0020918	10.0021410	11.0042319	19
42	8.9970356	9.9978473	8.9991883	11.0008117	10.0021524	11.0029644	18
43	8.9982994	9.9978347	9.0004647	10.9995353	10.0021653	11.0017006	17
44	8.9995595	9.9978220	9.0017375	10.9982625	10.0021780	11.0004405	16
45	9.0008160	9.9978093	9.0030066	10.9969934	10.0021907	10.9991840	15
46	9.0020687	9.9977966	9.0042721	10.9957279	10.0022034	10.9979313	14
47	9.0033179	9.9977838	9.0055340	10.9944660	10.0022162	10.9966821	13
48	9.0045634	9.9977710	9.0067924	10.9932076	10.0022290	10.9954366	12
49	9.0058053	9.9977582	9.0080471	10.9919529	10.0022418	10.9941947	11
50	9.0070436	9.9977453	9.0092984	10.9907016	10.0022547	10.9929564	10
51	9.0082784	9.9977323	9.0105461	10.9894539	10.0022677	10.9917216	9
52	9.0095096	9.9977194	9.0117903	10.9882097	10.0022806	10.9904904	8
53	9.0107374	9.9977064	9.0130310	10.9869690	10.0022936	10.9892626	7
54	9.0119616	9.9976933	9.0142682	10.9857318	10.0023067	10.9880384	6
55	9.0131823	9.9976803	9.0155021	10.9844979	10.0023197	10.9868177	5
56	9.0143996	9.9976672	9.0167325	10.9832675	10.0023328	10.9856004	4
57	9.0156135	9.9976540	9.0179594	10.9820406	10.0023460	10.9843865	3
58	9.0168239	9.9976408	9.0191831	10.9808169	10.0023592	10.9831761	2
59	9.0180309	9.9976276	9.0204033	10.9795967	10.0023724	10.9819691	1
60	9.0192346	9.9976143	9.0216202	10.9783798	10.0023857	10.9807654	0
	L. Co-Sine.	L. Sine.	L. Co Tang.	L. Tangent	L. Co-Secant	L. Secant.	M

84 DEGREES.

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6 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N. Co-Secant	
0	1045285	9945218	1051042	95143645	10055082	95667722	60
1	1048178	9944914	1053983	94878149	10055390	95403686	59
2	1051070	9944609	1056924	94614116	10055699	95141110	58
3	1053963	9944303	1059866	94351531	10056009	94879984	57
4	1056856	9943996	1062808	94090384	10056320	94620296	56
5	1059748	9943688	1065750	93830663	10056631	94362033	55
6	1062641	9943379	1068692	93572355	10056943	94105184	54
7	1065533	9943069	1071634	93315450	10057256	93849735	53
8	1068425	9942759	1074576	93059936	10057570	93595682	52
9	1071318	9942448	1077519	92805802	10057885	93343006	51
10	1074210	9942136	1080462	92553035	10058201	93091699	50
11	1077102	9941823	1083405	92301627	10058518	92841749	49
12	1079994	9941509	1086348	92051564	10058835	92593145	48
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	10060758	91129200	42
19	1100234	9939289	1106954	90337933	10061081	90889725	41
20	1103126	9938969	1109899	90098261	10061405	90651512	40
21	1106017	9938648	1112844	89859843	10061730	90414553	39
22	1108908	9938326	1115789	89622668	10062056	90178837	38
23	1111799	9938003	1118734	89386726	10062383	89944354	37
24	1114689	9937679	1121679	89152008	10062711	89711095	36
25	1117580	9937354	1124625	88918505	10063040	89479051	35
26	1120471	9937028	1127571	88686206	10063370	89248211	34
27	1123361	9936702	1130517	88455103	10063701	89018567	33
28	1126252	9936375	1133463	88225186	10064032	88790109	32
29	1129142	9936047	1136409	87996446	10064364	88562828	31
30	1132032	9935718	1139356	87768874	10064697	88336715	30
31	1134922	9935388	1142303	87542461	10065031	88111761	29
32	1137812	9935058	1145250	87317198	10065365	87887957	28
33	1140702	9934727	1148197	87093077	10065702	87665295	27
34	1143592	9934395	1151144	86870088	10066039	87443766	26
35	1146482	9934062	1154091	86648223	10066377	87223361	25
36	1149371	9933728	1157039	86427475	10066715	87004071	24
37	1152261	9933393	1159987	86207833	10067054	86[illegible]8[illegible]889	23
38	1155151	9933057	1162935	85989290	10067394	86568805	22
39	1158040	9932720	1165883	85771838	10067735	86352812	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
43	1169596	9931366	1177678	84912772	10069108	85499584	17
44	1172485	9931025	1180628	84700651	10069453	85288923	16
45	1175374	9930684	1183578	84489573	10069799	85079304	15
46	1178263	9930342	1186528	84279531	10070146	84870721	14
47	1181151	9929999	1189478	84070515	10070494	84663165	13
48	1184040	9929655	1192428	83862519	10070843	84456629	12
49	1186928	9929310	1195378	83655536	10071193	84251105	11
50	1189816	9928964	1198328	83449557	10071544	84046586	10
51	1192704	9928617	1201279	83244577	10071896	83843065	9
52	1195593	9928270	1204230	83040586	10072248	83640534	8
53	1198481	9927922	1207181	82837579	10072601	83438986	7
54	1201368	9927573	1210132	82635547	10072955	83238415	6
55	1204256	9927223	1213084	82434485	10073310	83038812	5
56	1207144	9926872	1216036	82234384	10073666	82840171	4
57	1210031	9926521	1218988	82035239	10074023	82642485	3
58	1212919	9926169	1221940	81837041	10074381	82445748	2
59	1215806	9925816	1224893	81639786	10074740	82249952	1
60	1218693	9925462	1227846	81443464	10075099	82055090	0
	N. Co-Sine.	N. Sine	N. Co Tang.	N. Tangent.	N·Co-Secant	N. Secant.	M

83 DEGREES.

6 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	9.0192346	9.9976143	9.0216202	10.9783798	10.0023857	10.9807654	60
1	9.0204348	9.9976011	9.0228338	10.9771662	10.0023989	10.9795652	59
2	9.0216318	9.9975877	9.0240441	10.9759559	10.0024123	10.9783682	58
3	9.0228254	9.9975743	9.0252510	10.9747490	10.0024257	10.9771746	57
4	9.0240157	9.9975609	9.0264548	10.9735452	10.0024391	10.9759843	56
5	9.0252027	9.9975475	9.0276552	10.9723448	10.0024525	10.9747973	55
6	9.0263865	9.9975340	9.0288524	10.9711476	10.0024660	10.9736135	54
7	9.0275669	9.9975205	9.0300464	10.9699536	10.0024795	10.9724331	53
8	9.0287442	9.9975069	9.0312373	11.9687627	10.0024931	10.9712558	52
9	9.0299182	9.9974933	9.0324249	10.9675751	10.0025067	10.9700818	51
10	9.0310890	9.9974797	9.0336093	10.9663907	10.0025203	10.9689110	50
11	9.0322567	9.9974660	9.0347906	10.9652094	10.0025340	10.9677433	49
12	9.0334212	9.9974523	9.0359688	10.9640312	10.0025477	10.9665788	48
13	9.0345825	9.9974386	9.0371439	10.9628561	10.0025614	10.9654175	47
14	9.0357407	9.9974248	9.0383159	10.9616841	10.0025752	10.9642593	46
15	9.0368958	9.9974110	9.0394848	10.9605152	10.0025890	10.9631042	45
16	9.0380477	9.9973971	9.0406506	10.9593494	10.0026029	10.9619523	44
17	9.0391966	9.9973833	9.0418134	10.9581866	10.0026167	10.9608034	43
18	9.0403424	9.9973693	9.0429731	10.9570269	10.0026307	10.9596576	42
19	9.0414852	9.9973554	9.0441299	10.9558701	10.0026446	10.9585148	41
20	9.0426249	9.9973414	9.0452836	10.9547164	10.0026586	10.9573751	40
21	9.0437617	9.9973273	9.0464343	10.9535657	10.0026727	10.9562383	39
22	9.0448954	9.9973132	9.0475821	10.9524179	10.0026868	10.9551046	38
23	9.0460261	9.9972991	9.0487270	10.9512730	10.0027009	10.9539739	37
24	9.0471538	9.9972850	9.0498689	10.9501311	10.0027150	10.9228462	36
25	9.0482786	9.9972708	9.0510078	10.9489922	10.0027292	10.9517214	35
26	9.0494005	9.9972566	9.0521439	10.9478561	10.0027434	10.9505995	34
27	9.0505194	9.9972423	9.0532771	10.9467229	10.0027577	10.9494806	33
28	9.0516354	9.9972280	9.0544074	10.9455926	10.0027720	10.9483646	32
29	9.0527485	9.9972137	9.0555349	10.9444651	10.0027862	10.9472515	31
30	9.0538588	9.9971993	9.0566595	10.9433405	10.0028007	10.9461412	30
31	9.0549661	9.9971849	9.0577813	10.9422187	10.0028151	10.9450339	29
32	9.0560706	9.9971704	9.0589002	10.9410998	10.0028296	10.9439294	28
33	9.0571723	9.9971559	9.0600164	10.9399836	10.0028441	10.9428377	27
34	9.0582711	9.9971414	9.0611297	10.9388703	10.0028586	10.9417289	26
35	9.0593672	9.9971268	9.0622403	10.9377597	10.0028732	10.9406328	25
36	9.0604604	9.9971122	9.0633482	10.9366518	10.0028878	10.9395496	24
37	9.0615509	9.9970976	9.0644533	10.9355467	10.0029024	10.9384491	23
38	9.0626386	9.9970829	9.0655556	10.9344444	10.0029171	10.9373614	22
39	9.0637235	9.9970682	9.0666553	10.9333447	10.0029318	10.9362765	21
40	9.0648057	9.9970535	9.0677522	10.9322478	10.0029465	10.9351943	20
41	9.0658852	9.9970387	9.0688465	10.9311535	10.0029613	10.9341148	19
42	9.0669619	9.9970239	9.0699381	10.9300619	10.0029761	10.9330381	18
43	9.0680360	9.9970090	9.0710270	10.9289730	10.0029910	10.9319640	17
44	9.0691074	9.9969941	9.0721133	10.9278867	10.0030059	10.9308926	16
45	9.0701761	9.9969792	9.0731969	10.9268031	10.0030208	10.9298239	15
46	9.0712421	9.9969642	9.0742779	10.9257221	10.0030358	10.9287579	14
47	9.0723055	9.9969492	9.0753563	10.9246437	10.0030508	10.9276945	13
48	9.0733663	9.9969342	9.0764321	10.9235679	10.0030658	10.9266337	12
49	9.0744244	9.9969191	9.0775053	10.9224947	10.0030809	10.9255756	11
50	9.0754799	9.9969040	9.0785760	10.9214240	10.0030960	10.9245201	10
51	9.0765329	9.9968888	9.0796441	10.9203559	10.0031112	10.9234671	9
52	9.0775832	9.9968736	9.0807096	10.9192904	10.0031264	10.9224168	8
53	9.0786310	9.9968584	9.0817726	10.9182274	10.0031416	10.9213690	7
54	9.0796762	9.9968431	9.0828331	10.9171669	10.0031569	10.9203238	6
55	9.0807189	9.9968278	9.0838911	10.9161089	10.0031722	10.9192811	5
56	9.0817590	9.9968125	9.0849466	10.9150534	10.0031875	10.9182410	4
57	9.0827966	9.9967971	9.0859996	10.9140004	10.0032029	10.9172034	3
58	9.0838317	9.9967817	9.0870501	10.9129499	10.0032183	10.9161683	2
59	9.0848643	9.9967662	9.0880981	10.9119019	10.0032338	10.9151357	1
60	9.0858945	9.9967507	9.0891438	10.9108562	10.0032493	10.9141055	0
	L. CoSine.	L. Sine	L. Co-Tang.	L. Tangent.	L Co-Secant.	L. Secant.	M.

83 DEGREES.

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7 DEGREES.							
M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	1218693	9925462	1227846	81443464	10075099	82055090	60
1	1221581	9925107	1230799	81248071	10075459	81861157	59
2	1224468	9924751	1233752	81053599	10075820	81668145	58
3	1227355	9924394	1236705	80860042	10076182	81476048	57
4	1230241	9924036	1239658	80667394	10076545	81284860	56
5	1233128	9923678	1242612	80475647	10076909	81094573	55
6	1236015	9923319	1245566	80284796	10077274	80905182	54
7	1238901	9922959	1248520	80094835	10077639	80716681	53
8	1241788	9922598	1251474	79905756	10078005	80529062	52
9	1244674	9922236	1254429	79717555	10078372	80342321	51
10	1247560	9921874	1257384	79530224	10078740	80156450	50
11	1250446	9921511	1260339	79343758	10079109	79971445	49
12	1253332	9921147	1263294	79158151	10079479	79787298	48
13	1256218	9920782	1266249	78973396	10079850	79604003	47
14	1259104	9920416	1269205	78789489	10080222	79421556	46
15	1261990	9920049	1272161	78606423	10080595	79239950	45
16	1264875	9919681	1275117	78424191	10080969	79059179	44
17	1267761	9919313	1278073	78242790	10081343	78879238	43
18	1270646	9918944	1281029	78062212	10081718	78700120	42
19	1273531	9918574	1283986	77882453	10082094	78521821	41
20	1276416	9918203	1286943	77703506	10082471	78344335	40
21	1279301	9917831	1289900	77525366	10082849	78167656	39
22	1282186	9917459	1292857	77348028	10083228	77991778	38
23	1285071	9917086	1295815	77171486	10083607	77816697	37
24	1287956	9916712	1298773	76995735	10083988	77642406	36
25	1290841	9916337	1301731	76820769	10084370	77468901	35
26	1293725	9915961	1304689	76646584	10084752	77296176	34
27	1296609	9915584	1307648	76473174	10085135	77124227	33
28	1299494	9915206	1310607	76300533	10085519	76953047	32
29	1302378	9914828	1313566	76128657	10085904	76782631	31
30	1305262	9914449	1316525	75957541	10086290	76612976	30
31	1308146	9914069	1319484	75787179	10086677	76444075	29
32	1311030	9913688	1322444	75617567	10087065	76275923	28
33	1313913	9913306	1325404	75448699	10087453	76108516	27
34	1316797	9912923	1328364	75280571	10087842	75941849	26
35	1319681	9912539	1331324	75113178	10088232	75775916	25
36	1322564	9912155	1334285	74946514	10088623	75610713	24
37	1325447	9911770	1337246	74780576	10089015	75446236	23
38	1328330	9911384	1340207	74615357	10089408	75282478	22
39	1331213	9910997	1343168	74450855	10089802	75119437	21
40	1334096	9910609	1346129	74287064	10090197	74957106	20
41	1336979	9910221	1349091	74123978	10090592	74797482	19
42	1339862	9909832	1352053	73961595	10090988	74634560	18
43	1342744	9909442	1355015	73799909	10091385	74474325	17
44	1345627	9909051	1357977	73638916	10091783	74314803	16
45	1348509	9908659	1360940	73478610	10092182	74155959	15
46	1351392	9908266	1363903	73318989	10092582	73997798	14
47	1354274	9907872	1366866	73160047	10092983	73840318	13
48	1357156	9907478	1369829	73001780	10093385	73683512	12
49	1360038	9907083	1372793	72844184	10093788	73527377	11
50	1362919	9906687	1375757	72687255	10094192	73371909	10
51	1365801	9906290	1378721	72530987	10094596	73217102	9
52	1368683	9905892	1381685	72375378	10095001	73062954	8
53	1371564	9905493	1384650	72220422	10095407	72909460	7
54	1374445	9905094	1387615	72066116	10095814	72756616	6
55	1377327	9904694	1390580	71912456	10096222	72604417	5
56	1380208	9904293	1393545	71759437	10096631	72452849	4
57	1383089	9903891	1396510	71607056	10097041	72301940	3
58	1385970	9903488	1399476	71455308	10097452	72151653	2
59	1388850	9903084	1402442	71304190	10097864	72001996	1
60	1391731	9902680	1405408	71153697	10098276	71852965	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant.	M
82 DEGREES.							

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7 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	9.0858945	9.9967507	9.0891438	10.9108562	10.0032493	10.9141055	60
1	9.0869221	9.9967352	9.0901869	10.9098131	10.0032648	10.9130779	59
2	9.0879473	9.9967196	9.0912277	10.9087723	10.0032804	10.9120527	58
3	9.0889700	9.9967040	9.0922660	10.9077340	10.0032960	10.9110300	57
4	9.0899903	9.9966884	9.0933020	10.9066980	10.0033116	10.9100097	56
5	9.0910082	9.9966727	9.0943355	10.9056645	10.0033273	10.9089918	55
6	9.0920237	9.9966570	9.0953669	10.9046333	10.0033430	10.9079763	54
7	9.0930367	9.9966412	9.0963955	10.9036045	10.0033588	10.9069633	53
8	9.0940474	9.9966254	9.0974219	10.9025781	10.0033746	10.9059526	52
9	9.0950556	9.9966096	9.0984460	10.9015540	10.0033904	10.9049444	51
10	9.0960615	9.9965937	9.0994678	10.9005322	10.0034063	10.9039385	50
11	9.0970651	9.9965778	9.1004872	10.8995128	10.0034222	10.9029349	49
12	9.0980662	9.9965619	9.1015044	10.8984956	10.0034381	10.9019338	48
13	9.0990651	9.9965419	9.1025192	10.8974808	10.0034541	10.9009349	47
14	9.1000616	9.9965299	9.1035317	10.8964683	10.0034701	10.8999384	46
15	9.1010558	9.9965138	9.1045420	10.8954580	10.0034862	10.8989442	45
16	9.1020477	9.9964977	9.1055500	10.8944500	10.0035023	10.8979523	44
17	9.1030373	9.9964816	9.1065557	10.8934443	10.0035184	10.8969627	43
18	9.1040246	9.9964655	9.1075591	10.8924409	10.0035345	10.8959754	42
19	9.1050096	9.9964493	9.1085604	10.8914396	10.0035507	10.8949904	41
20	9.1059924	9.9964330	9.1095594	10.8904406	10.0035670	10.8940076	40
21	9.1069729	9.9964167	9.1105562	10.8894438	10.0035833	10.8930271	39
22	9.1079512	9.9964004	9.1115508	10.8884492	10.0035996	10.8920488	38
23	9.1089272	9.9963841	9.1125431	10.8874569	10.0036159	10.8910728	37
24	9.1099010	9.9963677	9.1135333	10.8864667	10.0036323	10.8900990	36
25	9.1108726	9.9963513	9.1145213	10.8854787	10.0036487	10.8891274	35
26	9.1118420	9.9963348	9.1155072	10.8844928	10.0036652	10.8881580	34
27	9.1128092	9.9963183	9.1164909	10.8835091	10.0036817	10.8871908	33
28	9.1137742	9.9963018	9.1174724	10.8825276	10.0036982	10.8862258	32
29	9.1147370	9.9962852	9.1184518	10.8815482	10.0037148	10.8852630	31
30	9.1156977	9.9962686	9.1194291	10.8805709	10.0037314	10.8843023	30
31	9.1166562	9.9962519	9.1204043	10.8795957	10.0037481	10.8833438	29
32	9.1176125	9.9962352	9.1213773	10.8786227	10.0037648	10.8823875	28
33	9.1185667	9.9962185	9.1223482	10.8776518	10.0037815	10.8814333	27
34	9.1195188	9.9962017	9.1233171	10.8766829	10.0037983	10.8804812	26
35	9.1204688	9.9961849	9.1243839	10.8757161	10.0038151	10.8795312	25
36	9.1214167	9.9961681	9.1252486	10.8747514	10.0038319	10.8785833	24
37	9.1223624	9.9961512	9.1262112	10.8737888	10.0038488	10.8776376	23
38	9.1233061	9.9961343	9.1271718	10.8728282	10.0038657	10.8766939	22
39	9.1242477	9.9961174	9.1281303	10.8718697	10.0038826	10.8757523	21
40	9.1251872	9.9961004	9.1290868	10.8709132	10.0038996	10.8748128	20
41	9.1261246	9.9960834	9.1300413	10.8699587	10.0039165	10.8738754	19
42	9.1270600	9.9960663	9.1309937	10.8690063	10.0039337	10.8729490	18
43	9.1279934	9.9960492	9.1319442	10.8680558	10.0039508	10.8720066	17
44	9.1289247	9.9960321	9.1328926	10.8671074	10.0039697	10.8710753	16
45	9.1298539	9.9960149	9.1338391	10.8661609	10.0039851	10.8701461	15
46	9.1307812	9.9959977	9.1347835	10.8652165	10.0040023	10.8692188	14
47	9.1317064	9.9959804	9.1357260	10.8642740	10.0040196	10.8682936	13
48	9.1326297	9.9959631	9.1366665	10.8633335	10.0040369	10.8673703	12
49	9.1335509	9.9959458	9.1376051	10.8623949	10.0040542	10.8664491	11
50	9.1344702	9.9959284	9.1335417	10.8614583	10.0040716	10.8655298	10
51	9.1353875	9.9959111	9.1394764	10.8605236	10.0040889	10.8646125	9
52	9.1363028	9.9958936	9.1404092	10.8595908	10.0041064	10.8636972	8
53	9.1372161	9.9958761	9.1413400	10.8586600	10.0041239	10.8627839	7
54	9.1381275	9.9958586	9.1422689	10.8577311	10.0041414	10.8618725	6
55	9.1390370	9.9958411	9.1431959	10.8568041	10.0041589	10.8609630	5
56	9.1399445	9.9958235	9.1441210	10.8558790	10.0041765	10.8600555	4
57	9.1408501	9.9958059	9.1450442	10.8549558	10.0041941	10.8591499	3
58	9.1417537	9.9957882	9.1459655	10.8540345	10.0042118	10.8582463	2
59	9.1426555	9.9957705	9.1468850	10.8531150	10.0042295	10.8573445	1
60	9.1435553	9.9957528	9.1478025	10.8521975	10.0042472	10.8564447	0
	L. Co-Sine	L. Sine	L. Co-Tang.	L. Tangent.	L. Co-Secant.	L. Secant.	M

82 DEGREES.

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8 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N Co-Secant.	
0	1391731	9902680	1405408	71153697	10098276	71852965	60
1	1394612	9902275	1408374	71003826	10098689	71704556	59
2	1397492	9901869	1411341	70854573	10099103	71556764	58
3	1400372	9901462	1414308	70705934	10099518	71409587	57
4	1403252	9901054	1417275	70557905	10099934	71263019	56
5	1406132	9900645	1420243	70410482	10100351	71117058	55
6	1409012	9900236	1423211	70263662	10100769	70971700	54
7	1411892	9899826	1426179	70117441	10101188	70826941	53
8	1414772	9899415	1429147	69971806	10101607	70682777	52
9	1417651	9899003	1432115	69826781	10102027	70539205	51
10	1420531	9898590	1435084	69682335	10102448	70396220	50
11	1423410	9898176	1438053	69538473	10102870	70253820	49
12	1426289	9897762	1441022	69395192	10103293	70112001	48
13	1429168	9897347	1443991	69352489	10103717	69970760	47
14	1432047	9896931	1446961	69110359	10104142	69830092	46
15	1434926	9896514	1449931	68968799	10104568	69689994	45
16	1437805	9896096	1452901	68827807	10104995	69550464	44
17	1440684	9895677	1455871	68687378	10105423	69411496	43
18	1443562	9895257	1458842	68547508	10105851	69273089	42
19	1446440	9894837	1461813	68408196	10106280	69135239	41
20	1449319	9894416	1464784	68269437	10106710	68997942	40
21	1452197	9893994	1467755	68131227	10107141	68861195	39
22	1455075	9893571	1470727	67993565	10107573	68724995	38
23	1457953	9893147	1473699	67856446	10108006	68589338	37
24	1460830	9892723	1476671	67719867	10108440	68454222	36
25	1463708	9892298	1479644	67583826	10108875	68319642	35
26	1466585	9891872	1482617	67448319	10109311	68185597	34
27	1469463	9891445	1485590	67313341	10109747	68052082	33
28	1472340	9891017	1488563	67178891	10110184	67919095	32
29	1475217	9890588	1491536	67044966	10110622	67786632	31
30	1478094	9890158	1494510	66911562	10111061	67654691	30
31	1480971	9889728	1497484	66778677	10111501	67523268	29
32	1483848	9889297	1500458	66646307	10111942	67392360	28
33	1486724	9888865	1503433	66514449	10112384	67261965	27
34	1489601	9888432	1506408	66383100	10112827	67132079	26
35	1492477	9887995	1509383	66252258	10113271	67002699	25
36	1495353	9887563	1512358	66121919	10113715	66873822	24
37	1498230	9887128	1515333	65992080	10114160	66745446	23
38	1501106	9886692	1518309	65862739	10114606	66617568	22
39	1503981	9886255	1521285	65733892	10115053	66490184	21
40	1506857	9885817	1524261	65605538	10115501	66363293	20
41	1509733	9865378	1527238	65477672	10115950	66236890	19
42	1512608	9884938	1530215	65350293	10116400	66110973	18
43	1515484	9884498	1533192	65223396	10116851	65985540	17
44	1518359	9884057	1536189	65096981	10117303	65860587	16
45	1521234	9883615	1539147	64971043	10117756	65736112	15
46	1524109	9883172	1542125	64845581	10118209	65612113	14
47	1526984	9882728	1545103	64720591	10118663	65488586	13
48	1529858	9882283	1548082	64596070	10119118	65365528	12
49	1532733	9881838	1551061	64472017	10119574	65242938	11
50	1535607	9881392	1554040	64348428	10120031	65120812	10
51	1538482	9880945	1557019	64225301	10120489	64999148	9
52	1541356	9880497	1559998	64102633	10120948	64877944	8
53	1544230	9880048	1562978	63980422	10121408	64757195	7
54	1547104	9879598	1565958	63858665	10121869	64636901	6
55	1549978	9879148	1568938	63737359	10122331	64517059	5
56	1552851	9878697	1571919	63616502	10122793	64397666	4
57	1555725	9878245	1574900	63496092	10123256	64278719	3
58	1558598	9877792	1577881	63376126	10123720	64160216	2
59	1561472	9877338	1580862	63256601	10124185	64042154	1
60	1564345	9876883	1583844	63137515	10124651	63924532	0
	N Co-Sine.	N. Sine.	N Co Tang.	N. Tangent.	N. Co-Secant	N. Secant.	M

81 DEGREES.

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8 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	9.1435553	9.9957528	9.1478025	10.8521975	10.0042472	10.8564447	60
1	9.1444532	9.9957350	9.1487182	10.8512818	10.0042650	10.8555468	59
2	9.1453493	9.9957172	9.1496321	10.8503679	10.0042828	10.8546507	58
3	9.1462435	9.9956993	9.1505441	10.8494559	10.0043007	10.8537565	57
4	9.1471358	9.9956815	9.1514543	10.8485457	10.0043185	10.8528642	56
5	9.1480262	9.9956635	9.1523627	10.8476373	10.0043365	10.8519738	55
6	9.1489148	9.9956456	9.1532692	10.8467308	10.0043544	10.8510852	54
7	9.1498015	9.9956276	9.1541739	10.8458261	10.0043724	10.8501985	53
8	9.1506864	9.9956095	9.1550769	11.8449231	10.0043905	10.8493136	52
9	9.1515694	9.9955915	9.1559780	10.8440220	10.0044085	10.8484306	51
10	9.1524507	9.9955734	9.1568773	10.8431227	10.0044266	10.8475493	50
11	9.1533301	9.9955552	9.1577748	10.8422252	10.0044448	10.8466699	49
12	9.1542076	9.9955370	9.1586706	10.8413294	10.0044630	10.8457924	48
13	9.1550834	9.9955188	9.1595646	10.8404354	10.0044812	10.8449166	47
14	9.1559574	9.9955005	9.1604569	10.8395431	10.0044995	10.8440426	46
15	9.1568296	9.9954822	9.1613473	10.8386527	10.0045178	10.8431704	45
16	9.1577000	9.9954639	9.1622361	10.8377639	10.0045361	10.8423000	44
17	9.1585686	9.9954455	9.1631231	10.8368769	10.0045545	10.8414314	43
18	9.1594354	9.9954272	9.1640083	10.8359917	10.0045729	10.8405646	42
19	9.1603005	9.9954087	9.1648919	10.8351081	10.0045913	10.8396995	41
20	9.1611639	9.9953902	9.1657737	10.8342263	10.0046098	10.8388361	40
21	9.1620254	9.9953717	9.1666538	10.8333462	10.0046283	10.8379745	39
22	9.1628853	9.9953531	9.1675322	10.8324678	10.0046469	10.8371147	38
23	9.1637434	9.9953345	9.1684089	10.8315911	10.0046655	10.8362566	37
24	9.1645998	9.9953159	9.1692839	10.8307161	10.0046841	10.8354002	36
25	9.1654544	9.9952972	9.1701572	10.8298428	10.0047028	10.8345456	35
26	9.1663074	9.9952785	9.1710289	10.8289711	10.0047215	10.8336926	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	10.0047779	10.8311441	31
30	9.1697021	9.9952033	9.1744988	10.8255012	10.0047967	10.8302979	30
31	9.1705465	9.9951844	9.1753622	10.8246378	10.0048156	10.8294534	29
32	9.1713893	9.9951654	9.1762239	10.8237761	10.0048346	10.8286107	28
33	9.1722305	9.9951464	9.1770840	10.8229160	10.0048536	10.8277695	27
34	9.1730699	9.9951274	9.1779425	10.8220575	10.0048726	10.8269301	26
35	9.1739077	9.9951084	9.1787993	10.8212007	10.0048916	10.8260923	25
36	9.1747439	9.9950893	9.1796546	10.8203454	10.0049107	10.8252561	24
37	9.1755784	9.9950702	9.1805082	10.8194918	10.0049298	10.8244216	23
38	9.1764112	9.9950510	9.1813602	10.8186398	10.0049490	10.8235888	22
39	9.1772425	9.9950318	9.1822106	10.8177894	10.0049682	10.8227575	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	10.8210999	19
42	9.1797265	9.9949740	9.1847525	10.8152475	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	10.0050648	10.8186256	16
45	9.1821960	9.9949158	9.1872802	10.8127198	10.0050842	10.8178040	15
46	9.1830160	9.9948964	9.1881196	10.8118804	10.0051036	10.8169840	14
47	9.1838344	9.9948769	9.1889575	10.8110425	10.0051231	10.8161656	13
48	9.1846512	9.9948573	9.1897939	10.8102061	10.0051427	10.8153488	12
49	9.1854665	9.9948377	9.1906287	10.8093713	10.0051623	10.8145335	11
50	9.1862802	9.9948181	9.1914621	10.3085379	10.0051819	10.8137199	10
51	9.1870923	9.9947985	9.1922939	10.8077061	10.0052015	10.8129077	9
52	9.1879029	9.9947788	9.1931241	10.8068759	10.0052212	10.8120971	8
53	9.1887120	9.9947591	9.1939529	10.8060471	10.0052409	10.8112880	7
54	9.1895195	9.9947393	9.1947802	10.8052198	10.0052607	10.8104805	6
55	9.1903254	9.9947195	9.1956059	10.8043941	10.0052805	10.8096746	5
56	9.1911299	9.9946997	9.1964302	10.8035698	10.0053003	10.8088701	4
57	9.1919328	9.9946798	9.1972530	10.8027470	10.0053202	10.8080672	3
58	9.1927342	9.9946599	9.1980743	10.8019257	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	10.0053801	10.8056676	0
	L. Co-Sine	L. Sine	L. Co-Tang.	L. Tangent.	L. CoSecant.	L. Secant.	M

81 DEGREES.

9 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N. Co-Secant.	
0	1564345	9876883	1583844	63137515	10124651	63924522	60
1	1567218	9876428	1586826	63018866	10125118	63807347	59
2	1570091	9875972	1589808	62900651	10125586	63690595	58
3	1572963	9875515	1592791	62782868	10126055	63574276	57
4	1575836	9875057	1595774	62665514	10126525	63458386	56
5	1578708	9874598	1598757	62548588	10126996	63342923	55
6	1581581	9874138	1601740	62432086	10127467	63227884	54
7	1584453	9873677	1604724	62316007	10127939	63113269	53
8	1587325	9873216	1607708	62200347	10128412	62999073	52
9	1590197	9872754	1610692	62085106	10128886	62885295	51
10	1593069	9872291	1613677	61970279	10129361	62771933	50
11	1595940	9871827	1616662	61855867	10129837	62658984	49
12	1598812	9871362	1619647	61741865	10130314	62546416	48
13	1601683	9870897	1622632	61628272	10130792	62434316	47
14	1603555	9870431	1625617	61515085	10131271	62322594	46
15	1607426	9869964	1628603	61402303	10131751	62211275	45
16	1610297	9869496	1631589	61289923	10132231	62100359	44
17	1613167	9869027	1634576	61177943	10132712	61989843	43
18	1616038	9868557	1637563	61066360	10133194	61879725	42
19	1618909	9868086	1640550	60955174	10133677	61770003	41
20	1621779	9867615	1643537	60844381	10134161	61660674	40
21	1624650	9867143	1646525	60733979	10134646	61551736	39
22	1627520	9866670	1649513	60623967	10135132	61443189	38
23	1630390	9866196	1652501	60514343	10135619	61335028	37
24	1633260	9865721	1655489	60405103	10136107	61227253	36
25	1636129	9865246	1658478	60296247	10136595	61119861	35
26	1638999	9864770	1661467	60187772	10137084	61012850	34
27	1641808	9864293	1664456	60079676	10137574	60906219	33
28	1644738	9863815	1667446	59971957	10138065	60799964	32
29	1647607	9863336	1670436	59864614	10138557	60694085	31
30	1650476	9862856	1673426	59757644	10139050	60588580	30
31	1653345	9862375	1676416	59651045	10139544	60483445	29
32	1656214	9861894	1679407	59544815	10140039	60378680	28
33	1659082	9861412	1682398	59438952	10140535	60274282	27
34	1661951	9860929	1685389	59333455	10141032	60170250	26
35	1664819	9860445	1688381	59228322	10141530	60066581	25
36	1667687	9859960	1691373	59123550	10142029	59963274	24
37	1670555	9859474	1694365	59019138	10142529	59860326	23
38	1673423	9858988	1697358	58915084	10143029	59757737	22
39	1676291	9858501	1700351	58811386	10143530	59655504	21
40	1579159	9858013	1703344	58708042	10144032	59553625	20
41	1682026	9857524	1706337	58605051	10144535	59452098	19
42	1684894	9857034	1709331	58502410	10145039	59350922	18
43	1687761	9856544	1712325	58400117	10145544	59250095	17
44	1690628	9856053	1715310	58298172	10146050	59149614	16
45	1693495	9855561	1718314	58196572	10146557	59049479	15
46	1696362	9855068	1721309	58095315	10147064	58949688	14
47	1699228	9854574	1724304	57994400	10147572	58850238	13
48	1702095	9854079	1727300	57893825	10148081	58751128	12
49	1704961	9853583	1730296	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
54	1719291	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
60	1736482	9848077	1763270	56712818	10154267	57587705	0
	N. Co-Sine.	N. Sine	N. Co Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M

80 DEGREES.

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9 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant.	
0	9.1943324	9.9946199	9.1997125	10.8002875	10.0053801	10.8056676	60
1	9.1951293	9.9945999	9.2005294	10.7994706	10.0054001	10.8048707	59
2	9.1959247	9.9945798	9.2013449	10.7986551	10.0054202	10.8040753	58
3	9.1967186	9.9945597	9.2021588	10.7978411	10.0054403	10.8032814	57
4	9.1975110	9.9945395	9.2029714	10.7970286	10.0054604	10.8024890	56
5	9.1983019	9.9945194	9.2037825	10.7962175	10.0054806	10.8016981	55
6	9.1990913	9.9944992	9.2045922	10.7954078	10.0055008	10.8009087	54
7	9.1998793	9.9944789	9.2054004	10.7945996	10.0055211	10.8001207	53
8	9.2006658	9.9944587	9.2062072	10.7937928	10.0055413	10.7993342	52
9	9.2014509	9.9944383	9.2070126	10.7929874	10.0055617	10.7985491	51
10	9.2022345	9.9944180	9.2078165	10.7921835	10.0055820	10.7977655	50
11	9.2030167	9.9943975	9.2086191	10.7913809	10.0056025	10.7969833	49
12	9.2037974	9.9943771	9.2094203	10.7905797	10.0056229	10.7962026	48
13	9.2045766	9.9943566	9.2102200	10.7897800	10.0056434	10.7954234	47
14	9.2053545	9.9943361	9.2110184	10.7889816	10.0056639	10.7946455	46
15	9.2061309	9.9943156	9.2118153	10.7881847	10.0056844	10.7938691	45
16	9.2069059	9.9942950	9.2126109	10.7873891	10.0057050	10.7930941	44
17	9.2076795	9.9942743	9.2134051	10.7865919	10.0057257	10.7923205	43
18	9.2084516	9.9942537	9.2141980	10.7858020	10.0057463	10.7915484	42
19	9.2092224	9.9942330	9.2149894	10.7850106	10.0057670	10.7907776	41
20	9.2099917	9.9942122	9.2157795	10.7842205	10.0057878	10.7900083	40
21	9.2107597	9.9941914	9.2165683	10.7834317	10.0058086	10.7892403	39
22	9.2115263	9.9941706	9.2173556	10.7826444	10.0058294	10.7884737	38
23	9.2122914	9.9941498	9.2181417	10.7818583	10.0058502	10.7877586	37
24	9.2130552	9.9941289	9.2189264	10.7810736	10.0058711	10.7869448	36
25	9.2138176	9.9941079	9.2197097	10.7802903	10.0058921	10.7861824	35
26	9.2145787	9.9940870	9.2204917	10.7795083	10.0059130	10.7854213	34
27	9.2153384	9.9940659	9.2212724	10.7787276	10.0059341	10.7846616	33
28	9.2160967	9.9940449	9.2220518	10.7779482	10.0059551	10.7839033	32
29	9.2168536	9.9940238	9.2228298	10.7771702	10.0059762	10.7831464	31
30	9.2176092	9.9940027	9.2236065	10.7763935	10.0059973	10.7823908	30
31	9.2183635	9.9939815	9.2243819	10.7756181	10.0060185	10.7816365	29
32	9.2191164	9.9939603	9.2251561	10.7748439	10.0060397	10.7808836	28
33	9.2198680	9.9939391	9.2259289	10.7740711	10.0060609	10.7801320	27
34	9.2206182	9.9939178	9.2267004	10.7732996	10.0060822	10.7793818	26
35	9.2213671	9.9938965	9.2274706	10.7725294	10.0061035	10.7786329	25
36	9.2221147	9.9938752	9.2282395	10.7717605	10.0061248	10.7778853	24
37	9.2228609	9.9938538	9.2290071	10.7709929	10.0061462	10.7771391	23
38	9.2236059	9.9938324	9.2297735	10.7702265	10.0061676	10.7763941	22
39	9.2243495	9.9938109	9.2305386	10.7694614	10.0061891	10.7756505	21
40	9.2250918	9.9937894	9.2313024	10.7686976	10.0062106	10.7749082	20
41	9.2258328	9.9937679	9.2320650	10.7679350	10.0062321	10.7741672	19
42	9.2265725	9.9937463	9.2328262	10.7671738	10.0062537	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	10.7648974	10.0063187	10.7712161	15
46	9.2295185	9.9936596	9.2358589	10.7641411	10.0063404	10.7704815	14
47	9.2302518	9.9936378	9.2366139	10.7633861	10.0063622	10.7697482	13
48	9.2309838	9.9936160	9.2373678	10.7626322	10.0063840	10.7690162	12
49	9.2317145	9.9935942	9.2381203	10.7618797	10.0064058	10.7682855	11
50	9.2324440	9.9935723	9.2388717	10.7611283	10.0064277	10.7675560	10
51	9.2331722	9.9935504	9.2396218	10.7603782	10.0064495	10.7668278	9
52	9.2338992	9.9935285	9.2403708	10.7596292	10.0064715	10.7661008	8
53	9.2346249	9.9935065	9.2411185	10.7588815	10.0064935	10.7653751	7
54	9.2353494	9.9934844	9.2418650	10.7581350	10.0065156	10.7646506	6
55	9.2360726	9.9934624	9.2426103	10.7573897	10.0065376	10.7639274	5
56	9.2367946	9.9934403	9.2433543	10.7566457	10.0065597	10.7632054	4
57	9.2375153	9.9934181	9.2440972	10.7559028	10.0065819	10.7624847	3
58	9.2382349	9.9933959	9.2448389	10.7551611	10.0066041	10.7617651	2
59	9.2389532	9.9933737	9.2455794	10.7544206	10.0066263	10.7610468	1
60	9.2396702	9.9933515	9.2463188	10.7536812	10.0066485	10.7603298	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent	L. Co-Secant	L. Secant	M

80 DEGREES.

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10 DEGREES.

M	N Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	1736482	9848077	1763270	56712818	10154267	57587705	60
1	1739346	9847571	1766269	56016509	10154788	57492861	59
2	1742211	9847065	1769269	56520516	10155310	57398333	58
3	1745075	9846558	1772269	56424838	10155833	57304121	57
4	1747939	9846050	1775269	56329474	10156357	57210223	56
5	1750803	9845541	1778270	56234421	10156882	57116636	55
6	1753667	9845031	1781271	56139680	10157408	57023360	54
7	1756531	9844521	1784272	56045247	10157935	56930393	53
8	1759395	9844010	1787274	55951121	10158463	56837734	52
9	1762258	9843498	1790276	55857302	10158992	56745380	51
10	1765121	9842985	1793278	55763786	10159521	56653331	50
11	1767984	9842471	1796281	55670574	10160051	56561584	49
12	1770847	9841956	1799284	55577663	10160582	56470140	48
13	1773710	9841440	1802287	55485052	10161114	56378995	47
14	1776573	9840924	1805291	55392740	10161647	56288148	46
15	1779435	9840407	1808295	55300724	10162181	56197599	45
16	1782298	9839889	1811299	55209005	10162716	56107345	44
17	1785160	9839370	1814303	55117579	10163252	56017386	43
18	1788022	9838850	1817308	55026446	10163789	55927719	42
19	1790884	9838329	1820313	54935604	10164327	55838343	41
20	1793746	9837808	1823318	54845052	10164866	55749258	40
21	1796607	9837286	1826324	54754788	10165406	55660460	39
22	1799469	9836763	1829330	54664812	10165946	55571950	38
23	1802330	9836239	1832336	54575121	10166487	55483726	37
24	1805191	9835714	1835343	54485715	10167029	55395786	36
25	1808052	9835189	1838350	54396592	10167572	55308129	35
26	1810913	9834663	1841357	54307750	10168116	55220754	34
27	1813774	9834136	1844365	54219188	10168661	55133659	33
28	1816635	9833608	1847373	54130906	10169207	55046843	32
29	1819495	9833079	1850381	54042901	10169754	54960305	31
30	1822355	9832549	1853390	53955172	10170302	54874043	30
31	1825215	9832018	1856390	53867718	10170851	54788055	29
32	1828075	9831487	1859408	53780538	10171401	54702342	28
33	1830935	9830955	1862418	53693630	10171952	54616901	27
34	1833795	9830422	1865428	53606993	10172504	54531731	26
35	1836654	9829888	1868438	53520626	10173056	54446831	25
36	1839513	9829353	1871449	53434527	10173609	54362199	24
37	1842373	9828817	1874460	53348696	10174163	54277835	23
38	1845232	9828281	1877471	53263131	10174718	54193737	22
39	1848091	9827744	1880483	53177830	10175274	54109903	21
40	1850949	9827206	1883495	53092793	10175831	54026333	20
41	1853808	9826667	1886507	53008018	10176389	53943026	19
42	1856666	9826127	1889520	52923505	10176948	53859979	18
43	1859524	9825587	1892533	52839251	10177508	53777192	17
44	1862382	9825046	1895546	52755255	10178069	53694664	16
45	1865240	9824504	1898559	52671517	10178631	53612393	15
46	1868098	9823961	1901573	52588035	10179194	53530379	14
47	1870956	9823417	1904587	52504809	10179758	53448620	13
48	1873813	9822872	1907602	52421836	10180322	53367114	12
49	1876670	9822327	1910617	52339116	10180887	53285861	11
50	1879527	9821781	1913632	52256647	10181453	53204860	10
51	1882384	9821234	1916648	52174428	10182020	53124109	9
52	1885241	9820686	1919664	52092459	10182588	53043608	8
53	1888098	9820137	1922680	52010738	10183157	52963354	7
54	1890954	9819587	1925696	51929264	10183727	52883347	6
55	1893811	9819036	1928713	51848035	10184298	52803587	5
56	1896667	9818485	1931730	51767051	10184870	52724070	4
57	1899523	9817933	1934748	51686311	10185443	52644798	3
58	1902379	9817380	1937766	51605813	10186017	52565768	2
59	1905234	9816826	1940784	51525557	10186592	52486979	1
60	1908090	9816271	1943803	51445540	10187168	52408431	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant.	M

79 DEGREES.

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10 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant.	
0	9.2396702	9.9933515	9.2463188	10.7536812	10.0066485	10.7603298	60
1	9.2403861	9.9933292	9.2470569	10.7529431	10.0066708	10.7596139	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	55
6	9.2439472	9.9932171	9.2507301	10.7492699	10.0067829	10.7560528	54
7	9.2446558	9.9931946	9.2514612	10.7485388	10.0068054	10.7553442	53
8	9.2453632	9.9931720	9.2521912	10.7478088	10.0068280	10.7546368	52
9	9.2460695	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	9.2481811	9.9930814	9.2550996	10.7449003	10.0069186	10.7518189	48
13	9.2488827	9.9930587	9.2558240	10.7441760	10.0069413	10.7511173	47
14	9.2495830	9.9930359	9.2565472	10.7434528	10.0069641	10.7504170	46
15	9.2502822	9.9930131	9.2572691	10.7427308	10.0069869	10.7497178	45
16	9.2509803	9.9929902	9.2579901	10.7420099	10.0070098	10.7490197	44
17	9.2516772	9.9929673	9.2587099	10.7412901	10.0070327	10.7483228	43
18	9.2523729	9.9929444	9.2594285	10.7405715	10.0070556	10.7476271	42
19	9.2530675	9.9929214	9.2601461	10.7398539	10.0070786	10.7469325	41
20	9.2537609	9.9928984	9.2608625	10.7391375	10.0071016	10.7462391	40
21	9.2544532	9.9928753	9.2615779	10.7384221	10.0071247	10.7455468	39
22	9.2551444	9.9928522	9.2622921	10.7377079	10.0071478	10.7448556	38
23	9.2558344	9.9928291	9.2630053	10.7369947	10.0071709	10.7441656	37
24	9.2565233	9.9928059	9.2637173	10.7362827	10.0071941	10.7434767	36
25	9.2572110	9.9927827	9.2644283	10.7355717	10.0072173	10.7427890	35
26	9.2578977	9.9927595	9.2651382	10.7348618	10.0072405	10.7421023	34
27	9.2585832	9.9927362	9.2658470	10.7341530	10.0072638	10.7414168	33
28	9.2592676	9.9927129	9.2665547	10.7334453	10.0072871	10.7407324	32
29	9.2599509	9.9926895	9.2672613	10.7327387	10.0073105	10.7400491	31
30	9.2606330	9.9926661	9.2679669	10.7320331	10.0073339	10.7393670	30
31	9.2613141	9.9926427	9.2686714	10.7313286	10.0073573	10.7386859	29
32	9.2619941	9.9926192	9.2693749	10.7306251	10.0073808	10.7380059	28
33	9.2626729	9.9925957	9.2700772	10.7299228	10.0074043	10.7373271	27
34	9.2633507	9.9925722	9.2707786	10.7292214	10.0074278	10.7366493	26
35	9.2640274	9.9925486	9.2714788	10.7285212	10.0074514	10.7359729	25
36	9.2647030	9.9925250	9.2721780	10.7278220	10.0074750	10.7352970	24
37	9.2653775	9.9925013	9.2728762	10.7271238	10.0074987	10.7346225	23
38	9.2660509	9.9924776	9.2735733	10.7264267	10.0075224	10.7339491	22
39	9.2667232	9.9924539	9.2742693	10.7257306	10.0075461	10.7332768	21
40	9.2673945	9.9924301	9.2749644	10.7250356	10.0075699	10.7326055	20
41	9.2680647	9.9924063	9.2756584	10.7243416	10.0075937	10.7319353	19
42	9.2687338	9.9923824	9.2763514	10.7236486	10.0076176	10.7312662	18
43	9.2694019	9.9923585	9.2770434	10.7229566	10.0076415	10.7305981	17
44	9.2700689	9.9923346	9.2777343	10.7222657	10.0076654	10.7299311	16
45	9.2707348	9.9923106	9.2784242	10.7215758	10.0076894	10.7292652	15
46	9.2713997	9.9922866	9.2791131	10.7208869	10.0077134	10.7286003	14
47	9.2720635	9.9922626	9.2798009	10.7201991	10.0077374	10.7275365	13
48	9.2727263	9.9922385	9.2804878	10.7195122	10.0077615	10.7272737	12
49	9.2733880	9.9922144	9.2811736	10.7188264	10.0077856	10.7266120	11
50	9.2740487	9.9921902	9.2818585	10.7181415	10.0078098	10.7259513	10
51	9.2747083	9.9921660	9.2825423	10.7174577	10.0078340	10.7252917	9
52	9.2753669	9.9921418	9.2832251	10.7167749	10.0078582	10.7246331	8
53	9.2760245	9.9921175	9.2839070	10.7160930	10.0078825	10.7239755	7
54	9.2766811	9.9920932	9.2845878	10.7154122	10.0079068	10.7233189	6
55	9.2773366	9.9920689	9.2852677	10.7147323	10.0079311	10.7226634	5
56	9.2779911	9.9920445	9.2859466	10.7140534	10.0079555	10.7220089	4
57	9.2786445	9.9920201	9.2866245	10.7133755	10.0079799	10.7213555	3
58	9.2792970	9.9919956	9.2873014	10.7126986	10.0080044	10.7207030	2
59	9.2799484	9.9919711	9.2879773	10.7120227	10.0080289	10.7200516	1
60	9.2705988	9.9919466	9.2886523	10.7113477	10.0080534	10.7194012	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent	L. Co-Secant	L. Secant.	M

79 DEGREES.

11 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	1908090	9816271	1943803	51445540	10187168	52408431	60
1	1910945	9815716	1946822	51365763	10187744	52330121	59
2	1913800	9815160	1949841	51286224	10188321	52252050	58
3	1916655	9814603	1952861	51206921	10188899	52174216	57
4	1919510	9814045	1955881	51127855	10189478	52096618	56
5	1922365	9813486	1958901	51049024	10190058	52019254	55
6	1925220	9812926	1961922	50970426	10190639	51942125	54
7	1928074	9812366	1964943	50892061	10191221	51865228	53
8	1930928	9811805	1967964	50813928	10191804	51788563	52
9	1933782	9811243	1970986	50736025	10192388	51712128	51
10	1936636	9810680	1974008	50658352	10192973	51635924	50
11	1939490	9810116	1977030	50580907	10193559	51559948	49
12	1942344	9809551	1980053	50503690	10194146	51484199	48
13	1945197	9808986	1983076	50426700	10194734	51408677	47
14	1948050	9808420	1986100	50349935	10195323	51333381	46
15	1950903	9807853	1989124	50273395	10195912	51258309	45
16	1953756	9807285	1992148	50197078	10196502	51183461	44
17	1956609	9806716	1995172	50120984	10197093	51108835	43
18	1959461	9806146	1998197	50045111	10197685	51034431	42
19	1962314	9805576	2001222	49969459	10198278	50960248	41
20	1965166	9805005	2004248	49894027	10198872	50886284	40
21	1968018	9804433	2007274	49818813	10199467	50812539	39
22	1970870	9803860	2010300	49743817	10200063	50739012	38
23	1973722	9803286	2013327	49669037	10200660	50665701	37
24	1976573	9802711	2016354	49594474	10201258	50592606	36
25	1979425	9802136	2019381	49520125	10201857	50519726	35
26	1982276	9801560	2022409	49445590	10202457	50447060	34
27	1985127	9800983	2025437	49372068	10203058	50374607	33
28	1987978	9800405	2028465	49298358	10203660	50302367	32
29	1990829	9799826	2031494	49224859	10204263	50230337	31
30	1993679	9799247	2034523	49151570	10204867	50158517	30
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
36	2010779	9795752	2052705	48716201	10208506	49731964	24
37	2013629	9795167	2055737	48644359	10209116	49661591	23
38	2016478	9794581	2058769	48572719	10209727	49591421	22
39	2019327	9793994	2061801	48501282	10210339	49521453	21
40	2022176	9793406	2064834	48430045	10210952	49451687	20
41	2025024	9792817	2067867	48359010	10211566	49382120	19
42	2027873	9792228	2070900	48288174	10212181	49312754	18
43	2030721	9791638	2073934	48217536	10212797	49243586	17
44	2033569	9791047	2076968	48147096	10213414	49174616	16
45	2036417	9790455	2080003	48076854	10214032	49105844	15
46	2039265	9789862	2083038	48006808	10214650	49037267	14
47	2042113	9789268	2086073	47936957	10215269	48968886	13
48	2044961	9788674	2089109	47867300	10215889	48900700	12
49	2047808	9788079	2092145	47797837	10216510	48372707	11
50	2050655	9787483	2095181	47728567	10217132	48764907	10
51	2053502	9786886	2098218	47659490	10217755	48697299	9
52	2056349	9786288	2101255	47590603	10218379	48629883	8
53	2059195	9785689	2104293	47521907	10219004	48562657	7
54	2062042	9785090	2107331	47453401	10219630	48495621	6
55	2064888	9784498	2110369	47385083	10220257	48428774	5
56	2067734	6783889	2113407	47316954	10220885	48362114	4
57	2070580	9783287	2116446	47249012	10221514	48295643	3
58	2073426	9782684	2119485	47181256	10222144	48229357	2
59	2076271	9782080	2122525	47113686	10222775	48163258	1
60	2079117	9781476	2125565	47046301	10223407	48097343	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant.	M

78 DEGREES.

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11 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant.	
0	9.2805988	9.9919466	9.2886523	10.7113477	10.0080534	10.7194012	60
1	9.2812483	9.9919220	9.2893263	10.7106737	10.0080780	10.7187517	59
2	9.2818967	9.9918974	9.2899993	10.7100007	10.0081026	10.7181033	58
3	9.2825441	9.9918727	9.2906713	10.7093287	10.0081273	10.7174559	57
4	9.2831905	9.9918480	9.2913424	10.7086576	10.0081526	10.7168095	56
5	9.2838359	9.9918233	9.2920126	10.7079874	10.0081767	10.7161641	55
6	9.2844803	9.9917986	9.2926817	10.7073183	10.0082014	10.7155197	54
7	9.2851237	9.9917737	9.2933500	10.7066500	10.0082263	10.7148763	53
8	9.2857661	9.9917489	9.2940172	10.7059828	10.0082511	10.7142339	52
9	9.2864076	9.9917240	9.2946836	10.7053164	10.0082760	10.7135924	51
10	9.2870480	9.9916991	9.2953489	10.7046511	10.0083009	10.7129520	50
11	9.2876875	9.9916741	9.2960134	10.7039866	10.0083259	10.7123125	49
12	9.2883260	9.9916492	9.2966769	10.7033231	10.0083508	10.7116840	48
13	9.2889636	9.9916241	9.2973395	10.7026605	10.0083759	10.7110364	47
14	9.2896001	9.9915990	9.2980011	10.7019989	10.0084010	10.7103999	46
15	9.2902357	9.9915739	9.2986618	10.7013382	10.0084261	10.7097643	45
16	9.2908704	9.9915488	9.2993216	10.7006784	10.0084512	10.7091296	44
17	9.2915040	9.9915236	9.2999804	10.7000196	10.0084764	10.7084960	43
18	9.2921367	9.9914984	9.3006383	10.6993617	10.0085016	10.7078633	42
19	9.2927685	9.9914731	9.3012954	10.6987046	10.0085269	10.7072315	41
20	9.2933993	9.9914478	9.3019514	10.6980486	10.0085522	10.7066007	40
21	9.2940291	9.9914225	9.3026066	10.6973934	10.0085775	10.7059709	39
22	9.2946980	9.9913974	9.3032609	10.6967391	10.0086029	10.7053420	38
23	9.2952859	9.9913717	9.3039143	10.6960857	10.0086283	10.7047141	37
24	9.2959129	9.9913462	9.3045667	10.6954333	10.0086538	10.7040871	36
25	9.2965390	9.9913207	9.3052183	10.6947817	10.0086793	10.7034610	35
26	9.2971641	9.9912952	9.3058689	10.6941311	10.0087048	10.7028359	34
27	9.2977883	9.9912696	9.3065187	10.6934813	10.0087304	10.7022117	33
28	9.2984116	9.9912440	9.3071674	10.6928325	10.0087560	10.7015884	32
29	9.2990339	9.9912184	9.3078155	10.6921845	10.0087816	10.7009661	31
30	9.2996553	9.9911927	9.3084626	10.6915374	10.0088073	10.7003447	30
31	9.3002758	9.9911670	9.3091088	10.6908912	10.0088330	10.6997242	29
32	9.3008953	9.9911412	9.3097541	10.6902459	10.0088588	10.6991047	28
33	9.3015140	9.9911154	9.3103985	10.6896015	10.0088846	10.6984860	27
34	9.3021317	9.9910986	9.3110421	10.6889579	10.0089104	10.6978683	26
35	9.3027485	9.9910637	9.3116848	10.6883152	10.0089363	10.6972515	25
36	9.3033644	9.9910378	9.3123266	10.6876734	10.0089622	10.6966356	24
37	9.3039794	9.9910119	9.3129675	10.6870325	10.0089881	10.6960206	23
38	9.3045934	9.9909859	9.3136076	10.6863924	10.0090141	10.6954066	22
39	9.3052066	9.9909598	9.3142465	10.6857532	10.0090402	10.6947934	21
40	9.3058189	9.9909338	9.3148851	10.6851149	10.0090662	10.6941811	20
41	9.3064303	9.9909077	9.3155226	10.6844774	10.0090923	10.6935697	19
42	9.3070407	9.9908815	9.3161592	10.6838408	10.0091185	10.6929593	18
43	9.3076503	9.9908553	9.3167950	10.6832050	10.0091447	10.6923497	17
44	9.3082590	9.9908291	9.3174299	10.6825701	10.0091709	10.6917410	16
45	9.3088668	9.9908029	9.3180640	10.6819360	10.0091971	10.6911332	15
46	9.3094737	9.9907766	9.3186972	10.6813028	10.0092234	10.6905263	14
47	9.3100798	9.9907502	9.3193295	10.6806705	10.0092498	10.6899202	13
48	9.3106849	9.99072[illegible]	9.3199611	10.6800389	10.0092761	10.6893151	12
49	9.3112892	9.9906974	9.3205918	10.6794082	10.0093026	10.6887108	11
50	9.3118926	9.9906710	9.3212216	10.6787784	10.0093290	10.6881074	10
51	9.3124951	9.9906445	9.3218506	10.6781494	10.0093555	10.6875049	9
52	9.3130968	9.9906180	9.3224788	10.6775212	10.0093820	10.6869032	8
53	9.3136976	9.9905914	9.3231061	10.6768939	10.0094086	10.6863024	7
54	9.3142975	9.9905648	9.3237327	10.6762673	10.0094352	10.6857025	6
55	9.3148965	9.9905382	9.3243584	10.6756416	10.0094618	10.6851035	5
56	9.3154947	9.9905115	9.3249832	10.6750168	10.0094885	10.6845053	4
57	9.3160921	9.9904848	9.3256073	10.6743927	10.0095152	10.6839079	3
58	9.3166885	9.9904580	9.3262305	10.6737695	10.0095420	10.6833115	2
59	9.3172841	9.9904312	9.3268529	10.6731471	10.0095688	10.6827159	1
60	9.317878	9.9904044	9.3274745	10.6725255	10.0095956	10.6821211	0
	L. Co-Sin	L. Sine.	L. CoTang.	L. Tangent	L. Co-Secant	L. Secant.	M.

78 DEGREES.

12 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant.	
0	2079117	9781476	2125565	47046301	10223407	48097343	60
1	2081962	9780871	2128606	46979100	10224040	48031613	59
2	2084807	9780265	2131647	46912083	10224673	47966066	58
3	2087652	9779658	2134688	46845248	10225307	47900702	57
4	2090497	9779050	2137730	46778595	10225942	47835520	56
5	2093341	9778441	2140772	46712124	10226578	47770519	55
6	2096186	9777832	2143814	46645832	10227215	47705699	54
7	2099030	9777222	2146857	46579721	10227853	47641058	53
8	2101874	9776611	2149900	46513788	10228492	47576596	52
9	2104718	9775999	2152944	46448034	10229132	47512312	51
10	2107561	9775386	2155988	46382457	10229773	47438206	50
11	2110405	9774773	2159032	46317056	10230415	47384277	49
12	2113248	9774159	2162077	46251832	10231058	47320523	48
13	2116091	9773544	2165122	46186783	10231702	47256945	47
14	2118934	9772928	2168167	46121908	10232347	47193542	46
15	2121777	9772311	2171213	46057207	10232993	47130313	45
16	2124619	9771693	2174259	45992680	10233640	47067256	44
17	2127462	9771075	2177306	45928325	10234288	47004372	43
18	2130304	9770456	2180353	45864141	10234937	46941660	42
19	2133146	9769836	2183400	45800129	10235587	46879119	41
20	2135988	9769215	2186448	45736287	10236238	46816748	40
21	2138829	9768593	2189496	45672614	10236890	46754548	39
22	2141671	9767970	2192544	45609111	10237543	46692516	38
23	2144512	9767347	2195593	45545776	10238196	46630652	37
24	2147353	9766723	2198642	45482608	10238850	46568956	36
25	2150194	9766098	2201692	45419608	10239505	46507427	35
26	2153035	9765472	2204742	45356773	10240161	46446064	34
27	2155876	9764845	2207793	45294105	10240818	46384867	33
28	2158716	9764217	2210844	45231601	10241476	46323835	32
29	2161556	9763589	2213895	45169261	10242135	46262967	31
30	2164396	9762960	2216947	45107085	10242795	46202263	30
31	2167236	9762330	2219999	45045072	10243456	46141722	29
32	2170076	9761699	2223051	44983221	10244118	46081343	28
33	2172915	9761067	2226104	44921532	10244781	46021126	27
34	2175754	9760435	2229157	44860004	10245445	45961070	26
35	2178593	9759802	2232211	44798636	10246110	45901174	25
36	2181432	9759168	2235265	44737428	10246776	45841439	24
37	2184271	9758533	2238319	44676379	10247443	45781862	23
38	2187110	9757897	2241374	44615489	10248111	45722444	22
39	2189948	9757260	2244429	44554756	10248780	45663183	21
40	2192786	9756623	2247485	44494181	10249449	45604080	20
41	2195624	9755985	2250541	44433762	10250119	45545134	19
42	2198462	9755346	2253597	44373495	10250790	45486344	18
43	2201300	9754706	2256654	44313392	10251462	45427709	17
44	2204137	9754065	2259711	44253439	10252135	45369229	16
45	2206974	9753423	2262769	44193641	10252809	45310903	15
46	2209811	9752781	2265827	44133996	10253484	45252730	14
47	2212648	9752138	2268885	44074504	10254160	45194711	13
48	2215485	9751494	2271944	44015164	10254837	45136844	12
49	2218321	9750849	2271003	43955976	10255515	45079129	11
50	2221158	9750203	2278063	43896940	10256194	45021565	10
51	2223994	9749556	2281123	43838054	10256874	44964152	9
52	2226830	9748909	2284183	43779317	10257555	44906889	8
53	2229666	9748261	2287244	43720731	10258237	44849775	7
54	2232501	9747612	2290305	43662293	10258920	44792810	6
55	2235337	9746962	2293367	43604003	10259604	44735993	5
56	2238172	9746311	2296429	43545861	10260288	44679324	4
57	2241007	9745660	2299492	43487866	10260973	44622802	3
58	2243841	9745008	2302555	43430018	10261662	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

77 DEGREES.

12 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	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	10.0096225	10.6815272	59
2	9.3190659	9.9903506	9.3287153	10.6712847	10.0096494	10.6809341	58
3	9.3196581	9.9903237	9.3293345	10.6706655	10.0096763	10.6803419	57
4	9.3202495	9.9902967	9.3299528	10.6700472	10.0097033	10.6797505	56
5	9.3208400	9.9902697	9.3305704	10.6694296	10.0097303	10.6791600	55
6	9.3214297	9.9902426	9.3311872	10.6688128	10.0097574	10.6785703	54
7	9.3220186	9.9902155	9.3318031	10.6681969	10.0097845	10.6779814	53
8	9.3226066	9.9901883	9.3324183	10.6675817	10.0098117	10.6773934	52
9	9.3231938	9.9901612	9.3330327	10.6669673	10.0098388	10.6768062	51
10	9.3237802	9.9901339	9.3336463	10.6663537	10.0098661	10.6762198	50
11	9.3243657	9.9901067	9.3342591	10.6657409	10.0098933	10.6756343	49
12	9.3249505	9.9900794	9.3348711	10.6651289	10.0099206	10.6750495	48
13	9.3255344	9.9900521	9.3354823	10.6645177	10.0099479	10.6744656	47
14	9.3261174	9.9900247	9.3360927	10.6639073	10.0099753	10.6738826	46
15	9.3266997	9.9899973	9.3367024	10.6632976	10.0100027	10.6733003	45
16	9.3272811	9.9899698	9.3373113	10.6526887	10.0100302	10.6727189	44
17	9.3278617	9.9899423	9.3379194	10.6620806	10.0100577	10.6721383	43
18	9.3284416	9.9899148	9.3385267	10.6614733	10.0100852	10.6715584	42
19	9.3290206	9.9898873	9.3391333	10.6608667	10.0101127	10.6709794	41
20	9.3295988	9.9898597	9.3397391	10.6602609	10.0101403	10.6704012	40
21	9.3301771	9.9898320	9.3403441	10.6596559	10.0101690	10.6698229	39
22	9.3307527	9.9898043	9.3409484	10.6590516	10.0101957	10.6692473	38
23	9.3313285	9.9897766	9.3415519	10.6584481	10.0102234	10.6686715	37
24	9.3319035	9.9897489	9.3421546	10.6578454	10.0102511	10.6680965	36
25	9.3324777	9.9897211	9.3427566	10.6572434	10.0102789	10.6675223	35
26	9.3330511	9.9896932	9.3433578	10.6566422	10.0103068	10.6669489	34
27	9.3336237	9.9896654	9.3439583	10.6560417	10.0103346	10.6667763	33
28	9.3341955	9.9896374	9.3445580	10.6554420	10.0103626	10.6658045	32
29	9.3347665	9.9896095	9.3451570	10.6548430	10.0103905	10.6652335	31
30	9.3353368	9.9895815	9.3457552	10.6542448	10.0104185	10.6646632	30
31	9.3359062	9.9895535	9.3463527	10.6536473	10.0104465	10.6640938	29
32	9.3364749	9.9895254	9.3469494	10.6530506	10.0104746	10.6635251	28
33	9.3370428	9.9894973	9.3475454	10.6524546	10.0105027	10.6629572	27
34	9.3376099	9.9894692	9.3481407	10.6518593	10.0105308	10.6623901	26
35	9.3381762	9.9894410	9.3487352	10.6512648	10.0105590	10.6618274	25
36	9.3387418	9.9894128	9.3493290	10.6506710	10.0105872	10.6612582	24
37	9.3393065	9.9893845	9.3499220	10.6500780	10.0106155	10.6606935	23
38	9.3398706	9.9893562	9.3505143	10.6494857	10.0106438	10.6601293	22
39	9.3404338	9.9893279	9.3511059	10.6488941	10.0106721	10.6595662	21
40	9.3409963	9.9892995	9.3516968	10.6483032	10.0107005	10.6590037	20
41	9.3415580	9.9892711	9.3522869	10.6477131	10.0107289	10.6584420	19
42	9.3421190	9.9892427	9.3528763	10.6471237	10.0107573	10.6578810	18
43	9.3426792	9.9892142	9.3534650	10.6465350	10.0107858	10.6573208	17
44	9.3432386	9.9891856	9.3540530	10.6459470	10.0108144	10.6567614	16
45	9.3437973	9.9891571	9.3546402	10.6453598	10.0108429	10.6562027	15
46	9.3443552	9.9891285	9.3552267	10.6446733	10.0108716	10.6556448	14
47	9.3449124	9.9890998	9.3558126	10.6441874	10.0109002	10.6550876	13
48	9.3454688	9.9890711	9.3563977	10.6436023	10.0109289	10.6545312	12
49	9.3460245	9.9890424	9.3569821	10.6430179	10.0109576	10.6539755	11
50	9.3465794	9.9890137	9.3575658	10.6424342	10.0109863	10.6534206	10
51	9.3471336	9.9889849	9.3581487	10.6418513	10.0110151	10.6528664	9
52	9.3476870	9.9889560	9.3587310	10.6412690	10.0110440	10.6523130	8
53	9.3482397	9.9889271	9.3595126	10.6406874	10.0110729	10.6517603	7
54	9.3487917	9.9888982	9.3598935	10.6401065	10.0111018	10.6512083	6
55	9.3493429	9.9888693	9.3604736	10.6395264	10.0111307	10.6506561	5
56	9.3498934	9.9888403	9.3610531	10.6389469	10.0111597	10.6501066	4
57	9.3504432	9.9888113	9.3616319	10.6383681	10.0111887	10.6495568	3
58	9.3509922	9.9887822	9.3622100	10.6377900	10.0112178	10.6490078	2
59	9.3515405	9.9887531	9.3627874	10.6372126	10.0112469	10.6484595	1
60	9.3520880	9.9887239	9.3633641	10.6366359	10.0112761	10.6479120	0
	L. Co-Sine.	L. Sine	L. Co-Tang.	L. Tangent	L. Co-Secant.	L. Secant.	M

77 DEGREES.

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13 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	2249511	9743701	2308682	43314759	10263039	44454115	60
1	2252345	9743046	2311746	43257347	10263729	44398176	59
2	2255179	9742390	2314811	43200079	10264420	44342382	58
3	2258013	9741734	2317876	43142955	10265112	44286731	57
4	2260846	9741077	2320941	43085974	10265805	44231224	56
5	2263680	9740419	2324007	43029136	10266499	44175859	55
6	2266513	9739760	2327073	42972440	10267194	44120637	54
7	2269346	9739100	2330140	42915885	10267890	44065556	53
8	2272179	9738439	2333207	42859472	10268587	44010616	52
9	2275012	9737778	2336274	42803199	10269284	43955817	51
10	2277844	9737116	2339342	42747066	10269982	43901158	50
11	2280677	9736453	2342410	42691072	10270681	43846638	49
12	2283509	9735789	2345479	42635218	10271381	43792257	48
13	2286341	9735124	2348548	42579501	10272082	43738015	47
14	2289172	9734458	2351617	42523923	10272784	43683910	46
15	2292004	9733792	2354687	42468482	10273487	43629943	45
16	2294835	9733125	2357758	42413177	10274191	43576113	44
17	2297666	9732457	2360829	42358009	10274896	43522419	43
18	2300497	9731788	2363900	42302977	10275602	43468861	42
19	2303328	9731118	2366972	42248080	10276309	43415438	41
20	2306159	9730448	2370044	42193318	10277017	43362150	40
21	2308989	9729777	2373116	42138690	10277726	43308996	39
22	2311819	9729105	2376189	42084196	10278436	43255977	38
23	2314649	9728432	2379262	42029835	10279147	43203090	37
24	2317479	9727758	2382336	41975606	10279859	43150336	36
25	2320309	9727084	2385410	41921510	10280572	43097715	35
26	2323138	9726409	2388485	41867546	10281286	43045225	34
27	2325967	9725733	2391560	41813713	10282001	42992867	33
28	2328796	9725056	2394635	41760011	10282717	42940640	32
29	2331625	9724378	2397711	41706440	10283434	42888543	31
30	2334454	9723699	2400787	41652998	10284152	42836576	30
31	2337282	9723019	2403864	41599685	10284871	42784738	29
32	2340110	9722339	2406941	41546501	10285591	42733029	28
33	2342938	9721658	2410019	41493446	10286312	42681449	27
34	2345766	9720976	2413097	41440519	10287034	42629996	26
35	2348594	9720293	2416176	41387719	10287757	42578671	25
36	2351421	9719609	2419255	41335046	10288481	42527474	24
37	2354248	9718925	2422334	41282499	10289206	42476402	23
38	2357075	9718240	2425414	41230079	10289932	42425457	22
39	2359902	9717554	2428494	41177784	10290658	42374637	21
40	2362729	9716867	2431575	41125614	10291385	42323943	20
41	2365555	9716179	2434656	41073569	10292113	42273373	19
42	2368381	9715491	2437737	41021649	10292842	42222928	18
43	2371207	9714802	2440819	40969852	10293572	42172606	17
44	2374033	9714112	2443901	40918178	10294303	42122408	16
45	2376859	9713421	2446984	40866627	10295035	42072333	15
46	2379684	9712729	2450067	40815199	10295768	42022380	14
47	2382510	9712036	2453151	40763892	10296502	41972549	13
48	2385335	9711343	2456235	40712707	10297237	41922840	12
49	2388159	9710649	2459320	40661643	10297973	41873252	11
50	2390984	9709954	2462405	40610700	10298710	41823785	10
51	2393808	9709258	2465491	40559877	10299448	41774438	9
52	2396633	9708561	2468577	40509174	10300187	41725210	8
53	2399457	9707863	2471663	40458590	10300927	41676102	7
54	2402280	9707165	2474750	40408125	10301668	41627114	6
55	2405104	9706466	2477837	40357779	10302410	41578243	5
56	2407927	9705766	2480925	40307550	10303153	41529491	4
57	2410751	9705065	2484013	40257440	10303897	41480856	3
58	2413574	9704363	2487102	40207446	10304642	41432339	2
59	2416396	9703660	2490191	40157570	10305388	41383939	1
60	2419219	9702957	2493280	40107809	10306135	41335655	0
	N Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co-Secant.	N. Secant.	M

76 DEGREES.

13 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L Co-Secant	
0	9.3520880	9.9887239	9.3633641	10.6366359	10.0112761	10.6479120	60
1	9.3526349	9.9886947	9.3639401	10.6360599	10.0113053	10.6473651	59
2	9.3531810	9.9886655	9.3645155	10.6354845	10.0113345	10.6468190	58
3	9.3537264	9.9886363	9.3650901	10.6349099	10.0113637	10.6462636	57
4	9.3542710	9.9886070	9.3656641	10.6343359	10.0113930	10.6457290	56
5	9.3548150	9.9885776	9.3662374	10.6337626	10.0114224	10.6451850	55
6	9.3553582	9.9885482	9.3668100	10.6337900	10.0114518	10.6446418	54
7	9.3559149	9.9885188	9.3673819	10.6326181	10.0114812	10.6440993	53
8	9.3564426	9.9884894	9.3679532	10.6320468	10.0115106	10.6435574	52
9	9.3569836	9.9884599	9.3685238	10.6314762	10.0115401	10.6430164	51
10	9.3575240	9.9884303	9.3690937	10.6309063	10.0115697	10.6424760	50
11	9.3580637	9.9884008	9.3696629	10.6303371	10.0115992	10.6419363	49
12	9.3586027	9.9883712	9.3702315	10.6297685	10.0116288	10.6413973	48
13	9.3591409	9.9883415	9.3707994	10.6292006	10.0116585	10.6408591	47
14	9.3596785	9.9883118	9.3713657	10.6286333	10.0116882	10.6403215	46
15	9.3602154	9.9882821	9.3719333	10.6280667	10.0117179	10.6397846	45
16	9.3607515	9.9882523	9.3724992	10.6275008	10.0117477	10.6392485	44
17	9.3612870	9.9882225	9.3730645	10.6269355	10.0117775	10.6387130	43
18	9.3618217	9.9881927	9.3736291	10.6263709	10.0118073	10.6381783	42
19	9.3623558	9.9881628	9.3741930	10.6258070	10.0118372	10.6376442	41
20	9.3628892	9.9881329	9.3747563	10.6252437	10.0118671	10.6371108	40
21	9.3634219	9.9881029	9.3753190	10.6246810	10.0118971	10.6365781	39
22	9.3639539	9.9880729	9.3758810	10.6241190	10.0119271	10.6360461	38
23	9.3644852	9.9880429	9.3764423	10.6235577	10.0119571	10.6355148	37
24	9.3650158	9.9880128	9.3770030	10.6229970	10.0119872	10.6349842	36
25	9.3655458	9.9879826	9.3775631	10.6224369	10.0120173	10.6341542	35
26	9.3660750	9.9879525	9.3781225	10.6218775	10.0120475	10.6339250	34
27	9.3666036	9.9879223	9.3786813	10.6213187	10.0120777	10.6333964	33
28	9.3671315	9.9878921	9.3792394	10.6207606	10.0121079	10.6328685	32
29	9.3676587	9.9878618	9.3797969	10.6202031	10.0121382	10.6323413	31
30	9.3681853	9.9878315	9.3803537	10.6196463	10.0121685	10.6318147	30
31	9.3687111	9.9878012	9.3809100	10.6190900	10.0121988	10.6312889	29
32	9.3692363	9.9877708	9.3814655	10.6185345	10.0122292	10.6307637	28
33	9.3697608	9.9877404	9.3820205	10.6179795	10.0122596	10.6302392	27
34	9.3702847	9.9877099	9.3825748	10.6174252	10.0122901	10.6297153	26
35	9.3708079	9.9876794	9.3831285	10.6168715	10.0123206	10.6291921	25
36	9.3713304	9.9876488	9.3836816	10.6163184	10.0123512	10.6286696	24
37	9.3718523	9.9876183	9.3842340	10.6157660	10.0123817	10.6281477	23
38	9.3723735	9.9875876	9.3847858	10.6152142	10.0124124	10.6276265	22
39	9.3728940	9.9875570	9.3853370	10.6146630	10.0124430	10.6271060	21
40	9.3734139	9.9875263	9.3858876	10.6141124	10.0124737	10.6265861	20
41	9.3739331	9.9874955	9.3864376	10.6135624	10.0125045	10.6260669	19
42	9.3744517	9.9874648	9.3869869	10.6130131	10.0125352	10.6255483	18
43	9.3749696	9.9874339	9.3875356	10.6124644	10.0125661	10.6250304	17
44	9.3754868	9.9874031	9.3880837	10.6119163	10.0125969	10.6245132	16
45	9.3760034	9.9873722	9.3886312	10.6113688	10.0126278	10.6239966	15
46	9.3765194	9.9873413	9.3891781	10.6108219	10.0126587	10.6234806	14
47	9.3770347	9.9873103	9.3897244	10.6102756	10.0126897	10.6229653	13
48	9.3775493	9.9872793	9.3902700	10.6097300	10.0127207	10.6224507	12
49	9.3780633	9.9872482	9.3908151	10.6091849	10.0127518	10.6219367	11
50	9.3785767	9.9872171	9.3913595	10.6086405	10.0127829	10.6214233	10
51	9.3790894	9.9871860	9.3919034	10.6080966	10.0128140	10.6209106	9
52	9.3796015	9.9871549	9.3924466	10.6075534	10.0128451	10.6203985	8
53	9.3801129	9.9871236	9.3929893	10.6070107	10.0128764	10.6198871	7
54	9.3806237	9.9870924	9.3935313	10.6064687	10.0129076	10.6193763	6
55	9.3811339	9.9870611	9.3940727	10.6059273	10.0129389	10.6188661	5
56	9.3816434	9.9870298	9.3946136	10.6053864	10.0129702	10.6183566	4
57	9.3821523	9.9869984	9.3951538	10.6048462	10.0130016	10.6178477	3
58	9.3826605	9.9869670	9.3956935	10.6043065	10.0130330	10.6173395	2
59	9.3831682	9.9869356	9.3962326	10.6037674	10.0130644	10.6168318	1
60	9.3836752	9.9869041	9.3967711	10.6032289	10.0130959	10.6163248	0
	L. Co-Sine	L. Sine	L. Co-Tang.	L. Tangent.	L. Co-Secant.	L. Secant.	M

76 DEGREES.

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14 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N. Co-Secant.	
0	2419219	9702957	2493280	40107809	10306135	41335655	60
1	2422041	9702253	2496370	40058165	10306883	41287487	59
2	2424863	9701548	2499460	40008636	10307632	41239435	58
3	2427685	9700842	2502551	39959283	10308382	41191498	57
4	2430507	9700135	2505642	39909924	10309133	41143675	56
5	2433329	9699428	2508734	39860739	10309885	41095967	55
6	2436150	9698720	2511826	39811669	10310638	41048374	54
7	2438971	9698011	2514919	39762712	10311392	41000893	53
8	2441792	9697301	2518012	39713868	10312147	40953526	52
9	2444613	9696590	2521106	39665137	10312903	40906272	51
10	2447433	9695879	2524200	39616518	10313660	40859130	50
11	2450254	9695167	2527294	39568011	10314418	40812100	49
12	2453074	9694454	2530589	39519615	10315177	40765281	48
13	2455894	9693740	2533484	39471331	10315936	40718374	47
14	2458713	9693025	2536580	39423157	10316697	40671677	46
15	2461533	9692309	2539676	39375084	10317459	40625091	45
16	2464352	9691592	2542733	39327141	10318222	40578615	44
17	2467171	9690875	2545870	39279297	10318985	40532249	43
18	2469990	9690157	2548968	39281563	10319750	40485992	42
19	2472809	9689438	2552066	39183937	10320516	40439844	41
20	2475627	9688718	2555165	39136420	10321282	40393804	40
21	2478445	9687998	2558264	39089011	10322050	40347872	39
22	2481263	9687277	2561363	39041710	10322818	40302048	38
23	2484087	9686555	2564463	38994516	10323588	40256332	37
24	2487899	9685832	2567563	38947429	10324359	40210722	36
25	2489716	9685108	2570664	38900448	10325130	40165219	35
26	2492533	9684383	2573766	38853574	10325903	40119823	34
27	2495350	9683657	2576868	38806805	10326676	40074532	33
28	2498167	9682931	2579970	38760142	10327451	40029347	32
29	2500984	9682204	2583073	38713584	10328227	39984267	31
30	2503800	9681476	2586176	38667131	10329003	39939292	30
31	2506616	9680747	2589280	38620782	10329781	39894421	29
32	2509432	9680018	2592384	38574537	10330559	39849654	28
33	2512248	9679288	2595488	38528396	10331339	39804991	27
34	2515063	9678557	2598593	38482358	10332119	39760431	26
35	2517879	9677825	2601699	38436424	10332901	39715975	25
36	2520694	9677092	2604805	38390591	10333683	39671621	24
37	2523508	9676358	2607911	38344861	10334467	39627369	23
38	2526323	9675623	2611018	38299233	10335251	39583219	22
39	2529137	9674888	2614126	38253707	10336037	39539171	21
40	2531952	9674152	2617234	38208281	10336823	39495224	20
41	2534766	9673415	2620342	38162957	10337611	39451379	19
42	2537579	9672677	2623451	38127733	10338399	39407633	18
43	2540393	9671938	2626560	38072609	10339188	39363988	17
44	2543206	9671199	2629670	38027585	10339979	39320443	16
45	2546019	9670459	2632780	37982661	10340770	39276997	15
46	2548832	9669718	2635891	37937835	10341563	39233651	14
47	2551645	9668976	2639002	37893109	10342356	39190403	13
48	2554458	9668233	2642114	37848481	10343151	39147254	12
49	2557270	9667490	2645226	37803951	10343946	39104203	11
50	2560082	9666746	2648339	37759519	10344743	39061250	10
51	2562894	9666001	2651452	37715185	10345540	39018395	9
52	2565705	9665255	2654566	37670947	10346338	38975637	8
53	2568517	9664508	2657680	37626807	10347138	38932976	7
54	2571328	9663760	2660794	37582763	10347938	38890411	6
55	2574139	9663012	2663909	37538815	10348740	38847943	5
56	2576950	9662263	2667025	37494963	10349542	38805570	4
57	2579760	9661513	2670141	37451207	10350346	38763293	3
58	2582570	9660762	2673257	37407546	10351150	38721112	2
59	2585381	9660010	2676374	37363980	10351955	38679025	1
60	2588190	9659258	2679492	37320508	10352762	38637033	0
	N Co-Sine.	N. Sine.	N Co Tang.	N. Tangent.	N Co-Secant.	N. Secant	M

75 DEGREES.

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14 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	9.3836752	9.9869041	9.3967711	10.6032289	10.0130959	10.6163248	60
1	9.3841815	9.9868726	9.3973089	10.6026911	10.0131274	10.6158185	59
2	9.3846872	9.9868410	9.3978463	10.6021537	10.0131590	10.6153127	58
3	9.3851924	9.9868094	9.3983830	10.6016170	10.0131906	10.6148076	57
4	9.3856969	9.9867778	9.3989191	10.6010809	10.0132222	10.6143031	56
5	9.3862008	9.9867461	9.3994547	10.6005453	10.0132539	10.6137992	55
6	9.3867040	9.9867144	9.3999896	10.6000104	10.0132856	10.6132960	54
7	9.3872067	9.9866827	9.4005240	10.5994760	10.0133173	10.6127933	53
8	9.3877087	9.9866509	9.4010578	10.5989422	10.0133491	10.6122913	52
9	9.3882101	9.9866191	9.4015910	10.5984090	10.0133809	10.6117898	51
10	9.3887109	9.9865872	9.4021237	10.5978763	10.0134128	10.6112891	50
11	9.3892111	9.9865553	9.4026558	10.5973442	10.0134447	10.6107889	49
12	9.3897106	9.9865233	9.4031873	10.5968127	10.0134767	10.6102894	48
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	9.4047784	10.5952216	10.0135727	10.6087943	45
16	9.3917028	9.9863952	9.4053076	10.5946924	10.0136048	10.6082972	44
17	9.3921993	9.9863630	9.4058363	10.5941637	10.0136370	10.6078007	43
18	9.3926952	9.9863308	9.4063644	10.5936356	10.0136692	10.6073048	42
19	9.3931905	9.9862986	9.4068919	10.5931081	10.0137014	10.6068005	41
20	9.3936852	9.9862663	9.4074189	10.5925811	10.0137337	10.6063148	40
21	9.3941794	9.9862340	9.4079453	10.5920547	10.0137660	10.6058206	39
22	9.3946729	9.9862017	9.4084712	10.5915288	10.0137983	10.6053271	38
23	9.3951658	9.9861693	9.4089965	10.5910035	10.0138307	10.6048342	37
24	9.3956581	9.9861369	9.4095212	10.5914788	10.0138631	10.6043419	36
25	9.3961499	9.9861045	9.4100054	10.5899546	10.0138955	10.6038501	35
26	9.3966410	9.9860720	9.4105690	10.5894310	10.0139280	10.6033590	34
27	9.3971315	9.9860394	9.4110921	10.5889079	10.0139606	10.6028685	33
28	9.3976215	9.9860069	9.4116146	10.5883854	10.0139931	10.6023785	32
29	9.3981109	9.9859742	9.4121366	10.5878634	10.0140258	10.6018891	31
30	9.3985996	9.9859416	9.4126581	10.5873419	10.0140584	10.6014004	30
31	9.3990878	9.9859089	9.4131789	10.5868211	10.0140911	10.6009122	29
32	9.3995754	9.9858762	9.4136993	10.5863007	10.0141238	10.6004246	28
33	9.4000625	9.9858434	9.4142191	10.5857809	10.0141566	10.5999375	27
34	9.4005489	9.9858106	9.4147383	10.5852617	10.0141894	10.5994511	26
35	9.4010348	9.9857777	9.4152570	10.5847430	10.0142223	10.5989652	25
36	9.4015201	9.9857449	9.4157752	10.5842248	10.0142551	10.5984799	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	21
40	9.4034554	9.9856129	9.4178425	10.5821575	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
43	9.4049009	9.9855135	9.4193874	10.5806126	10.0144865	10.5950991	17
44	9.4053816	9.9854803	9.4199013	10.5800987	10.0145197	10.5946184	16
45	9.4058617	9.9854471	9.4204146	10.5795854	10.0145529	10.5941383	15
46	9.4063413	9.9854138	9.4209275	10.5790725	10.0145862	10.5936587	14
47	9.4068203	9.9853805	9.4213398	10.5785602	10.0146195	10.5931797	13
48	9.4072987	9.9853471	9.4219515	10.5780485	10.0146529	10.5927013	12
49	9.4077766	9.9853138	9.4224628	10.5775372	10.0146862	10.5922234	11
50	9.4082539	9.9852803	9.4229735	10.5770265	10.0147196	10.5917461	10
51	9.4087306	9.9852468	9.4234838	10.5765162	10.0147532	10.5912694	9
52	9.4092068	9.9852133	9.4239935	10.5760065	10.0147867	10.5907932	8
53	9.4096824	9.9851798	9.4245026	10.5754974	10.0148202	10.5903176	7
54	9.4101575	9.9851462	9.4250113	10.5749887	10.0148538	10.5898425	6
55	9.4106320	9.9851125	9.4255194	10.5744806	10.0148875	10.5893680	5
56	9.4111059	9.9850789	9.4260271	10.5739729	10.0149211	10.5888941	4
57	9.4115793	9.9850452	9.4265342	10.5734658	10.0149548	10.5884207	3
58	9.4120522	9.9850114	9.4270408	10.5729592	10.0149886	10.5879478	2
59	9.4125245	9.9849776	9.4275469	10.5724531	10.0150224	10.5874755	1
60	9.4129962	9.9849438	9.4280525	10.5719475	10.0150562	10.5870038	0
	L. Co-Sine	L. Sine	L. Co-Tang.	L. Tangent.	L. Co-Secant.	L. Secant.	M

75 DEGREES.

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15 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant.	
0	2588190	9659258	2679492	37320580	10352762	38637033	60
1	2591000	9658505	2682610	37277131	10353569	38595135	59
2	2593810	9657751	2685728	37233847	10354378	38553332	58
3	2596619	9656996	2688847	37190658	10355187	38511622	57
4	2599428	9656240	2691967	37147561	10355998	38470005	56
5	2602237	9655483	2695087	37104558	10356809	38428482	55
6	2605045	9654726	2698207	37061648	10357621	38387051	54
7	2607853	9653968	2701328	37018830	10358435	38345713	53
8	2610661	9653209	2704449	36976103	10359249	38304467	52
9	2613469	9652449	2707571	36933469	10360065	38263313	51
10	2616277	9651688	2710693	36890927	10360881	38222251	50
11	2619085	9650927	2713816	36848475	10361699	38181280	49
12	2621892	9650165	2716940	36806115	10362517	38140399	48
13	2624699	9649402	2720064	36763845	10363337	38099610	47
14	2627506	9648638	2723188	36721665	10364157	38058911	46
15	2630312	9647873	2726313	36679575	10364979	38018301	45
16	2633118	9647107	2729438	36637575	10365801	37977782	44
17	2635924	9646341	2732564	36595565	10366625	37937352	43
18	2638730	9645574	2735690	36553844	10367449	37897011	42
19	2641536	9644806	2738817	36512111	10368275	37856760	41
20	2544342	9644037	2741944	36470467	10369101	37816596	40
21	2647147	9643267	2745072	36428911	10369929	37776522	39
22	2649952	9642497	2748201	36387444	10370757	37736535	38
23	2652757	9641726	2751330	36346064	10371587	37696536	37
24	2655561	9640954	2754459	36304771	10372417	37656824	36
25	2658365	9640181	2757589	36263566	10373249	37617100	35
26	2661169	9639407	2760719	36222447	10374082	37577462	34
27	2663973	9638633	2763850	36181415	10374915	37537911	33
28	2666777	9637858	2766981	36140469	10375750	37498447	32
29	2669581	9637082	2770113	36099609	10376585	37459068	31
30	2672384	9636305	2773245	36058835	10377422	37419775	30
31	2675187	9635527	2776378	36018146	10378260	37380568	29
32	2677989	9634748	2779512	35977543	10379098	37341446	28
33	2680792	9633969	2782646	35937024	10379938	37302409	27
34	2683594	9633189	2785780	35896590	10380779	37263457	26
35	2686396	9632408	2788915	35856241	10381621	37224589	25
36	2689198	9631626	2792050	35815975	10382463	37185805	24
37	2692000	9630843	2795186	35775794	10383307	37147105	23
38	2694801	9630059	2798322	35735696	10384152	37108489	22
39	2697602	9629275	2801459	35695681	10384998	37069956	21
40	2700403	9628490	2804597	35655749	10385844	37031506	20
41	2703204	9627704	2807735	35615900	10386692	36993139	19
42	2706004	9626917	2810873	35576133	10387541	36954854	18
43	2708805	9626130	2814012	35536449	10388391	36916652	17
44	2711605	9625342	2817152	35496846	10389242	36878532	16
45	2714404	9624553	2820292	35457325	10390094	36840493	15
46	2717204	9623763	2823432	35417886	10390947	36802536	14
47	2720003	9622972	2826573	35378528	10391800	36764660	13
48	2722802	9622180	2829715	35339251	10392655	36726865	12
49	2725601	9621387	2832857	35300054	10393511	36689151	11
50	2728400	9620594	2835999	35260938	10394368	36651518	10
51	2731198	9619800	2839142	35221902	10395226	36613964	9
52	2733996	9619005	2842286	35182946	10396085	36576491	8
53	2736794	9618209	2845430	35144070	10396945	36539097	7
54	2739592	9617413	2848575	35105273	10397806	36501783	6
55	2742390	9616616	2851720	35066555	10398669	36464548	5
56	2745187	9615818	2854866	35027916	10399532	36427392	4
57	2747984	9615019	2858012	34989356	10400396	36390315	3
58	2750781	9614219	2861159	34950874	10401261	36353316	2
59	2753578	9613418	2864306	34912470	10402127	36316395	1
60	2756374	9612617	2867454	34874144	10402994	36279553	0
	N Co-Sine.	N. Sine.	N Co Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M

74 DEGREES.

15 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L Co-Secant	
0	9.4129962	9.9849438	9.4280525	10.5719475	10.0150562	10.5870038	60
1	9.4134674	9.9849099	9.4285575	10.5714425	10.0150901	10.5865326	59
2	9.4139381	9.9848760	9.4290621	10.5709379	10.0151240	10.5860619	58
3	9.4144082	9.9848420	9.4295661	10.5704339	10.0151580	10.5855918	57
4	9.4148778	9.9848081	9.4300697	10.5699303	10.0151919	10.5851222	56
5	9.4153468	9.9847740	9.4305727	10.5694273	10.0152260	10.5846532	55
6	9.4158152	9.9847400	9.4310753	10.5689247	10.0152600	10.5841848	54
7	9.4162832	9.9847059	9.4315773	10.5684227	10.0152941	10.5837168	53
8	9.4167506	9.9846717	9.4320789	10.5679211	10.0153283	10.5832494	52
9	9.4172174	9.9846375	9.4325799	10.5674201	10.0153625	10.5827826	51
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	10.5818505	49
12	9.4186148	9.9845347	9.4340800	10.5659200	10.0154653	10.5813852	48
13	9.4190795	9.9845004	9.4345791	10.5654209	10.0154996	10.5809205	47
14	9.4195436	9.9844660	9.4350776	10.5649224	10.0155340	10.5804564	46
15	9.4200073	9.9844316	9.4355757	10.5644243	10.0155684	10.5799927	45
16	9.4204704	9.9843971	9.4360733	10.5639267	10.0156029	10.5795296	44
17	9.4209330	9.9843626	9.4365704	10.5634296	10.0156374	10.5790670	43
18	9.4213950	9.9843281	9.4370670	10.5629330	10.0156719	10.5786050	42
19	9.4218566	9.9842935	9.4375631	10.5624369	10.0157065	10.5781434	41
20	9.4223176	9.9842589	9.4380587	10.5619413	10.0157411	10.5776824	40
21	9.4227780	9.9842242	9.4385538	10.5614462	10.0157758	10.5772220	39
22	9.4232380	9.9841895	9.4390485	10.5609515	10.0158105	10.5767620	38
23	9.4236974	9.9841548	9.4395426	10.5604574	10.0158452	10.5763026	37
24	9.4241563	9.9841200	9.4400363	10.5599637	10.0158800	10.5758437	36
25	9.4246147	9.9840852	9.4405295	10.5594705	10.0159148	10.5753853	35
26	9.4250726	9.9840503	9.4410222	10.5589778	10.0159497	10.5749274	34
27	9.4255299	9.9840154	9.4415145	10.5584855	10.0159846	10.5744701	33
28	9.4259867	9.9839805	9.4420062	10.5579938	10.0160195	10.5740133	32
29	9.4264430	9.9839455	9.4424975	10.5575025	10.0160545	10.5735570	31
30	9.4268988	9.9839105	9.4429883	10.5570117	10.0160895	10.5731012	30
31	9.4273541	9.9838755	9.4434786	10.5565214	10.0161245	10.5726459	29
32	9.4278089	9.9838404	9.4439685	10.5560315	10.0161596	10.5721911	28
33	9.4282631	9.9838052	9.4444579	10.5555421	10.0161948	10.5717369	27
34	9.4287169	9.9837701	9.4449468	10.5550532	10.0162299	10.5712831	26
35	9.4291701	9.9837348	9.4454352	10.5545648	10.0162652	10.5708299	25
36	9.4296228	9.9836996	9.4459232	10.5540768	10.0163004	10.5703772	24
37	9.4300750	9.9836643	9.4464107	10.5535893	10.0163357	10.5699250	23
38	9.4305267	9.9836290	9.4468978	10.5531022	10.0163710	10.5694733	22
39	9.4309779	9.9835936	9.4473843	10.5526157	10.0164064	10.5690221	21
40	9.4314286	9.9835582	9.4478704	10.5521296	10.0164418	10.5685714	20
41	9.4318788	9.9835227	9.4483561	10.5516439	10.0164773	10.5681212	19
42	9.4323285	9.9834872	9.4488413	10.5511587	10.0165128	10.5676715	18
43	9.4327777	9.9834517	9.4493260	10.5506740	10.0165483	10.5672223	17
44	9.4332264	9.9834161	9.4498102	10.5501898	10.0165839	10.5667736	16
45	9.4336746	9.9833805	9.4502940	10.5497060	10.0166195	10.5663254	15
46	9.4341223	9.9833449	9.4507774	10.5492226	10.0166551	10.5658777	14
47	9.4345694	9.9833092	9.4512602	10.5487398	10.0166908	10.5654306	13
48	9.4350161	9.9832735	9.4517427	10.5482573	10.0167265	10.5649839	12
49	9.4354623	9.9832377	9.4522246	10.5477754	10.0167623	10.5645377	11
50	9.4359080	9.9832019	9.4527061	10.5472939	10.0167981	10.5640920	10
51	9.4363532	9.9831661	9.4531872	10.5468128	10.0168339	10.5636468	9
52	9.4367980	9.9831302	9.4536678	10.5463322	10.0168698	10.5632020	8
53	9.4372422	9.9830942	9.4541479	10.5458521	10.0169058	10.5627578	7
54	9.4376850	9.9830583	9.4546276	10.5453724	10.0169417	10.5623141	6
55	9.4381292	9.9830223	9.4551069	10.5448931	10.0169777	10.5618708	5
56	9.4385719	9.9829862	9.4555857	10.5444143	10.0170138	10.5614281	4
57	9.4390142	9.9829501	9.4560641	10.5439359	10.0170499	10.5609858	3
58	9.4394560	9.9829140	9.4565420	10.5434580	10.0170860	10.5605440	2
59	9.4398973	9.9828778	9.4570194	10.5429805	10.0171222	10.5601027	1
60	9.4403381	9.9828416	9.4574964	10.5425036	10.0171586	10.5596619	0
	L.Co-Sine.	L. Sine	L. Co-Tang.	L. Tangent.	L. Co-Secant.	L. Secant.	M

74 DEGREES.

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16 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	2756374	9612617	2867454	34874144	10402994	36279553	60
1	2759170	9611815	2870602	34835896	10403863	36242788	59
2	2761965	9611012	2873751	34797726	10404732	36206101	58
3	2764761	9610208	2876900	34759632	10405602	36169490	57
4	2767556	9609403	2880050	34721616	10406473	36132957	56
5	2770352	9608598	2883201	34683676	10407346	36096501	55
6	2773147	9607792	2886352	34645813	10408219	3606012	54
7	2775941	9606985	2889503	34608026	10409094	36023818	53
8	2778736	9606177	2892655	34570315	10409969	35987590	52
9	2781530	9605368	2895808	34532679	10410845	35951439	51
10	2784324	9604558	2898961	34495120	10411723	35915363	50
11	2787118	9603748	2902114	34457635	10412601	35879362	49
12	2789911	9602937	2905268	34420226	10413481	35843437	48
13	2792704	9602125	2908423	34382891	10414362	35807586	47
14	2795497	9601312	2911578	34345631	10415243	35771810	46
15	2798290	9600498	2914734	34308446	10416126	35736108	45
16	2801083	9599684	2917890	34271334	10417009	35700481	44
17	2803875	9598869	2921047	34234297	10417894	35664928	43
18	2806667	9598053	2924205	34197333	10418780	35629448	42
19	2809459	9597236	2927363	34160443	10419667	35594042	41
20	2812251	9596418	2930521	34123626	10420554	35558710	40
21	2815042	9595600	2933680	34086882	10421443	35523450	39
22	2817833	9594781	2936839	34050216	10422333	35488263	38
23	2820624	9593961	2939999	34013612	10423224	35453149	37
24	2823415	9593140	2943160	33977085	10424116	35418107	36
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	35209365	30
31	2842942	9587370	2965299	33723403	10430388	35174824	29
32	2845731	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	9580729	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	10440348	34799392	18
43	2876391	9577389	3003315	33296543	10441259	34765785	17
44	2879177	9576552	3006486	33261419	10442172	34732146	16
45	2881963	9575714	3009658	33226362	10443086	34698576	15
46	2884748	9574875	3012831	33191373	10444001	34665037	14
47	2887533	9574035	3016004	33156452	10444917	34631673	13
48	2890318	9573195	3019178	33121598	10445833	3459826[illegible]	12
49	2893103	9572354	3022352	33086811	10446751	34564969	11
50	2895887	9571512	3025527	33052091	10447670	34531735	10
51	2898671	9570669	3028703	33017438	10448590	34498568	9
52	2901455	9569825	3031879	32982851	10449511	34465467	8
53	2904239	9568981	3035055	32948330	10450433	34432433	7
54	2907022	9568136	3038232	32913876	10451257	34399465	6
55	2909805	9567290	3041410	32879487	10452281	34366563	5
56	2912588	9566443	3044588	32845164	10453206	34333727	4
57	2915371	9565595	3047767	32810907	10454132	34300956	3
58	2918153	9564747	3050946	32776715	10455060	34268251	2
59	2920935	9563898	3054126	32742588	10455988	34235611	1
60	2923717	9563048	3057307	32708526	10456918	34203036	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co-Secant.	N. Secant.	M

73 DEGREES.

16 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant	
0	9.4403381	9.9828416	9.4574964	10.5425036	10.0171584	10.5596619	60
1	9.4407784	9.9828054	9.4579730	10.5420270	10.0171946	10.5592216	59
2	9.4412182	9.9827691	9.4584491	10.5415509	10.0172309	10.5587818	58
3	9.4416576	9.9827328	9.4589248	10.5410752	10.0172672	10.5583424	57
4	9.4420965	9.9826964	9.4594001	10.5405999	10.0173036	10.5579035	56
5	9.4425349	9.9826600	9.4598749	10.5401251	10.0173400	10.5574651	55
6	9.4429728	9.9826236	9.4603492	10.5396508	10.0173764	10.5570272	54
7	9.4434103	9.9825871	9.4608232	10.5391768	10.0174129	10.5565897	53
8	9.4438472	9.9825506	9.4612967	10.5387033	10.0174494	10.5561528	52
9	9.4442837	9.9825140	9.4617697	10.5382303	10.0174860	10.5557163	51
10	9.4447197	9.9824774	9.4622423	10.5377557	10.0175226	10.5552803	50
11	9.4451553	9.9824408	9.4627145	10.5372855	10.0175592	10.5548447	49
12	9.4455904	9.9824041	9.4631863	10.5368137	10.0175959	10.5544096	48
13	9.4460250	9.9823674	9.4636576	10.5363424	10.0176326	10.5539750	47
14	9.4464591	9.9823306	9.4641285	10.5358715	10.0176694	10.5535409	46
15	9.4468927	9.9822938	9.4645990	10.5354010	10.0177062	10.5531073	45
16	9.4473259	9.9822569	9.4650690	10.5349310	10.0177431	10.5526741	44
17	9.4477586	9.9822201	9.4655386	10.5344614	10.0177799	10.5522414	43
18	9.4481909	9.9821831	9.4660078	10.5339922	10.0178169	10.5518091	42
19	9.4486227	9.9821462	9.4664765	10.5335235	10.0178538	10.5513773	41
20	9.4490540	9.9821092	9.4669448	10.5330552	10.0178908	10.5509460	40
21	9.4494849	9.9820721	9.4674127	10.5325873	10.0179279	10.5505151	39
22	9.4499153	9.9820351	9.4678802	10.5321198	10.0179649	10.5500847	38
23	9.4503452	9.9819979	9.4683473	10.5316527	10.0180021	10.5496548	37
24	9.4507747	9.9819608	9.4688139	10.5311861	10.0180392	10.5492253	36
25	9.4512037	9.9819236	9.4692801	10.5307199	10.0180764	10.5487963	35
26	9.4516322	9.9818863	9.4697459	10.5302541	10.0181137	10.5483678	34
27	9.4520603	9.9818490	9.4702112	10.5297888	10.0181510	10.5479397	33
28	9.4524879	9.9818117	9.4706762	10.5293238	10.0181883	10.5475121	32
29	9.4529151	9.9817744	9.4711407	10.5288503	10.0182256	10.5470849	31
30	9.4533418	9.9817370	9.4716048	10.5283952	10.0182630	10.5466582	30
31	9.4537681	9.9816995	9.4720685	10.5279315	10.0183005	10.5462319	29
32	9.4541939	9.9816620	9.4725318	10.5274682	10.0183380	10.5458061	28
33	9.4546192	9.9816245	9.4729947	10.5270053	10.0183755	10.5453808	27
34	9.4550441	9.9815870	9.4734571	10.5265428	10.0184130	10.5449559	26
35	9.4554686	9.9815494	9.4739192	10.5260808	10.0184506	10.5445314	25
36	9.4558926	9.9815117	9.4743808	10.5256192	10.0184883	10.5441074	24
37	9.4563161	9.9814740	9.4748421	10.5251579	10.0185260	10.5436839	23
38	9.4567392	9.9814363	9.4753029	10.5246971	10.0185637	10.5432608	22
39	9.4571618	9.9813986	9.4757633	10.5242367	10.0186014	10.5428382	21
40	9.4575840	9.9813608	9.4762233	10.5237767	10.0186392	10.5424160	20
41	9.4580058	9.9813229	9.4766829	10.5233171	10.0186771	10.5419942	19
42	9.4584271	9.9812850	9.4771421	10.5228579	10.0187150	10.5415729	18
43	9.4588480	9.9812471	9.4776009	10.5223991	10.0187529	10.5411520	17
44	9.4592684	9.9812091	9.4780592	10.5219408	10.0187909	10.5407316	16
45	9.4596884	9.9811711	9.4785172	10.5214828	10.0188289	10.5403116	15
46	9.4601079	9.9811331	9.4789748	10.5210252	10.0188669	10.5398921	14
47	9.4605270	9.9810950	9.4794319	10.5205681	10.0189050	10.5394730	13
48	9.4609456	9.9810569	9.4798887	10.5201113	10.0189431	10.5390544	12
49	9.4613638	9.9810187	9.4803451	10.5196549	10.0189813	10.5386362	11
50	9.4617816	9.9809805	9.4808011	10.5191989	10.0190195	10.5382184	10
51	9.4621989	9.9809423	9.4812566	10.5187434	10.0190577	10.5378011	9
52	9.4626158	9.9809040	9.4817118	10.5182882	10.0190960	10.5373842	8
53	9.4630323	9.9808657	9.4821666	10.5178334	10.0191343	10.5369677	7
54	9.4634483	9.9808273	9.4826210	10.5173790	10.0191727	10.5365517	6
55	9.4638639	9.9807889	9.4830750	10.5169250	10.0192111	10.5361361	5
56	9.4642790	9.9807505	9.4835286	10.5164714	10.0192495	10.5357210	4
57	9.4646938	9.9807120	9.4839818	10.5160182	10.0192880	10.5353062	3
58	9.4651081	9.9806735	9.4844346	10.5155654	10.0193265	10.5348919	2
59	9.4655219	9.9806349	9.4848870	10.5151130	10.0193651	10.5344781	1
60	9.4659353	9.9805963	9.4853390	10.5146610	10.0194037	10.5340647	0
	L. Co-Sine.	L. Sine	L. Co-Tang.	L. Tangent	L. Co-Secant.	L. Secant.	M

73 DEGREES.

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17 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N Co-Secant.	
0	2923717	9563048	3057307	32708526	10456918	34203036	60
1	2926499	9562197	3060488	32674529	10457848	34170526	59
2	2929280	9561345	3063669	32640596	10458780	34138080	58
3	2932061	9560492	3066851	32606728	10459712	34105699	57
4	2934842	9559639	3070034	32572924	10460645	34073382	56
5	2937623	9558785	3073218	32539184	10461581	34041130	55
6	2940403	9557930	3076402	32505508	10462516	34008941	54
7	2943183	9557074	3079586	32471895	10463453	33976816	53
8	2945963	9556217	3082771	32438346	10464391	33944754	52
9	2948743	9555360	3085957	32404860	10465330	33912755	51
10	2951522	9554502	3089143	32371438	10466270	33880820	50
11	2954301	9553643	3092330	32338078	10467211	33848948	49
12	2957080	9552783	3095517	32304780	10468153	33817138	48
13	2959859	9551922	3098705	32271546	10469096	33785391	47
14	2962638	9551061	3101893	32238373	10470040	33753707	46
15	2965416	9550199	3105082	32205263	10470986	33722084	45
16	2968194	9549336	3108272	32172215	10471932	33690524	44
17	2970971	9548472	3111462	32139228	10472879	33659026	43
18	2973749	9547607	3114653	32106304	10473828	33627589	42
19	2976526	9546742	3117844	32073440	10474777	33596214	41
20	2979303	9545876	3121036	32040638	10475728	33564900	40
21	2982079	9545009	3124229	32007897	10476679	33533647	39
22	2984856	9544141	3127422	31975217	10477632	33502455	38
23	2987632	9543272	3130616	31942598	10478585	33471324	37
24	2990408	9542403	3133810	31910039	10479540	33440254	36
25	2993184	9541533	3137005	31877540	10480496	33409244	35
26	2995959	9540662	3140200	31845102	10481453	33379294	34
27	2998734	9539790	3143396	31812724	10482411	33347405	33
28	3001509	9538917	3146593	31780406	10483370	33316575	32
29	3004284	9538043	3149790	31748147	10484330	33285805	31
30	3007058	9537169	3152988	31715948	10485291	33255095	30
31	3009832	9536294	3156186	31683808	10486253	33224444	29
32	3012606	9535418	3159385	31651728	10487217	33193853	28
33	3015380	9534541	3162585	31619706	10488181	33163320	27
34	3018153	9533664	3165785	31587744	10489146	33132847	26
35	3020926	9532786	3168986	31555840	10490113	33102432	25
36	3023699	9531907	3172187	31523994	10491080	33072076	24
37	3026471	9531027	3175389	31492207	10492049	33041778	23
38	3029244	9530146	3178591	31460478	10493019	33011539	22
39	3032016	9529264	3181794	31428807	10493989	32981357	21
40	3034788	9528382	3184998	31397194	10494961	32951234	20
41	3037559	9527499	3188202	31365639	10495934	32921168	19
42	3040331	9526615	3191407	31334141	10496908	32891160	18
43	3043102	9525730	3194613	31302701	10497883	32861209	17
44	3045872	9524844	3197819	31271317	10498859	32831316	16
45	3048643	9523958	3201025	31239991	10499836	32801479	15
46	3051413	9523071	3204232	31208722	10500815	32771700	14
47	3054183	9522183	3207440	31177509	10501794	32741977	13
48	3056953	9521294	3210649	31146353	10502774	32712311	12
49	3059723	9520404	3213858	31115254	10503756	32682702	11
50	3062492	9519514	3217067	31084210	10504738	32653149	10
51	3065261	9518623	3220277	31053223	10505722	32623652	9
52	3068029	9517731	3223488	31022291	10506706	32594211	8
53	3070798	9516838	3226700	30991416	10507692	32564825	7
54	3073566	9515944	3229912	30960596	10508679	32535496	6
55	3076334	9515049	3233125	30929831	10509667	32506222	5
56	3079102	9514154	3236338	30899122	10510656	32477003	4
57	3081869	9513258	3239552	30868468	10511646	32447840	3
58	3084636	9512361	3242766	30837869	10512637	32418732	2
59	3087403	9511463	3245981	30807325	10513629	323896 8	1
60	3090170	9510565	3249197	30776835	10514622	32360680	0
	N Co-Sine.	N. Sine.	N Co Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M

72 DEGREES

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17 DEGREES.

M	*L. Sine.*	*L. Co.Sine.*	*L. Tangent*	*L. Co-Tang.*	*L. Secant.*	*L. Co-Secant*	
0	9.4659353	9.9805963	9.4853390	10.5146610	10.0194037	10.5340647	60
1	9.4663483	9.9805577	9.4857907	10.5142093	10.0194423	10.5336517	59
2	9.4667609	9.9805190	9.4862419	10.5137581	10.0194810	10.5332391	58
3	9.4671730	9.9804803	9.4866928	10.5133072	10.0195197	10.5328270	57
4	9.4675848	9.9804415	9.4871433	10.5128567	10.0195585	10.5324152	56
5	9.4679960	9.9804027	9.4875933	10.5124067	10.0195973	10.5320040	55
6	9.4684069	9.9803639	9.4880430	10.5119570	10.0196361	10.5315931	54
7	9.4688173	9.9803250	9.4884924	10.5115076	10.0196750	10.5311827	53
8	9.4692273	9.9802860	9.4889413	10.5110587	10.0197140	10.5307727	52
9	9.4696369	9.9802471	9.4893898	10.5106102	10.0197529	10.5303631	51
10	9.4700461	9.9802081	9.4898380	10.5101620	10.0197919	10.5299539	50
11	9.4704548	9.9801690	9.4902858	10.5097142	10.0198310	10.5295452	49
12	9.4708631	9.9801299	9.4907332	10.5092668	10.0198701	10.5291369	48
13	9.4712710	9.9800908	9.4911802	10.5088198	10.0199092	10.5237290	47
14	9.4716785	9.9800516	9.4916269	10.5083731	10.0199484	10.5283215	46
15	9.4720856	9.9800124	9.4920731	10.5079269	10.0199876	10.5279144	45
16	9.4724922	9.9799732	9.4925190	10.5074810	10.0200268	10.5275078	44
17	9.4728985	9.9799339	9.4929646	10.5070354	10.0200661	10.5271015	43
18	9.4733043	9.9798946	9.4938097	10.5065903	10.0201054	10.5266957	42
19	9.4737097	9.9798552	9.4938545	10.5061455	10.0201448	10.5262903	41
20	9.4741146	9.9798158	9.4942988	10.5057012	10.0201842	10.5258854	40
21	9.4745192	9.9797764	9.4947429	10.5052571	10.0202236	10.5254808	39
22	9.4749234	9.9797369	9.4951865	10.5048135	10.0202631	10.5250766	38
23	9.4753271	9.9796973	9.4956298	10.5043702	10.0203027	10.5246729	37
24	9.4757304	9.9796574	9.4960727	10.5039273	10.0203422	10.5242696	36
25	9.4761334	9.9796182	9.4965152	10.5034848	10.0203818	10.5238666	35
26	9.4765359	9.9795785	9.4969574	10.5030426	10.0204215	10.5234641	34
27	9.4769380	9.9795388	9.4973991	10.5026009	10.0204612	10.5230620	33
28	9.4773396	9.9794991	9.4978406	10.5021594	10.0205009	10.5226604	32
29	9.4777409	9.9794593	9.4982816	10.5017184	10.0205407	10.5222591	31
30	9.4781418	9.9794195	9.4987223	10.5012777	10.0205805	10.5218582	30
31	9.4785423	9.9793796	9.4991626	10.5008374	10.0206204	10.5214577	29
32	9.4789423	9.9793398	9.4996026	10.5003974	10.0206602	10.5210577	28
33	9.4793420	9.9792998	9.5000422	10.4999578	10.0207002	10.5206580	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	9.9791798	9.5013588	10.4986412	10.0208202	10.5194615	24
37	9.4809366	9.9791397	9.5017969	10.4982031	10.0208603	10.5190634	23
38	9.4813342	9.9790996	9.5022347	10.4977653	10.0209004	10.5186658	22
39	9.4817315	9.9790594	9.5026721	10.4973279	10.0209405	10.5182685	21
40	9.4821283	9.9790192	9.5031092	10.4968908	10.0209808	10.5178717	20
41	9.4825248	9.9789789	9.5035459	10.4964541	10.0210211	10.5174752	19
42	9.4829208	9.9789386	9.5039822	10.4960178	10.0210614	10.5170792	18
43	9.4833165	9.9788983	9.5044182	10.4955818	10.0211017	10.5166835	17
44	9.4837117	9.9788579	9.5048538	10.4951462	10.0211421	10.5162883	16
45	9.4841066	9.9788175	9.5052891	10.4947109	10.0211825	10.5158934	15
46	9.4845010	9.9787770	9.5057240	10.4942760	10.0212230	10.5154990	14
47	9.4848951	9.9787365	9.5061586	10.4938414	10.0212635	10.5151049	13
48	9.4852888	9.9786960	9.5065928	10.4934072	10.0213040	10.5147112	12
49	9.4856820	9.9786554	9.5070267	10.4929733	10.0213446	10.5143180	11
50	9.4860749	9.9786148	9.5074602	10.4925398	10.0213852	10.5139251	10
51	9.4864674	9.9785741	9.5078933	10.4921067	10.0214259	10.5135326	9
52	9.4868595	9.9785334	9.5083261	10.4916739	10.0214666	10.5131405	8
53	9.4872512	9.9784927	9.5087586	10.4912414	10.0215073	10.5127488	7
54	9.4876426	9.9784519	9.5091907	10.4908093	10.0215481	10.5123574	6
55	9.4880335	9.9784111	9.5096224	10.4903776	10.0215889	10.5119665	5
56	9.4884240	9.9783702	9.5100539	10.4899461	10.0216298	10.5115760	4
57	9.4888142	9.9783293	9.5104849	10.4895151	10.0216707	10.5111858	3
58	9.4892040	9.9782883	9.5109156	10.4890844	10.0217117	10.5107960	2
59	9.4895934	9.9782474	9.5113460	10.4886540	10.0217526	10.5104066	1
60	9.4899824	9.9782063	9.5117760	10.4882240	10.0217937	10.5100176	0
	L. Co-Sine.	*L. Sine*	*L. Co-Tang.*	*L. Tangent*	*L. Co-Secant.*	*L. Secant.*	M

72 DEGREES.

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18 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N Co-Secant.	
0	3090170	9510565	3249197	30776835	10514622	32360680	60
1	3092936	9509666	3252413	30746400	10515627	32331736	59
2	3095702	9508766	3255630	30716020	10516612	32302845	58
3	3098468	9507865	3258848	30685698	10517608	32274011	57
4	3101234	9506763	3262066	30655421	10518606	32245230	56
5	3103999	9506060	3265285	30625203	10519605	32216503	55
6	3106764	9505157	3268504	30595038	10520604	32187830	54
7	3109529	9504253	3271724	30564928	10521605	32159210	53
8	3112294	9503348	3274944	30534870	10522607	32130644	52
9	3115058	9502442	3278165	30504866	10523610	32102132	51
10	3117822	9501536	3281387	30474915	10524614	32073673	50
11	3120586	9500629	3284610	30445018	10525619	32045266	49
12	3123349	9499721	3287833	30415173	10526625	32016913	48
13	3126112	9498812	3291056	30385381	10527633	31988613	47
14	3128875	9497902	3294280	30355641	10528641	31960365	46
15	3131638	9496991	3297505	30325954	10529651	31932170	45
16	3134400	9496080	3300731	38296320	10530661	31904028	44
17	3137163	9495168	3303957	30266737	10531673	31875937	43
18	3139925	9494255	3307184	30237207	10532686	31847899	42
19	3142686	9493341	3310411	30207728	10533699	31819913	41
20	3145448	9492426	3313639	30178301	10534714	31791978	40
21	3148209	9491511	3316868	30148926	10535730	31764095	39
22	3150969	9490595	3320097	30119602	10536747	31736264	38
23	3153730	9489678	3323327	30090330	10537765	31708484	37
24	3156490	9488760	3326557	30061109	10538785	31680756	36
25	3159250	9487841	3329788	30031939	10539805	31653078	35
26	3162010	9486922	3333020	30002820	10540826	31625452	34
27	3164770	9486002	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
31	3175805	9482313	3349188	29857983	10545950	31488079	29
32	3178563	9481389	3352424	29829166	10546978	31460756	28
33	3181321	9480464	3355660	29800400	10548007	31433483	27
34	3184079	9479538	3358897	29771683	10549037	31406259	26
35	3186836	9478611	3362134	29743016	10550068	31379086	25
36	3189593	9477684	3365372	29714399	10551101	31351962	24
37	3192350	9476756	3368511	29685831	10552134	31324887	23
38	3195106	9475827	3371850	29657312	10553169	31297862	22
39	3197863	9474897	3375090	29628842	10554204	31270886	21
40	3200619	9473966	3378330	29600422	10555241	31243959	20
41	3203374	9473035	3381571	29572050	10556279	31217081	19
42	3206130	9472103	3384813	20543727	10557318	31190252	18
43	3208885	9471170	3388056	29515453	10558358	31163472	17
44	3211640	9470236	3391299	29487227	10559399	31136740	16
45	3214395	9469301	3394543	29459050	10560441	31110057	15
46	3217149	9468366	3397787	29430921	10561485	31083422	14
47	3219903	9467430	3401032	29402840	10562529	31056825	13
48	3222657	9466493	3404278	29374807	10563575	31030296	12
49	3225410	9465555	3407524	29346822	10564621	31003805	11
50	3228164	9464616	3410771	29318885	10565669	30977363	10
51	3230917	9463676	3414019	29290995	10566718	30950967	9
52	3233670	9462730	3417267	29263152	10567768	30924620	8
53	3236422	9461765	3420516	29235358	10568819	30898319	7
54	3239174	9460853	3423765	29207610	10569871	30872066	6
55	3241926	9459910	3427015	29179909	10570924	30845860	5
56	3244678	9458967	3430266	29152256	10571978	30819702	4
57	3247429	9458023	3433518	29124649	10573034	30793590	3
58	3250180	9457078	3436770	29097089	10574090	30767525	2
59	3252931	9456132	3440023	29069576	10575148	30741507	1
60	3255682	9455185	3443276	29042109	10576207	30715535	0
	N Co-Sine.	N. Sine.	N Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M

71 DEGREES.

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18 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co-Tang.	L. Secant.	L Co-Secant	
0	9.4899824	9.9782063	9.5117760	10.4882240	10.0217937	10.5100176	60
1	9.4903710	9.9781653	9.5122057	10.4877943	10.0218347	10.5096290	59
2	9.4907592	9.9781241	9.5126351	10.4873649	10.0218759	10.5092408	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	10.4860790	10.0219994	10.5080784	55
6	9.4923083	9.9779593	9.5143490	10.4856510	10.0220407	10.5076917	54
7	9.4926946	9.9779180	9.5147766	10.4852234	10.0220820	10.5073054	53
8	9.4930806	9.9778766	9.5152039	10.4847961	10.0221233	10.5069194	52
9	9.4934661	9.9778353	9.5156309	10.4843691	10.0221647	10.5065339	51
10	9.4938513	9.9777938	9.5160575	10.4839425	10.0222062	10.5061487	50
11	9.4942361	9.9777523	9.5164838	10.4835162	10.0222477	10.5057639	49
12	9.4946205	9.9777108	9.5169097	10.4830903	10.0222892	10.5053795	48
13	9.4950046	9.9776693	9.5173353	10.4826647	10.0223307	10.5049954	47
14	9.4953883	9.9776277	9.5177606	10.4822394	10.0223723	10.5046117	46
15	9.4957716	9.9775860	9.5181855	10.4818145	10.0224140	10.5042284	45
16	9.4961545	9.9775444	9.5186101	10.4813899	10.0224556	10.5038455	44
17	9.4965370	9.9775026	9.5190344	10.4809656	10.0224974	10.5034630	43
18	9.4969192	9.9774609	9.5194583	10.4805417	10.0225391	10.5030808	42
19	9.4973010	9.9774191	9.5198819	10.4801181	10.0225809	10.5026990	41
20	9.49 6824	9.9773772	9.5203052	10.4796948	10.0226228	10.5023176	40
21	9.4980635	9.9773354	9.5207282	10.4792718	10.0226646	10.5019365	39
22	9.4984442	9.9772934	9.5211508	10.4788492	10.0227066	10.5015558	38
23	9.4988245	9.9772515	9.5215730	10.4784270	10.0227485	10.5011755	37
24	9.4992045	9.9772095	9.5219950	10.4780050	10.0227905	10.5007955	36
25	9.4995840	9.9771674	9.5224166	10.4775834	10.0228326	10.5004160	35
26	9.4999633	9.9771253	9.5228379	10.4771621	10.0228747	10.5000367	34
27	9.5003421	9.9770832	9.5231589	10.4767411	10.0229168	10.4996579	33
28	9.5007206	9.9770410	9.5236795	10.4763205	10.0229590	10.4992794	32
29	9.5010987	9.9769988	9.5240999	10.4759001	10.0230012	10.4989013	31
30	9.5014764	9.9769566	9.5245199	10.4754801	10.0230434	10.4985236	30
31	9.5018538	9.9769143	9.5249395	10.4750605	10.0230857	10.4981462	29
32	9.5022308	9.9768720	9.5253589	10.4746411	10.0231280	10.4977692	28
33	9.5026075	9.9768296	9.5257779	10.4742221	10.0231704	10.4973925	27
34	9.5029838	9.9767872	9.5261966	10.4738034	10.0232128	10.4970162	26
35	9.5033597	9.9767447	9.5266150	10.4733850	10.0232553	10.4966403	25
36	9.5037353	9.9767022	9.5270331	10.4729669	10.0232978	10.4962647	24
37	9.5041105	9.9766597	9.5274508	10.4725492	10.0233403	10.4958895	23
38	9.5044853	9.9766171	9.5278682	10.4721318	10.0233829	10.4955147	22
39	9.5048598	9.9765745	9.5282853	10.4717147	10.0234255	10.4951402	21
40	9.5052339	9.9765318	9.5287021	10.4712979	10.0234682	10.4947661	20
41	9.5056077	9.9764891	9.5291186	10.4708814	10.0235109	10.4943923	19
42	9.5059811	9.9764464	9.5295347	10.4704653	10.0235536	10.4940189	18
43	9.5063542	9.9764036	9.5299505	10.4700495	10.0235964	10.4936458	17
44	9.5067268	9.9763608	9.5303661	10.4696339	10.0236392	10.4932731	16
45	9.5070992	9.9763179	9.5307813	10.4692187	10.0236821	10.4929008	15
46	9.5074712	9.9762750	9.5311961	10.4688039	10.0237250	10.4925288	14
47	9.5078428	9.9762321	9.5316107	10.4683893	10.0237679	10.4921572	13
48	9.5082141	9.9761891	9.5320250	10.4679750	10.0238109	10.4917859	12
49	9.5085850	9.9761461	9.5324389	10.4675611	10.0238539	10.4914150	11
50	9.5089556	9.9761030	9.5328526	10.4661474	10.0238970	10.4910444	10
51	9.5093258	9.9760599	9.5332659	10.4667341	10.0239401	10.4906742	9
52	9.5096956	9.9760167	9.5336789	10.4663211	10.0239833	10.4903044	8
53	9.5100651	9.9759736	9.5340916	10.4659084	10.0240264	10.4899349	7
54	9.5104343	9.9759303	9.5345040	10.4654960	10.0240697	10.4895657	6
55	9.5108031	9.9758870	9.5342161	10.4650839	10.0241130	10.4891969	5
56	9.5111716	9.9758437	9.5353278	10.4646722	10.0241563	10.4888284	4
57	9.5115397	9.9758004	9.5357393	10.4642607	10.0241996	10.4884603	3
58	9.5119074	9.9757570	9.5361505	10.4638495	10.0242430	10.4880926	2
59	9.5122749	9.9757135	9.5365613	10.4634387	10.0242865	10.4877251	1
60	9.5126419	9.9756701	9.5369719	10.4630281	10.0243299	10.4873581	0
	LCo-Sine.	L. Sine	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

71 DEGREES.

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19 DEGREES.

M	N Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	3255682	9455185	3443276	29042109	10576207	30715535	60
1	3258432	9454238	3446530	29014688	10577267	30689610	59
2	3261182	9453290	3449785	28987314	10578328	30663743	58
3	3263931	9452341	3453040	28959986	10579390	30637898	57
4	3266681	9451391	3456296	28932704	10580453	30612111	56
5	3269430	9450440	3459553	28905467	10581517	30586370	55
6	3272179	9449489	3462810	28878277	10582583	30560675	54
7	3274928	9448537	3466068	28851132	10583649	30535026	53
8	3277676	9447584	3469327	28824033	10584717	30509423	52
9	3280424	9446630	3472586	28796979	10585786	30483864	51
10	3283172	9445675	3475846	28769970	10586855	30458352	50
11	3285919	9444720	3479107	28743007	10587926	30432884	49
12	3288666	9443764	3482368	28716088	10588999	30407462	48
13	3291413	9442807	3485630	28689215	10590072	30382084	47
14	3294160	9441849	3488893	28662386	10591146	30356752	46
15	3296906	9440890	3492156	28635602	10592221	30331464	45
16	3299652	9439931	3495420	28608863	10593298	30306221	44
17	3302398	9438971	3498685	28582168	10594376	30231023	43
18	3305144	9438010	3501950	28555517	10593454	30255868	42
19	3307889	9437048	3505216	28528911	10596534	30230759	41
20	3310634	9436085	3508483	28502349	10597615	30205693	40
21	3313379	9435121	3511750	28475831	10598697	30180672	39
22	3316123	9434157	3515018	28449356	10599781	30155694	38
23	3318867	9433192	3518287	28422926	10600805	30130760	37
24	3321611	9432226	3521556	28396539	10601951	30105870	36
25	3324355	9431260	3524826	28370196	10603037	30081024	35
26	3327098	9430293	3528097	28343896	10604125	30056221	34
27	3329841	9429325	3531368	28317639	10605214	30031462	33
28	3332584	9428356	3534640	28291426	10606304	30006746	32
29	3335327	9427386	3537913	28265256	10607395	29982073	31
30	3338069	9426415	3541186	28239129	10608487	29957443	30
31	3340810	9425443	3544460	28213045	10609580	29932856	29
32	3343552	9424471	3547735	28187003	10610675	29908312	28
33	3346293	9423498	3551010	28161104	10611770	29883811	27
34	3349034	9422524	3554286	28135048	10612867	29859352	26
35	3351775	9421550	3557563	28109134	10613965	29835936	25
36	3354516	9420575	3560840	28083263	10615064	29810563	24
37	3357256	9419599	3564118	28057433	10616164	29786231	23
38	3359996	9418622	3567397	28031646	10617265	29761942	22
39	3362735	9417644	3570676	28005901	10618367	29737695	21
40	3365475	9416665	3573956	27980198	10619471	29713490	20
41	3368214	9415685	3577237	27954537	10620575	29689327	19
42	3370953	9414705	3580518	27928917	10621681	29665205	18
43	3373691	9413724	3583800	27903339	10622788	29641125	17
44	3376429	9412742	3587083	27877802	10623896	29617087	16
45	3379167	9411760	3590367	27852307	10625005	29593090	15
46	3381905	9410777	3593651	27826853	10626115	29569135	14
47	3384642	9409793	3596930	27801440	10627227	29545221	13
48	3387379	9408808	3600222	27776069	10628339	29521348	12
49	3390116	9407822	3603508	27750738	10629453	29497516	11
50	3392583	9406835	3606795	27725448	10630568	29473725	10
51	3395589	9405848	3610083	27700199	10631684	29449975	9
52	3398325	9404860	3613371	27674990	10632801	29426265	8
53	3401060	9403871	3616660	27649822	10633919	29402597	7
54	3403795	9402881	3619950	27624695	10635038	29378968	6
55	3406530	9401890	3623240	27599608	10636158	29355380	5
56	3409265	9400899	3626531	27574561	10637280	29331833	4
57	3412000	9399907	3629823	27549554	10638403	29308326	3
58	3414734	9398914	3633115	27524588	10639527	29284858	2
59	3417468	9397920	3636408	27499661	10640652	29261431	1
60	3420202	9396926	3639702	27474774	10641778	29238044	0
	N Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co-Secant.	N. Secant.	M

70 DEGREES.

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19 DEGREES.

M	L. Sine.	L. Co-Sine.	L. Tangent	L. Co Tang.	L. Secant.	L. Co-Secant	
0	9.5126419	9.9756701	9.5369719	10.4630281	10.0243299	10.4873581	60
1	9.5130086	9.9756265	9.5373821	10.4626179	10.0243735	10.4869914	59
2	9.5133750	9.9755830	9.5377920	10.4622080	10.0244170	10.4866250	58
3	9.5137410	9.9755394	9.5382017	10.4617983	10.0244606	10.4862590	57
4	9.5141067	9.9754957	9.5386110	10.4613890	10.0245043	10.4858933	56
5	9.5144724	9.9754521	9.5390200	10.4609800	10.0245479	10.4855279	55
6	9.5148371	9.9754083	9.5394287	10.4605713	10.0245917	10.4851629	54
7	9.5152017	9.9753646	9.5398371	10.4601629	10.0246354	10.4847983	53
8	9.5155660	9.9753208	9.5402453	10.4597547	10.0246792	10.4844340	52
9	9.5159303	9.9752769	9.5406531	10.4593469	10.0247231	10.4840700	51
10	9.5162936	9.9752330	9.5410606	10.4589394	10.0247670	10.4837064	50
11	9.5166569	9.9751891	9.5414678	10.4585322	10.0248109	10.4832431	49
12	9.5170198	9.9751451	9.5418747	10.4581253	10.0248549	10.4829802	48
13	9.5173824	9.9751011	9.5422813	10.4577187	10.0248989	10.4826176	47
14	9.5177447	9.9750570	9.5426877	10.4573123	10.0249430	10.4822553	46
15	9.5181066	9.9750129	9.5430937	10.4569063	10.0249871	10.4818934	45
16	9.5184682	9.9749688	9.5434994	10.4565006	10.0250312	10.4815318	44
17	9.5188295	9.9749246	9.5439048	10.4560952	10.0250754	10.4811705	43
18	9.5191904	9.9748804	9.5443100	10.4556900	10.0251196	10.4808096	42
19	9.5195510	9.9748361	9.5447148	10.4552852	10.0251639	10.4804490	41
20	9.5199112	9.9747918	9.5451193	10.4548807	10.0252082	10.4800888	40
21	9.5202711	9.9747475	9.5455236	10.4544764	10.0252525	10.4797289	39
22	9.5206307	9.9747031	9.5459276	10.4540724	10.0252969	10.4793693	38
23	9.5209899	9.9746587	9.5463312	10.4536688	10.0253413	10.4790101	37
24	9.5213488	9.9746142	9.5467346	10.4532654	10.0253858	10.4786512	36
25	9.5217074	9.9745697	9.5471377	10.4528623	10.0254303	10.4782926	35
26	9.5220656	9.9745252	9.5475405	10.4524595	10.0254748	10.4779344	34
27	9.5224235	9.9744806	9.5479430	10.4520570	10.0255194	10.4775765	33
28	9.5227811	9.9744359	9.5483452	10.4516548	10.0255641	10.4772189	32
29	9.5231383	9.9743912	9.5487471	10.4512529	10.0256087	10.4768617	31
30	9.5234953	9.9743466	9.5491487	10.4508513	10.0256534	10.4765047	30
31	9.5238518	9.9743018	9.5495500	10.4504500	10.0256982	10.4761482	29
32	9.5242081	9.9742570	9.5499511	10.4500489	10.0257430	10.4757919	28
33	9.5245640	9.9742122	9.5503519	10.4496481	10.0257878	10.4754360	27
34	9.5249196	9.9741673	9.5507523	10.4492477	10.0258327	10.4750804	26
35	9.5252749	9.9741224	9.5511525	10.4488475	10.0258776	10.4747215	25
36	9.5256298	9.9740774	9.5515524	10.4484476	10.0259226	10.4743702	24
37	9.5259844	9.9740324	9.5519521	10.4480479	10.0259676	10.4740156	23
38	9.5263387	9.9739873	9.5523514	10.4476486	10.0260127	10.4736613	22
39	9.5266927	9.9739422	9.5527504	10.4472496	10.0260578	10.4733073	21
40	9.5270463	9.9738971	9.5531492	10.4468508	10.0261029	10.4729537	20
41	9.5273997	9.9738519	9.5535477	10.4464523	10.0261481	10.4726003	19
42	9.5277526	9.9738067	9.5539459	10.4460541	10.0261933	10.4722474	18
43	9.5281053	9.9737615	9.5543438	10.4456562	10.0262385	10.4718947	17
44	9.5284577	9.9737162	9.5547415	10.4452585	10.0262838	10.4715423	16
45	9.5288097	9.9736709	9.5551388	10.4448612	10.0263291	10.4711903	15
46	9.5291614	9.9736255	9.5555359	10.4444641	10.0263745	10.4708386	14
47	9.5295128	9.9735801	9.5559327	10.4440673	10.0264199	10.4704872	13
48	9.5298638	9.9735346	9.5563292	10.4436708	10.0264654	10.4701362	12
49	9.5302146	9.9734891	9.5567255	10.4432745	10.0365109	10.4697854	11
50	9.5305650	9.9734435	9.5571214	10.4428786	10.0265565	10.4694350	10
51	9.5309151	9.9733980	9.5575171	10.4424829	10.0266020	10.4690849	9
52	9.5312649	9.9733523	9.5579125	10.4420875	10.0266477	10.4687351	8
53	9.5316143	9.9733067	9.5583077	10.4416923	10.0266933	10.4683857	7
54	9.5319635	9.9732610	9.5587025	10.4412975	10.0267390	10.4680365	6
55	9.5323123	9.9732152	9.5590971	10.4409029	10.0267848	10.4676877	5
56	9.5326608	9.9731694	9.5594914	10.4405086	10.0268306	10.4673392	4
57	9.5330090	9.9731236	9.5598854	10.4401146	10.0268764	10.4669910	3
58	9.5333569	9.9730777	9.5602792	10.4397208	10.0269223	10.4666431	2
59	9.5337044	9.9730318	9.5606727	10.4393273	10.0269682	10.4662956	1
60	9.5340517	9.9729858	9.5610659	10.4389341	10.0270142	10.4659483	0
	L. Co-Sine	L Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

70 DEGREES.

20 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N Co-Secant	
0	342 202	9396926	3639702	27474774	10641778	29238044	60
1	3422935	9395931	3642997	27449927	10642905	29214697	59
2	3425668	9394935	3646292	27425120	10644033	29191389	58
3	3428401	9393938	3649588	27400352	10645163	29168121	57
4	3431133	9392940	3652885	27375623	10646294	29144892	56
5	3433865	9391942	3656182	27350934	10647426	29121703	55
6	3436597	9390943	3659480	27326284	10648559	29098553	54
7	3439329	9389943	3662779	27301674	10649693	29075443	53
8	3442060	9388942	3666079	27277102	10650828	29052372	52
9	3444791	9387940	3669379	27252569	10651064	29029339	51
10	3447522	9386937	3672680	27228075	10653101	29006346	50
11	3450252	9385934	3675982	27203620	10654240	28983391	49
12	3452982	9384930	3679284	27179204	10655380	28960475	48
13	3455712	9383925	3682587	27154826	10656521	28937598	47
14	3458442	9382919	3685891	27130487	10657663	28914760	46
15	3461171	9381913	3689195	27106186	10658807	28891959	45
16	3463900	9380906	3692500	27081923	10659951	28869198	44
17	3466629	9379898	3695806	27057699	10661097	28846474	43
18	3469357	9378889	3699113	27033513	10662243	28823789	42
19	3472085	9377879	3702420	27009364	10663391	28801142	41
20	3474813	9376869	3705728	26985254	10664540	28778532	40
21	3477540	9375858	3709037	26961181	10665690	28755961	39
22	3480267	9374846	3712346	26937147	10666842	28733428	38
23	3482994	9373833	3715656	26913149	10667994	28710932	37
24	3485721	9372819	3718967	26889190	10669148	28688474	36
25	3488447	9371805	3722278	26865267	10670302	28666053	35
26	3491173	9370790	3725590	26841383	10671458	28643670	34
27	3493899	9369774	3728903	26817535	10672615	28621324	33
28	3496624	9368757	3732217	26793725	10673774	28599015	32
29	3499349	9367740	3735532	26769951	10674934	28576744	31
30	3502074	9366722	3738847	26746215	10676094	28554509	30
31	3504799	9365703	3742163	26722516	10677255	28532312	29
32	3507523	9364683	3745479	26698853	10678418	28510152	28
33	3510247	9363662	3748797	26675227	10679582	28488028	27
34	3512970	9362640	3752115	26651638	10680747	28465941	26
35	3515693	9361618	3755434	26628085	10681914	28443891	25
36	3518416	9360595	3758753	26604569	10683081	28421877	24
37	3521139	9359571	3762073	26581089	10684250	28399899	23
38	3523862	9358546	3765394	26557645	10685420	28377959	22
39	3526584	9357521	3768716	26534238	10686591	28356054	21
40	3529306	9356495	3772038	26510867	10687763	28334185	20
41	3532027	9355468	3775361	26487531	10688936	28312353	19
42	3534748	9354440	3778685	26464232	10690110	28390556	18
43	3537469	9353411	3782010	26440969	10691286	28268796	17
44	3540190	9352382	3785335	26417741	10692463	28247071	16
45	3542910	9351352	3788661	26394549	10693641	28225382	15
46	3545630	9350321	3791988	26371392	10694820	28203729	14
47	3548350	9349289	3795316	26348271	10696000	28182111	13
48	3551070	9348256	3798644	26325186	10697182	28160519	12
49	3553789	9347223	3801973	26302136	10698364	28138982	11
50	3556508	9346189	3805303	26279121	10699548	28117471	10
51	3559225	9345154	3808633	26256141	10700733	28095995	9
52	3561944	9344118	3811964	26233196	10701919	28074554	8
53	3564662	9343082	3815296	26210286	10703106	28053148	7
54	3567380	9342045	3818629	26187411	10704295	28031777	6
55	3570097	9341007	3821962	26164571	10705484	28010441	5
56	3572814	9339968	3825296	26141766	10706675	27989140	4
57	3575531	9338928	3828631	26118995	10707867	27967873	3
58	3578248	9337887	3831967	26096259	10709060	27946641	2
59	3580964	9336846	3835303	26073558	10710254	27925444	1
60	3583679	9335804	3838640	26050891	10711450	27904281	0
	N. Co-Sine	N. Sine.	N Co Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M

69 DEGREES.

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20 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L Co-Secant	
0	9.5340517	9.9729858	9.5610658	10.4389341	10.0270142	10.4659483	60
1	9.5343986	9.9729398	9.5614588	10.4385412	10.0270602	10.4656014	59
2	9.5347452	9.9728938	9.5618515	10.4381485	10.0271062	10.4652548	58
3	9.5350915	9.9728477	9.5622439	10.4377561	10.0271523	10.4649085	57
4	9.5354375	9.9728016	9.5626360	10.4373640	10.0271984	10.4645625	56
5	9.5357832	9.9727554	9.5630278	10.4369722	10.0272446	10.4642168	55
6	9.5361286	9.9727092	9.5634194	10.4365806	10.0272908	10.4638714	54
7	9.5364737	9.9726629	9.5638107	10.4361893	10.0273371	10.4635263	53
8	9.5368184	9.9726166	9.5642018	10.4352982	10.0273834	10.4631816	52
9	9.5371628	9.9725703	9.5645925	10.4354075	10.0274297	10.4628272	51
10	9.5375069	9.9725239	9.5649831	10.4350169	10.0274761	10.4624930	50
11	9.5378508	9.9724775	9.5653733	10.4346267	10.0275225	10.4621492	49
12	9.5381943	9.9724310	9.5657633	10.4342367	10.0275690	10.4618057	48
13	9.5385375	9.9723845	9.5661530	10.4338470	10.0276155	10.4614625	47
14	9.5388804	9.9723380	9.5665424	10.4334576	10.0276620	10.4611196	46
15	9.5392230	9.9722914	9.5669316	10.4330684	10.0277086	10.4607770	45
16	9.5395653	9.9722448	9.5673205	10.4326795	10.0277552	10.4604347	44
17	9.5399073	9.9721981	9.5677091	10.4322909	10.0278019	10.4600927	43
18	9.5402489	9.9721514	9.5680975	10.4319025	10.0278486	10.4597511	42
19	9.5405903	9.9721047	9.5684856	10.4315144	10.0278953	10.4594097	41
20	9.5409314	9.9720579	9.5688735	10.4311265	10.0279421	10.4590686	40
21	9.5412721	9.9720110	9.5692611	10.4307389	10.0279890	10.4587279	39
22	9.5416126	9.9719642	9.5696484	10.4303516	10.0280358	10.4583874	38
23	9.5419527	9.9719172	9.5700355	10.4299645	10.0280828	10.4580473	37
24	9.5422926	9.9718703	9.5704223	10.4295777	10.0281297	10.4577074	36
25	9.5426321	9.9718233	9.5708088	10.4291912	10.0281767	10.4573679	35
26	9.5429713	9.9717762	9.5711951	10.4288049	10.0282238	10.4570287	34
27	9.5433103	9.9717291	9.5715811	10.4284189	10.0282709	10.4566897	33
28	9.5436489	9.9716820	9.5719669	10.4280331	10.0283180	10.4563511	32
29	9.5439873	9.9716348	9.5723524	10.4276476	10.0283652	10.4560127	31
30	9.5443253	9.9715876	9.5727377	10.4272623	10.0284124	10.4556747	30
31	9.5446630	9.9715404	9.5731227	10.4268773	10.0284596	10.4553370	29
32	9.5450005	9.9714931	9.5735074	10.4264926	10.0285009	10.4549995	28
33	9.5453376	9.9714457	9.5738919	10.4261081	10.0285543	10.4546624	27
34	9.5456745	9.9713984	9.5742761	10.4257239	10.0286016	10.4543255	26
35	9.5460110	9.9713509	9.5746601	10.4253399	10.0286491	10.4539890	25
36	9.5463472	9.9713035	9.5750438	10.4249562	10.0286965	10.4536415	24
37	9.5466832	9.9712560	9.5754272	10.4245728	10.0287440	10.4533165	23
38	9.5470189	9.9712084	9.5758104	10.4241896	10.0287916	10.4529811	22
39	9.5473542	9.9711608	9.5761934	10.4238066	10.0288392	10.4526458	21
40	9.5476893	9.9711132	9.5765761	10.4234239	10.0288868	10.4523107	20
41	9.5480240	9.9710655	9.5769585	10.4230415	10.0289345	10.4519760	19
42	9.5483585	9.9710178	9.5773407	10.4226593	10.0289822	10.4516415	18
43	9.5486927	9.9709701	9.5777226	10.4222774	10.0290299	10.4513073	17
44	9.5490266	9.9709223	9.5781043	10.4218957	10.0290777	10.4509734	16
45	9.5493602	9.9708744	9.5784858	10.4215142	10.0291256	10.4506398	15
46	9.5496935	9.9708265	9.5788669	10.4211331	10.0291735	10.4503065	14
47	9.5500265	9.9707786	9.5792479	10.4207521	10.0292214	10.4499735	13
48	9.5503592	9.9707306	9.5796286	10.4203714	10.0292694	10.4496408	12
49	9.5506916	9.9706826	9.5800090	10.4199910	10.0293174	10.4493084	11
50	9.5510237	9.9706346	9.5803892	10.4196108	10.0293654	10.4489763	10
51	9.5513556	9.9705865	9.5807691	10.4192309	10.0294135	10.4486444	9
52	9.5516871	9.9705383	9.5811488	10.4188512	10.0294617	10.4483129	8
53	9.5420184	9.9704902	9.5815282	10.4184718	10.0295098	10.4479816	7
54	9.5523494	9.9704419	9.5819074	10.4180926	10.0295581	10.4476506	6
55	9.5526801	9.9703937	9.5822864	10.4177136	10.0296063	10.4473199	5
56	9.5530105	9.9703454	9.5826651	10.4173349	10.0296546	10.4469895	4
57	9.5533406	9.9702970	9.5830435	10.4169565	10.0297030	10.4466594	3
58	9.5536704	9.9702486	9.5834217	10.4165783	10.0297514	10.4463296	2
59	9.5539999	9.9702002	9.5837997	10.4162003	10.0297998	10.4460001	1
60	9.5543292	9.9701517	9.5841774	10.4158226	10.0298483	10.4456708	0
	L Co-Sine.	L. Sine	L.Co-Tang.	L. Tangent.	L.Co-Secant	L. Secant.	M.

69 DEGREES.

21 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	3583679	9335804	3838640	26050891	10711450	27904281	60
1	3586395	9334761	3841978	26028258	10712647	27883153	59
2	3589110	9333717	3845317	26005659	10713844	27862059	58
3	3591825	9332673	3848656	25983095	10715043	27840999	57
4	3594540	9331628	3851996	25960564	10716244	27819973	56
5	3597254	9330582	3855337	25938068	10717445	27798982	55
6	3599968	9329535	3858679	25915606	10718647	27778024	54
7	3602682	9328487	3862021	25893177	10719851	27757100	53
8	3605395	9327439	3865364	25870782	10721056	27736211	52
9	3608108	9326390	3868708	25848421	10722262	27715355	51
10	3610821	9325340	3872053	25826094	10723469	27694532	50
11	3613533	9324289	3875398	25803800	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
15	3624380	9320079	3888787	25714957	10729523	27590923	45
16	3627091	9319024	3892136	25692830	10730737	27570301	44
17	3629802	9317968	3895486	25670735	10731953	27549712	43
18	3632512	9316912	3898837	25648674	10733170	27529157	42
19	3635222	9315855	3902189	25626645	10734388	27508634	41
20	3637932	9314797	3905541	25604649	10735607	27488144	40
21	3640641	9313738	3908894	25582686	10736827	27467687	39
22	3643350	9312679	3912248	25560756	10738048	27447263	38
23	3646059	9311619	3915602	25538858	10739271	27429871	37
24	3648768	9310558	3918957	25516992	10740495	27406512	36
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	3659599	9306306	3932386	25429855	10745402	27325400	32
29	3662306	9305241	3935745	25408151	10746631	27305203	31
30	3665013	9304175	3939105	25386479	10747862	27285038	30
31	3667719	9303109	3942466	25364839	10749095	27264905	29
32	3670425	9302042	3945827	25343231	10750328	27244808	28
33	3673131	9300974	3949189	25321655	10751562	27224735	27
34	3675836	9299905	3952552	25300111	10752798	27204698	26
35	3678541	9298835	3955916	25278598	10754035	27184693	25
36	3681246	9297765	3959280	25257117	10755273	27164719	24
37	3683950	9296694	3962645	25235667	10756512	27144777	23
38	3686654	9295622	3966011	25214249	10757753	27124866	22
39	3689358	9294549	3969378	25192863	10758995	27104987	21
40	3692062	9293475	3972746	25161507	10760237	27085139	20
41	3694765	9292401	3976114	25150183	10761481	27065323	19
42	3697468	9291326	3979483	25128890	10762727	27045538	18
43	3700170	9290250	3982853	25107629	10763973	27025784	17
44	3702872	9289173	3986224	25086398	10765221	27006061	16
45	3705574	9288095	3989596	25065198	10766470	26986370	15
46	3708276	9287017	3992968	25044029	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	4007465	24959661	10772732	26888374	10
51	3721780	9281614	4009841	24938645	10773988	26868867	9
52	3724480	9280531	4013218	24917660	10774246	26849391	8
53	3727179	9279447	4016596	24896706	10776504	26829945	7
54	3729878	9278362	4019975	24865781	10777765	26810530	6
55	3732577	9276277	4023354	24854887	10779025	26791145	5
56	3735275	9276191	4026734	24834023	10780287	26771790	4
57	3737973	9275104	4030115	24813190	10781550	26752465	3
58	3740671	9274016	4033497	24792386	10782815	26733170	2
59	3743369	9272928	4036879	24771612	10784080	26713906	1
60	3746066	9271839	4040262	24750869	10785347	26694672	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co-Secant.	N. Secant.	M

68 DEGREES.

21 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	9.5543292	9.9701517	9.5841774	10.4158226	10.0298483	10.4456708	60
1	9.5546581	9.9701032	9.5845549	10.4154451	10.0298968	10.4453419	59
2	9.5549868	9.9700547	9.5849321	10.4150679	10.0299453	10.4450132	58
3	9.5553152	9.9700061	9.5853091	10.4146909	10.0299989	10.4446848	57
4	9.5556433	9.9699574	9.5856859	10.4143141	10.0300426	10.4443567	56
5	9.5559711	9.9699087	9.5860624	10.4139376	10.0300913	10.4440289	55
6	9.5562987	9.9698600	9.5864386	10.4135614	10.0301400	10.4437013	54
7	9.5566259	9.9698112	9.5868147	10.4131853	10.0301888	10.4433741	53
8	9.5569529	9.9697624	9.5871904	10.4128096	10.0302376	10.4430471	52
9	9.5572796	9.9697136	9.5875660	10.4124340	10.0302864	10.4427204	51
10	9.5576060	9.9696647	9.5879413	10.4120587	10.0303353	10.4423940	50
11	9.5579321	9.9696158	9.5883163	10.4116837	10.0303842	10.4420679	49
12	9.5582579	9.9695668	9.5886912	10.4113088	10.0304332	10.4417421	48
13	9.5585835	9.9695177	9.5890657	10.4109343	10.0304823	10.4414165	47
14	9.5589088	9.9694687	9.5894401	10.4105599	10.0305313	10.4410912	46
15	9.5592338	9.9694196	9.5898142	10.4101850	10.0305804	10.4407662	45
16	9.5595585	9.9693704	9.5901881	10.4098119	10.0306296	10.4404415	44
17	9.5598829	9.9693212	9.5905617	10.4094383	10.0306788	10.4401171	43
18	9.5602071	9.9692720	9.5909351	10.4090649	10.0307280	10.4397929	42
19	9.5605310	9.9692227	9.5913082	10.4086918	10.0307773	10.4394690	41
20	9.5608546	9.9691734	9.5916812	10.4083188	10.0308266	10.4391554	40
21	9.5611779	9.9691240	9.5920539	10.4079461	10.0308759	10.4388221	39
22	9.5615010	9.9690746	9.5924263	10.4075737	10.0309254	10.4384990	38
23	9.5618237	9.9990252	9.5927985	10.4072015	10.0309748	10.4381763	37
24	9.5621462	9.9689757	9.5931705	10.4068295	10.0310243	10.4378538	36
25	9.5624685	9.9689262	9.5935422	10.4064577	10.0310738	10.4375315	35
26	9.5627904	9.9688766	9.5939138	10.4060862	10.0311234	10.4372096	34
27	9.5631121	9.9688270	9.5942851	10.4057149	10.0311730	10.4368879	33
28	9.5634335	9.9687773	9.5946561	10.4053439	10.0312227	10.4365665	32
29	9.5637546	9.9687276	9.5950269	10.4049731	10.0312724	10.4362454	31
30	9.5640754	9.9686779	9.5953975	10.4046025	10.0313221	10.4359246	30
31	9.5643960	9.9686281	9.5957679	10.4042321	10.0313719	10.4356040	29
32	9.5647163	9.9685783	9.5961380	10.4038620	10.0314217	10.4352837	28
33	9.5650363	9.9685284	9.5965079	10.4034921	10.0314716	10.4349637	27
34	9.5653561	9.9684785	9.5968776	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
37	9.5663137	9.9683285	9.5979852	10.4020148	10.0316715	10.4336863	23
38	9.5666324	9.9682784	9.5983540	10.4016460	10.0317216	10.4333676	22
39	9.5669508	9.9682283	9.5987225	10.4012778	10.0317717	10.4330492	21
40	9.5672689	9.9681781	9.5990908	10.4009092	10.0318219	10.4327311	20
41	9.5675868	9.9681279	9.5994588	10.4005411	10.0318721	10.4324132	19
42	9.5679044	9.9680777	9.5998267	10.4001733	10.0319223	10.4320956	18
43	9.5682217	9.9680274	9.6001943	10.3998057	10.0319726	10.4317783	17
44	9.5685387	9.9679771	9.6005617	10.3994383	10.0320229	10.4314613	16
45	9.5688555	9.9679267	9.6009289	10.3990711	10.0320733	10.4311445	15
46	9.5691721	9.9678763	9.6012958	10.3987042	10.0321237	10.4308279	14
47	9.5694883	9.9678258	9.6016625	10.3983375	10.0321742	10.4305117	13
48	9.5698043	9.9677753	9.6020290	10.3979710	10.0322247	10.4301957	12
49	9.5701200	9.9677247	9.6023953	10.3976047	10.0322753	10.4298800	11
50	9.5704355	9.9676741	9.6027613	10.3972387	10.0323259	10.4295645	10
51	9.5707506	9.9676235	9.6031271	10.3968729	10.0323705	10.4292494	9
52	9.5710656	9.9675728	9.6034927	10.3965073	10.0324272	10.4289344	8
53	9.5713802	9.9675221	9.6038581	10.3961419	10.0324779	10.4286198	7
54	9.5716946	9.9674713	9.6042233	10.3957767	10.0325287	10.4283054	6
55	9.5720087	9.9674205	9.6045882	10.3954118	10.0325795	10.4279913	5
56	9.5723226	9.9673697	9.6049529	10.3950471	10.0326303	10.4276774	4
57	9.5726362	9.9673188	9.6053174	10.3946826	10.0326812	10.4273638	3
58	9.5729495	9.9672679	9.6056817	10.3943183	10.0327321	10.4270505	2
59	9.5732626	9.9672169	9.6060457	10.3939543	10.0327831	10.4267374	1
60	9.5735754	9.9671659	9.6064096	10.3935904	10.0328341	10.4264246	0
	L.Co-Sine.	L. Sine	L.Co-Tang.	L. Tangent.	L.Co-Secant	L. Secant.	M

68 DEGREES.

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22 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	3746066	9271839	4040262	24750869	10785347	26694672	60
1	3748763	9270749	4043646	24730155	10786616	26675467	59
2	3751459	9269658	4047031	24709470	10787885	26656292	58
3	3754156	9268566	4050417	24688816	10789156	26637148	57
4	3756852	9267473	4053804	24668191	10796427	26618033	56
5	3759547	9266380	4057191	24647596	10791700	26598947	55
6	3762243	9265286	4060579	24627030	10792975	26579891	54
7	3764938	9264191	4063968	24606494	10794250	26560865	52
8	3767632	9263096	4067358	24585987	10795527	26541868	51
9	3770327	9262000	4070748	24565509	10796805	26522901	50
10	3773021	9260903	4074139	24545061	10798084	26503962	49
11	3775714	9259805	4077531	24524642	10799364	26485054	53
12	3778408	9258706	4080924	24504252	10780646	26466174	48
13	3781101	9257606	4084318	24483891	10801928	26447323	47
14	3783794	9256506	4087713	24463559	10803212	26428502	46
15	3786486	9255405	4091108	24443256	10804497	26409709	45
16	3789178	9254303	4094504	24422982	10805784	26390946	44
17	3791870	9253200	4097901	24402736	10807071	26372211	43
18	3794562	9252097	4101299	24382519	10808360	26353505	42
19	3797253	9250993	4104697	24362331	10809650	26334828	41
20	3799944	9249888	4108097	24342172	10810942	26316180	40
21	3802634	9248782	4111497	24322041	10812234	26297560	39
22	3805324	9247675	4114898	24301938	10813528	26278969	38
23	3808014	9246568	4118300	24281864	10814823	26260406	37
24	3810704	9245460	4121703	24261819	10816119	26241872	36
25	3813393	9244351	4125106	24241801	10817417	26223366	35
26	3816082	9243241	4128510	24221812	10818715	26204888	34
27	3818770	9242131	4131915	24201851	10820015	26186439	33
28	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	4145544	24122286	10825227	26112922	29
32	3832209	9236567	4148953	24102465	10826533	26094613	28
33	3834895	9235452	4152363	24082672	10827840	26076332	27
34	3837582	9234336	4155774	24062906	10829149	26058078	26
35	3840268	9233219	4159186	24043168	10830458	26039852	25
36	3842953	9232102	4162599	24023457	10831769	26021654	24
37	3845639	9230984	4166012	24002774	10833081	26003484	23
38	3848324	9229865	4169426	23984118	10834395	25985341	22
39	3851008	9228745	4172841	23964490	10835709	25967225	21
40	3853693	9227624	4176257	23944889	10837025	25949137	20
41	3856877	9226503	4179674	23925316	10838342	25931077	19
42	3859060	9225381	4183091	23905769	10839661	25913043	18
43	3861744	9224258	4186509	23886250	10840980	25895037	17
44	3864427	9223134	4189928	23866758	10842301	25877058	16
45	3867110	9222009	4193348	23847293	10843623	25859107	15
46	3869792	9220884	4196769	23827855	10844947	25841182	14
47	3872474	9219758	4200191	23808444	10846271	25823284	13
48	3875156	9218631	4203613	23789060	10847597	25805414	12
49	3877837	9217503	4207036	23769703	10848924	25787570	11
50	3880518	9216375	4210460	23750372	10850252	25769753	10
51	3883199	9215246	4213885	23731068	10851582	25751963	9
52	3885880	9214116	4217311	23711791	10852913	25734199	8
53	3888560	9212985	4220738	23692540	10854245	25716462	7
54	3891239	9211854	4224166	23673316	10855578	25698752	6
55	3893919	9210722	4227594	23654118	10856912	27681060	5
56	3896598	9209589	4231023	23634946	10858248	25663412	4
57	3899277	9208455	4234453	23615801	10859585	25645781	3
58	3901955	9207320	4237884	23596683	10860924	25628176	2
59	3904633	9206185	4241316	23577590	10862263	25610599	1
60	3907311	9205049	4244749	23558524	10863604	25593047	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co-Secant.	N. Secant.	M

67 DEGREES.

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22 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co Tang.	L. Secant.	L. Co-Secant	
0	9.5735754	9.9671659	9.6064[illegible]	10.39359[illegible]4	10.0328341	10.4264245	60
1	9.5738880	9.9671144	9.606773[illegible]	10.3932[illegible]68	10.0328852	10.4261120	59
2	9.5742003	9.9670637	9.607136[illegible]	10.3928634	10.0329363	10.4257997	58
3	9.5745123	9.9670125	9.6074997	10.3925003	10.0329875	10.4254877	57
4	9.5748240	9.9669614	9.6078627	10.3921373	10.0330386	10.4251760	56
5	9.5751355	9.9669101	9.6082254	10.3917746	10.0330899	10.4248644	55
6	9.5754468	9.9668588	9.6085880	10.3914120	10.0331412	10.4245532	54
7	9.5757578	9.9668075	9.6089503	10.3910497	10.0331925	10.4242422	53
8	9.5760685	9.9667562	9.6093124	10.3906876	10.0332438	10.4239315	52
9	9.5763790	9.9667048	9.6096742	10.3903258	10.0332952	10.4236210	51
10	9.5766892	9.9666533	9.6100359	10.3899641	10.0333467	10.4233108	50
11	9.5769991	9.9666018	9.6103973	10.3896027	10.0333982	10.4230009	49
12	9.5773088	9.9665503	9.6107586	10.3892414	10.0334497	10.4226912	48
13	9.5776183	9.9664987	9.6111195	10.3888804	10.0335013	10.4223817	47
14	9.5779275	9.9664471	9.6114804	10.3885196	10.0335529	10.4220725	46
15	9.5782364	9.9663954	9.6118409	10.3881591	10.0336046	10.4217636	45
16	9.5785450	9.9663437	9.6122013	10.3877987	10.0336563	10.4214550	44
17	9.5788535	9.9662920	9.6125615	10.3874385	10.033708[illegible]	10.4211465	43
18	9.5791616	9.9662402	9.6129214	10.3870786	10.0337598	10.4208384	42
19	9.5794695	9.9661884	9.6132812	10.3867188	10.0338116	10.4205305	41
20	9.5797772	9.9661365	9.6136407	10.3863593	10.0338635	10.4202228	40
21	9.5800845	9.9660846	9.6140000	10.3860000	10.0339154	10.4199155	39
22	9.5803917	9.9660326	9.6143591	10.3856409	10.0339674	10.4196083	38
23	9.5806986	9.9659806	9.6147140	10.3852820	10.0340194	10.4193014	37
24	9.5810052	9.9659285	9.6150766	10.3849234	10.0340715	10.4189948	36
25	9.5813116	9.9658764	9.6154351	10.3845649	10.0341236	10.4186884	35
26	9.5816177	9.9658243	9.6157934	10.3842066	10.0341717	10.4183823	34
27	9.5819236	9.9657721	9.6161514	10.3838486	10.0342279	10.4180764	33
28	9.5822292	9.9657199	9.6165093	10.3834907	10.0342801	10.4177708	32
29	9.5825345	9.9656[illegible]77	9.6168669	10.3831331	10.0343323	10.4174655	31
30	9.5828397	9.9656153	9.6172243	10.3827757	10.0343847	10.4171603	30
31	9.5831445	9.9655630	9.6175815	10.3824185	10.0344370	10.4168555	29
32	9.5834491	9.9655106	9.6176385	10.3820615	10.0344894	10.4165509	28
33	9.5837535	9.9654582	9.6182953	10.3817047	10.0345418	10.4162465	27
34	9.5840576	9.9654057	9.6186[illegible]19	10.3813481	10.0345943	10.4159424	26
35	9.5843615	9.9653532	9.6190083	10.3809917	10.0346468	10.4156385	25
36	9.5846651	9.9653006	9.619364[illegible]	10.3806355	10.0346994	10.4153349	24
37	9.5849635	9.9652480	9.6197205	10.3802795	10.0347520	10.4150315	23
38	9.5852716	9.9651952	9.6200762	10.3799238	10.0348047	10.4147284	22
39	9.5855745	9.9651426	9.6204318	10.3795682	10.0348574	10.4144255	21
40	9.5858771	9.9650[illegible]99	9.6207872	10.3792128	10.0349101	10.4141229	20
41	9.5861795	9.9650371	9.6211423	10.3788577	10.0349629	10.4138205	19
42	9.5864816	9.9649843	9.6214973	10.3785027	10.0350157	10.4135188	18
43	9.5867835	9.9649314	9.6218520	10.3781480	10.0350686	10.4132165	17
44	9.5870851	9.9648785	9.6222066	10.3777934	10.0351215	10.4129149	16
45	9.5873865	9.9648256	9.6225609	10.3774391	10.0351744	10.4126135	15
46	9.5870876	9.9647726	9.622[illegible]150	10.3770850	10.0352274	10.4123124	14
47	9.5879885	9.9647195	9.6232690	10.3767310	10.0352805	10.4120115	13
48	9.3882892	9.9646665	9.6236227	10.3763773	10.0353335	10.4117108	12
49	9.5885896	9.9646133	9.6239763	10.3760237	10.0353867	10.4114104	11
50	9.5888897	9.9645602	9.6243296	10.3756704	10.0354398	10.4111103	10
51	9.5891897	9.9645069	9.6246827	10.3753173	10.0354931	10.4108103	9
52	9.5894893	9.9644537	9.6250356	10.3749644	10.0355463	10.4105107	8
53	9.5897888	9.9644004	9.6253884	10.3746116	10.0355996	10.4102112	7
54	9.5900880	9.9643470	9.6257409	10.3742591	10.0356530	10.4099120	6
55	9.5903869	9.9642937	9.6260932	10.3739068	10.0357063	10.4096131	5
56	9.5906856	9.9642402	9.6264454	10.3735546	10.0357598	10.4093144	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	9.9640797	9.6275006	10.3724994	10.0359203	10.4084197	1
60	9.5918780	9.9640261	9.62785[illegible]9	10.3721481	10.0359739	10.4081220	0
	L. Co-Sine.	L. Sine	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

67 DEGREES.

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23 DEGREES

M	N. Sine	N. Co-Sin	N. Tangent.	N. Co-Tang.	N. Secant	N Co-Secant.	
0	3907311	9205049	4244749	23558524	10863604	25593047	60
1	3909989	9203912	4248182	23539483	10864946	25575521	59
2	3912666	9202774	4251616	23520469	10866289	25558022	58
3	3915343	9201635	4255051	23501481	10867634	25540548	57
4	3918019	9200496	4258487	23482519	10868979	25523101	56
5	3920695	9199356	4261924	23463582	10870326	25505680	55
6	3923371	9198215	4265362	23444672	10871675	25488284	54
7	3926047	9197073	4268800	23425787	10873024	25470915	53
8	3928722	9195931	4272239	23406928	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	47
14	3944766	9189060	4292894	23294311	10882506	25350048	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
19	3958127	9183313	4310129	23201160	10889317	25264478	41
20	3960798	9182161	4313579	23182606	10890683	25247440	40
21	3963469	9181008	4317030	23164076	10892050	25230426	39
22	3966139	9179855	4320481	23145571	10893418	25213438	38
23	3968809	9178701	4323933	23127091	10894788	25196475	37
24	3971479	9177546	4327386	23108636	10896159	25179537	36
25	3974148	9176390	4330840	23090206	10897531	25162624	35
26	3976817	9175234	4334295	23071801	10898904	25145735	34
27	3979486	9174077	4337751	23053420	10900279	25128872	33
28	3982155	9172919	4341208	23035064	10901655	25112032	32
29	3984823	9171760	4344666	23016732	10903032	25095218	31
30	3987491	9170601	4348124	22998425	10904411	25078428	30
31	3990158	9169441	4351583	22980143	10905791	25061663	29
32	3992825	9168280	4355043	22961885	10907172	25044923	28
33	3995492	9167118	4358504	22943651	10908554	25028207	27
34	3998158	9165955	4361966	22925442	10909938	25011515	26
35	4000824	9164791	4365429	22907257	10910323	24994847	25
36	4003490	9163627	4368893	22889096	10912709	24978204	24
37	4006156	9162462	4372358	22870959	10914097	24961586	23
38	4008821	9161296	4375823	22852846	10915486	24944991	22
39	4011486	9160130	4379289	22834758	10916876	24928421	21
40	4014150	9158963	4382756	22816693	10918267	24911874	20
41	4016814	9157795	4386224	22798653	10919659	24895352	19
42	4019478	9156626	4389693	22780636	10921053	24878854	18
43	4022141	9155456	4393163	22762643	10922448	24862380	17
44	4024804	9154286	4396634	22744674	10923845	24845929	16
45	4027467	9153115	4400106	22726729	10925243	24829503	15
46	4030129	9151943	4403578	22708807	10926642	24813100	14
47	4032791	9150770	4407051	22690909	10928042	24796721	13
48	4035453	9149596	4410525	22673035	10929444	24780366	12
49	4038114	9148422	4414000	22655184	10930847	24764034	11
50	4040775	9147247	4417476	22637357	10932251	24747726	10
51	4043436	9146071	4420953	22619553	10933656	24731442	9
52	4046096	9144895	4424431	22601773	10935063	24715181	8
53	4048756	9143718	4427910	22584016	10936471	24698943	7
54	4051416	9142540	4431390	22566283	10937880	24682729	6
55	4054075	9141361	4434871	22548572	10939291	24666538	5
56	4056734	9140181	4438353	22530885	10940703	24650371	4
57	4059393	9139000	4441835	22513221	10942116	24634227	3
58	4062051	9137819	4445318	22495580	10943530	24618106	2
59	4064709	9136637	4448802	22477962	10944946	24602008	1
60	4067366	9135454	4452287	22460368	10946363	24585933	0
	N. Co-Sine	N. Sine.	N Co Tang.	N. Tangent.	N.Co-Secant.	N. Secant	M

66 DEGREES

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23 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	9.5918780	9.9640261	9.6278519	10.3721481	10.0359739	10.4081220	60
1	9.5921755	9.9639724	9.6282031	10.3717969	10.0360276	10.4078243	59
2	9.5924728	9.9639187	9.6285540	10.3714460	10.0360813	10.4079372	58
3	9.5927698	9.9638650	9.6289048	10.3710952	10.0361350	10.4072302	57
4	9.5930666	9.9638112	9.6292553	10.3707447	10.0361888	10.4069334	56
5	9.5933631	9.9637574	9.6296057	10.3703943	10.0362426	10.4066369	55
6	9.5936594	9.9637036	9.6299558	10.3700442	10.0362964	10.4063406	54
7	9.5939555	9.9636496	9.6303058	10.3696942	10.0363504	10.4060445	53
8	9.5942513	9.9635957	9.6306556	10.3693444	10.0364043	10.4057487	52
9	9.5945469	9.9635417	9.6310052	10.3689948	10.0364583	10.4054531	51
10	9.5948422	9.9634877	9.6313545	10.3686455	10.0365123	10.4051578	50
11	9.5951373	9.9634336	9.6317037	10.3682963	10.0365664	10.4048627	49
12	9.5954322	9.9633795	9.6320527	10.3679473	10.0366205	10.4045678	48
13	9.5957268	9.9633253	9.6324015	10.3675985	10.0366747	10.4042732	47
14	9.5960212	9.9632711	9.6327501	10.3672499	10.0367289	10.4039788	46
15	9.5963154	9.9632168	9.6330985	10.3669015	10.0367832	10.4036846	45
16	9.5966093	9.9631625	9.6334468	10.3665532	10.0368375	10.4033907	44
17	9.5969030	9.9631082	9.6337948	10.3662052	10.0368918	10.4030970	43
18	9.5971965	9.9630538	9.6341426	10.3658574	10.0369462	10.4028035	42
19	9.5974897	9.9629994	9.6344903	10.3655097	10.0370006	10.4025103	41
20	9.5977827	9.9629449	9.6348378	10.3651622	10.0370551	10.4022175	40
21	9.5980754	9.9628904	9.6351850	10.3648150	10.0371096	10.4019246	39
22	9.5983679	9.9628358	9.6355321	10.3644679	10.0371642	10.4016321	38
23	9.5986602	9.9627812	9.6358790	10.3641210	10.0372188	10.4013398	37
24	9.5989523	9.9627266	9.6362257	10.3637743	10.0372734	10.4010477	36
25	9.5992441	9.9626719	9.6365722	10.3634278	10.0373281	10.4007559	35
26	9.5995357	9.9626172	9.6369185	10.3630815	10.0373828	10.4004643	34
27	9.5998271	9.9625624	9.6372646	10.3627354	10.0374376	10.4001730	33
28	9.6001181	9.9625076	9.6376106	10.3623894	10.0374924	10.3998819	32
29	9.6004090	9.9624527	9.6379563	10.3620437	10.0375473	10.3995910	31
30	9.6006997	9.9623978	9.6383019	10.3616981	10.0376022	10.3993003	30
31	9.6009901	9.9623428	9.6386473	10.3613527	10.0376572	10.3990099	29
32	9.6012803	9.9622878	9.6389925	10.3610075	10.0377122	10.3987197	28
33	9.6015703	9.9622328	9.6393375	10.3606625	10.0377672	10.3984297	27
34	9.6018600	9.9621777	9.6396823	10.3603177	10.0378223	10.3981400	26
35	9.6021495	9.9621226	9.6400269	10.3599731	10.0378774	10.3978505	25
36	9.6024388	9.9620674	9.6403714	10.3596286	10.0379326	10.3975612	24
37	9.6027278	9.9620122	9.6407156	10.3592844	10.0379878	10.3972722	23
38	9.6030166	9.9619569	9.6410597	10.3589403	10.0380431	10.3969834	22
39	9.6033052	9.9619016	9.6414036	10.3585964	10.0382984	10.3966948	21
40	9.6035936	9.9618463	9.6417473	10.3582527	10.0381537	10.3964064	20
41	9.6038817	9.9617909	9.6420908	10.3579092	10.0382091	10.3961183	19
42	9.6041696	9.9617355	9.6424342	10.3575658	10.0382645	10.3958304	18
43	9.6044573	9.9616800	9.6427773	10.3572228	10.0383200	10.3955427	17
44	9.6047448	9.9616245	9.6431203	10.3568797	10.0383755	10.3952522	16
45	9.6050320	9.9615689	9.6434631	10.3565369	10.0384311	10.3949680	15
46	9.6053190	9.9615133	9.6438057	10.3561943	10.0384867	10.3946810	14
47	9.6056057	9.9614576	9.6441481	10.3558519	10.0385424	10.3943943	13
48	9.6058923	9.9614020	9.6444903	10.3555097	10.0385980	10.3941077	12
49	9.6061786	9.9613463	9.6448324	10.3551676	10.0386538	10.3938214	11
50	9.6064647	9.9612904	9.6451743	10.3548257	10.0387096	10.3935353	10
51	9.6067506	9.9612346	9.6455160	10.3544840	10.0387654	10.3932494	9
52	9.6070362	9.9611787	9.6458575	10.3541425	10.0388213	10.3929638	8
53	9.6073216	9.9611228	9.6461988	10.3538012	10.0388772	10.3926784	7
54	9.6076068	9.9610668	9.6465400	10.3534600	10.0389332	10.3923932	6
55	9.6078918	9.9610108	9.6468810	10.3531190	10.0389892	10.3921082	5
56	9.6081765	9.9609548	9.6472217	10.3527783	10.0390452	10.3918235	4
57	9.6084611	9.9608987	9.6475624	10.3524376	10.0391013	10.3915389	3
58	9.6087454	9.9608426	9.6479028	10.3520972	10.0391574	10.3912546	2
59	9.6090294	9.9607864	9.6482431	10.3517569	10.0392136	10.3909706	1
60	9.6093133	9.9607302	9.6485831	10.3514169	10.0392698	10.3906867	0
	L. Co-Sine.	L. Sine	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

66 DEGREES.

24 DEGREES

M	N. Sine	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant	N Co-Secant	
0	4067366	9135454	4452287	22460368	10946363	24585933	60
1	4070023	9134271	4455773	22442796	10947781	24569882	59
2	4072680	9133087	4459260	22425247	10949201	24553853	58
3	4075337	9131902	4462748	22407721	10950622	24537848	57
4	4077993	9130716	4466237	22390218	10952044	24521865	56
5	4080649	9129529	4469727	22372738	10953467	24505905	55
6	4083305	9128342	4473217	22355280	10954892	24489968	54
7	4085960	9127154	4476708	22337845	10956318	24474054	53
8	4088615	9125965	4480200	22320433	10957746	24458163	52
9	4091269	9124775	4483693	22303043	10959174	24442294	51
10	4093923	9123584	4487187	22285676	10960604	24426448	50
11	4096577	9122393	4490682	22268331	10962036	24410624	49
12	4099230	9121201	4494178	22251009	10963468	24394823	48
13	4101883	9120008	4497675	22233709	10964902	24379045	47
14	4104536	9118814	4501173	22216432	10966337	24363289	46
15	4107189	9117620	4504672	22199177	10967774	24347555	45
16	4109841	9116425	4508172	22181944	10969212	24331844	44
17	4112493	9115229	4511673	22164733	10970651	24316155	43
18	4115144	9114032	4515174	22147545	10972091	24300489	42
19	4117795	9112835	4518676	22130379	10973533	24284844	41
20	4120446	9111637	4522179	22113234	10974976	24269222	40
21	4123096	9110438	4525683	22096112	10976420	24253622	39
22	4125746	9109238	4529188	22079012	10977866	24238044	38
23	4128395	9108038	4532694	22061934	10979313	24222488	37
24	4131044	9106837	4536201	22044878	10980761	24206954	36
25	4133693	9105635	4539709	22027843	10982211	24191442	35
26	4136342	9104432	4543218	22010831	10983662	24175952	34
27	4138990	9103228	4546728	21993840	10985114	24160484	33
28	4141638	9102024	4550239	21976871	10986568	24145038	32
29	4144285	9100819	4553751	21959923	10988023	24129613	31
30	4146932	9099613	4557264	21942997	10989479	24114210	30
31	4149579	9098406	4560777	21926093	10990936	24098829	29
32	4152226	9097198	4564291	21909210	10992395	24083469	28
33	4154872	9095990	4567806	21892349	10993855	24068132	27
34	4157518	9094781	4571322	21875510	10995317	24052815	26
35	4160163	9093571	4574839	21858691	10996779	24037520	25
36	4162808	9092361	4578357	21841894	10998243	24022247	24
37	4165453	9091150	4581876	21825119	10999709	24006995	23
38	4168097	9089938	4585396	21808364	11001176	23991764	22
39	4170741	9088725	4588917	21791631	11002644	23976555	21
40	4173385	9087511	4592439	21774920	11004113	23961367	20
41	4176028	9086297	4595962	21758229	11005584	23946201	19
42	4178671	9085082	4599486	21741559	11007056	23931055	18
43	4181313	9083866	4603011	21724911	11008529	23915931	17
44	4183955	9082649	4606537	21708283	11010004	23900828	16
45	4186597	9081432	4610064	21691677	11011480	23885746	15
46	4189239	9080214	4613591	21675091	11012957	23870685	14
47	4191880	9078995	4617119	21658527	11014436	23855645	13
48	4194521	9077775	4620648	21641983	11015916	23840625	12
49	4197161	9076554	4624178	21625460	11017397	23825627	11
50	4199801	9075333	4627709	21608958	11018879	23810650	10
51	4202441	9074111	4631242	21592476	11020363	23795693	9
52	4205080	9072888	4634776	21576015	11021849	23780758	8
53	4207719	9071664	4638311	21559575	11023335	23765843	7
54	4210358	9070440	4641846	21543156	11024823	23750949	6
55	4212996	9069215	4645382	21526757	11026313	23736075	5
56	4215634	9067989	4648919	21510378	11027803	23721222	4
57	4218272	9066762	4652457	21494020	11029295	23706390	3
58	4220909	9065535	4655996	21477683	11030789	23691578	2
59	4223546	9064307	4659536	21461366	11032283	23676787	1
60	4226183	9063078	4663077	21445069	11033779	23662016	0
	N. Co-Sine	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M

65 DEGREES.

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24 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co-Tang.	L. Secant.	L Co-Secant	
0	9.6093133	9.9607302	9.6485831	10.3514169	10.0392698	10.3906807	60
1	9.6095969	9.9606739	9.6489230	10.3510770	10.0393261	10.3904031	59
2	9.6098803	9.9606176	9.6492628	10.3507372	10.0393824	10.3901197	58
3	9.6101635	9.9605612	9.6496023	10.3503977	10.0394388	10.3898365	57
4	9.6104465	9.9605048	9.6499417	10.3500583	10.0394952	10.3895535	56
5	9.6107293	9.9604484	9.6502809	10.3497191	10.0395516	10.3892707	55
6	9.6110118	9.9603919	9.6506199	10.3493801	10.0396081	10.3889882	54
7	9.6112941	9.9603354	9.6509587	10.3490413	10.0396646	10.3887059	53
8	9.6115762	9.9602788	9.6512974	10.3487026	10.0397212	10.3884238	52
9	9.6118580	9.9602222	9.6516359	10.3483641	10.0397778	10.3881420	51
10	9.6121397	9.9601655	9.6519742	10.3480258	10.0398345	10.3878603	50
11	9.6124211	9.9601088	9.6523123	10.3476877	10.0398912	10.3875789	49
12	9.6127023	9.9600520	9.6526503	10.3473497	10.0399480	10.3872977	48
13	9.6129833	9.9599952	9.6529881	10.3470119	10.0400048	10.3870167	47
14	9.6132641	9.9599384	9.6533257	10.3466743	10.0400616	10.3867359	46
15	9.6135446	9.9598815	9.6536631	10.3463369	10.0401185	10.3864554	45
16	9.6138250	9.9598246	9.6540004	10.3459996	10.0401754	10.3861750	44
17	9.6141051	9.9597676	9.6543375	10.3456625	10.0402324	10.3858949	43
18	9.6143850	9.9597106	9.6546744	10.3453256	10.0402894	10.3856150	42
19	9.6146647	9.9596535	9.6550112	10.3449888	10.0403465	10.3853353	41
20	9.6149441	9.9595964	9.6553477	10.3446523	10.0404036	10.3850559	40
21	9.6152234	9.9595393	9.6556841	10.3443159	10.0404607	10.3847766	39
22	9.6155024	9.9594821	9.6560204	10.3439796	10.0405179	10.3844976	38
23	9.6157812	9.9594248	9.6563564	10.3436436	10.0405752	10.3842188	37
24	9.6160598	9.9593675	9.6566923	10.3433077	10.0406325	10.3839401	36
25	9.6163382	9.9593102	9.6570280	10.3429720	10.0406898	10.3836618	35
26	9.6166164	9.9592528	9.6573636	10.3426364	10.0407472	10.3833836	34
27	9.6168944	9.9591954	9.6576989	10.3423011	10.0408046	10.3831056	33
28	9.6171721	9.9591380	9.6580341	10.3419659	10.0408620	10.3828279	32
29	9.6174496	9.9590805	9.6583692	10.3416308	10.0409195	10.3825504	31
30	9.6177270	9.9590229	9.6587041	10.3412960	10.0409771	10.3822730	30
31	9.6180041	9.9589653	9.6590387	10.3409613	10.0410347	10.3819959	29
32	9.6182809	9.9589077	9.6593733	10.3406267	10.0410923	10.3817191	28
33	9.6185576	9.9588500	9.6597076	10.3402924	10.0411500	10.3814424	27
34	9.6188341	9.9587923	9.6600418	10.3399582	10.0412077	10.3811659	26
35	9.6191103	9.9587345	9.6603758	10.3396242	10.0412655	10.3808897	25
36	9.6193864	9.9586767	9.6607097	10.3392903	10.0413233	10.3806136	24
37	9.6196622	9.9586188	9.6610434	10.3389566	10.0413812	10.3803378	23
38	9.6199378	9.9585609	9.6613769	10.3386231	10.0414391	10.3800622	22
39	9.6202132	9.9585030	9.6617103	10.3382897	10.0414970	10.3797868	21
40	9.6204884	9.9584450	9.6620434	10.3379566	10.0415550	10.3795116	20
41	9.6207634	9.9583869	9.6623765	10.3376235	10.0416131	10.3792366	19
42	9.6210382	9.9583288	9.6627093	10.3372907	10.0416712	10.3789618	18
43	9.6213127	9.9582707	9.6630420	10.3369580	10.0417293	10.3786873	17
44	9.6215871	9.9582125	9.6633745	10.3366255	10.0417875	10.3784129	16
45	9.6218612	9.9581543	9.6637069	10.3362931	10.0418457	10.3781388	15
46	9.6221351	9.9580961	9.6640391	10.3359609	10.0419039	10.3778649	14
47	9.6224088	9.9580378	9.6643711	10.3356289	10.0419622	10.3775912	13
48	9.6226824	9.9579794	9.6647030	10.3352970	10.0420206	10.3773176	12
49	9.6229557	9.9579210	9.6650346	10.3349654	10.0420790	10.3770443	11
50	9.6232287	9.9578626	9.6653662	10.3346338	10.0421374	10.3767713	10
51	9.6235016	9.9578041	9.6656975	10.3343025	10.0421959	10.3764984	9
52	9.6237743	9.9577456	9.6660288	10.3339712	10.0422544	10.3762257	8
53	9.6230467	9.9576870	9.6663598	10.3336402	10.0423130	10.3759532	7
54	9.6243190	9.9576284	9.6666907	10.3333093	10.0423716	10.3756810	6
55	9.6245911	9.9575697	9.6670214	10.3329786	10.0424303	10.3754089	5
56	9.6248629	9.9575110	9.6673519	10.3326481	10.0424890	10.3751371	4
57	9.6251346	9.9574522	9.6676823	10.3323177	10.0425478	10.3748654	3
58	9.6254060	9.9573934	9.6680126	10.3319874	10.0426066	10.3745940	2
59	9.6256772	9.9573346	9.6683426	10.3316574	10.0426654	10.3743228	1
60	9.6259483	9.9572757	9.6686725	10.3313275	10.0427243	10.3740517	0
	L Co-Sine.	L. Sine	L.Co-Tnag.	L. Tangent.	L.Co-Secant	L. Secant.	M

65 DEGREES.

25 DEGREES							
M	N. Sine	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant	N Co-Secant	
0	4226183	9063078	4663077	21445069	11033779	23662016	60
1	4228819	9061848	4666619	21428793	11035277	23647265	59
2	4231455	9060617	4670162	21412537	11036775	23632535	58
3	4234090	9059386	4673706	21396301	11038275	23617826	57
4	4236725	9058154	4677251	21380085	11039777	23603136	56
5	4239360	5056921	4680797	21363889	11041279	23588467	55
6	4241994	9055688	4684343	21347714	11042783	23573818	54
7	4244628	9054454	4687890	21331559	11044289	23559189	53
8	4247262	9053219	4691438	21315423	11045795	23544581	52
9	4249895	9051983	4694988	21299308	11047303	23529992	51
10	4252528	9050746	4698539	21283213	11048813	23515424	50
11	4255161	9049509	4702090	21267137	11050324	23500875	49
12	4257793	9048271	4705643	21251082	11051836	23486347	48
13	4260425	9047032	4709196	21235046	11053349	23471838	47
14	4263056	9045792	4712751	21219030	11054864	23457349	46
15	4265687	9044551	4716306	21203034	11056380	23442880	45
16	4268318	9043310	4719863	21187057	11057898	23428431	44
17	4270949	9042068	4723420	21171101	11059417	23414002	43
18	4273579	9040825	4726978	21155164	11060937	23399593	42
19	4276209	9039582	4730538	21139246	11062458	23385203	4.
20	4278838	9038338	4734098	21123348	11063981	23370833	40
21	4281467	9037093	4737659	21107470	11065506	23356482	39
22	4284095	9035847	4741222	21091611	11067031	23342152	38
23	4286723	9034600	4744785	21075771	11068558	23327840	37
24	4289351	9033353	4748349	21059951	11070087	23313548	36
25	4291979	9032105	4751914	21044150	11071616	23299276	35
26	4294606	9030856	4755481	21028369	11073147	23285023	34
27	4297233	9029606	4759048	21012607	11074680	23270790	33
28	4299859	9028356	4762616	20996864	11070214	23256575	32
29	4302485	9027105	4766185	20981140	11077749	23242381	31
30	4305111	9025853	4769755	20965436	11079285	23228205	30
31	4307736	9024600	4773326	20949751	11080823	23214049	29
32	4310361	9023347	4776899	20934084	11082363	23199911	28
33	4312986	9022093	4780472	20918437	11083903	23185794	27
34	4315610	9020838	4784046	20902809	11085445	23171695	26
35	4318234	9019582	4787621	20887200	11086989	23157615	25
36	4320857	9014325	4791197	20871610	11088533	23143554	24
37	4323480	9017068	4794774	20856039	11090079	23129513	23
38	4326103	9015810	4798352	20840486	11091627	23115490	22
39	4328726	9014551	4801932	20824953	11093176	23101486	21
40	4331348	9013291	4805512	20809438	11094726	23087501	20
41	4333970	9012031	4809093	20793942	11096277	23073535	19
42	4236591	9010770	4812675	20778465	11097830	23059588	18
43	4339212	9009508	4816258	20763007	11099385	23045660	17
44	4341833	9008245	4819842	20747567	11100941	23031751	16
45	4344453	9006982	4823427	20732146	11102498	23017860	15
46	4347073	9005718	4827014	20716743	11104056	23003988	14
47	4349692	9004453	4830601	20701359	11105616	22990134	13
48	4352311	9003187	4834189	20685993	11107177	22976299	12
49	4354930	9001921	4837778	20670646	11108740	22962483	11
50	4357548	9000654	4841368	20655318	11110304	22948685	10
51	4360166	8999386	4844959	20640008	11111869	22934906	9
52	4362784	8998117	4848552	20624716	11113436	22921145	8
53	4365401	8996848	4852145	20609442	11115004	22907403	7
54	4368018	8995578	4855739	20594187	11116573	22893679	6
55	4370634	8994307	4859334	20578950	11118144	22879974	5
56	4373250	8993035	4862931	20563732	11119716	22866286	4
57	4375866	8991762	4866528	20548531	11121290	22852618	3
58	4378482	8990489	4870126	20533349	11122865	22838967	2
59	4381097	8989215	4873726	20518184	11124442	22825334	1
60	4383712	8987940	4877326	20503038	11126019	22811720	0
	N. Co-Sine	N. Sine.	N Co Tang.	N. Tangent.	N.Co-Secant.	N. Secant	M
64 DEGREES.							

25 DEGREES.

M	*L. Sine.*	*L. Co.Sine.*	*L. Tangent*	*L. Co-Tang.*	*L. Secant.*	*L. Co-Secant*	
0	9.6259483	9.9572757	9.6686725	10.3313275	10.0427243	10.3740517	60
1	9.6262191	9.9572168	9.6690023	10.3309977	10.0427832	10.3737809	59
2	9.6264897	9.9571578	9.6693319	10.3306681	10.0428422	10.3735103	58
3	9.6267601	9.9570988	9.6696613	10.3303387	10.0429012	10.3732399	57
4	9.6270303	9.9570397	9.6699906	10.3300094	10.0429603	10.3729697	56
5	9.6273003	9.9569806	9.6703197	10.3296803	10.0430194	10.3726997	55
6	9.6275701	9.9569215	9.6706486	10.3293514	10.0430785	10.3724299	54
7	9.6278397	9.9568623	9.6709774	10.3290226	10.0431377	10.3721603	53
8	9.6281090	9.9568030	9.6713060	10.3286940	10.0431970	10.3718910	52
9	9.6283782	9.9567437	9.6716345	10.3283555	10.0432563	10.3716218	51
10	9.6286472	9.9566844	9.6719628	10.3280372	10.0433156	10.3713528	50
11	9.6289160	9.9566250	9.6722910	10.3277090	10.0433790	10.3710840	49
12	9.6291845	9.9565656	9.6726190	10.3273810	10.0434344	10.3708155	48
13	9.6294529	9.9565061	9.6729468	10.3270532	10.0434939	10.3705471	47
14	9.6297211	9.9564466	9.6732745	10.3267255	10.0435534	10.3702789	46
15	9.6299890	9.9563870	9.6736020	10.3263980	10.0436130	10.3700110	45
16	9.6302568	9.9563274	9.6739294	10.3260706	10.0436726	10.3697432	44
17	9.6305243	9.9562678	9.6742566	10.3257434	10.0437322	10.3694757	43
18	9.6307617	9.9562081	9.6745836	10.3254164	10.0437919	10.3692083	42
19	9.6310589	9.9561483	9.6749105	10.3250895	10.0438517	10.3689411	41
20	9.6313258	9.9560886	9.6752372	10.3247628	10.0439114	10.3686742	40
21	9.6315926	9.9560287	9.6755638	10.3244362	10.0439713	10.3684074	39
22	9.6318591	9.9559689	9.6758902	10.3241097	10.0440311	10.3681409	38
23	9.6321255	9.9559089	9.6762165	10.3237835	10.0440911	10.3678745	37
24	9.6323916	9.9558490	9.6765426	10.3234574	10.0441510	10.3676084	36
25	9.6326576	9.9557890	9.6768686	10.3231314	10.0442110	10.3673424	35
26	9.6329233	9.9557289	9.6771944	10.3228056	10.0442711	10.3670767	34
27	9.6331889	9.9556688	9.6775201	10.3224799	10.0443312	10.3668111	33
28	9.6334542	9.9556087	9.6778456	10.3221544	10.0443913	10.3665458	32
29	9.6337194	9.9555485	9.6781709	10.3218291	10.0444515	10.3662806	31
30	9.6339844	9.9554882	9.6784961	10.3215039	10.0445118	10.3660156	30
31	9.6342491	9.9554280	9.6788211	10.3211789	10.0445720	10.3657509	29
32	9.6345137	9.9553676	9.6791460	10.3208540	10.0446324	10.3654863	28
33	9.6347780	9.9553073	9.6794708	10.3205292	10.0446927	10.3652220	27
34	9.6350422	9.9552469	9.6797953	10.3202047	10.0447531	10.3649578	26
35	9.6353062	9.9[illegible]864	9.6801198	10.3198803	10.0448136	10.3646938	25
36	9.6355699	9.9551259	9.6804440	10.3195560	10.0448741	10.3644301	24
37	9.6358335	9.9550653	9.6807682	10.3192318	10.0449347	10.3641665	23
38	9.6360969	9.9550047	9.6810921	10.3189079	10.0449953	10.3639031	22
39	9.6363601	9.9549441	9.6814160	10.3185840	10.0450559	10.3636299	21
40	9.6366231	9.9548834	9.6817396	10.3182604	10.0451166	10.3633760	20
41	9.6368859	9.9548227	9.6820632	10.3179363	10.0451773	10.3631141	19
42	9.6371484	9.9547619	9.6823865	10.3176135	10.0452381	10.3628516	18
43	9.6374108	9.9547011	9.6827098	10.3172902	10.0452989	10.3625892	17
44	9.6376731	9.9546402	9.6830328	10.3169672	10.0453589	10.3623269	16
45	9.6379351	9.9545793	9.6833557	10.3166443	10.0454207	10.3620649	15
46	9.6381969	9.9545184	9.6836785	10.3163215	10.0454816	10.3618031	14
47	9.6384585	9.9544574	9.6840011	10.3159989	10.0455426	10.3615415	13
48	9.6387199	9.9543963	9.6843236	10.3156764	10.0456037	10.3612801	12
49	9.6389812	9.9543352	9.6846459	10.3153541	10.0456648	10.3610188	11
50	9.6392422	9.9542741	9.6849681	10.3150319	10.0457259	10.3607578	10
51	9.6395030	9.9542129	9.6852901	10.3147099	10.0457871	10.3604970	9
52	9.6397637	9.9541517	9.6856120	10.3143880	10.0457483	10.3602363	8
53	9.6400241	9.9540904	9.6859338	10.3140662	10.0459096	10.3599759	7
54	9.6402844	9.9540291	9.6862553	10.3137447	10.0459709	10.3597156	6
55	9.6405445	9.9539677	9.6865768	10.3134232	10.0460323	10.3594555	5
56	9.6408044	9.9539063	9.6868981	10.3131019	10.0460937	10.3591956	4
57	9.6410640	9.9538448	9.6872192	10.3127808	10.0461552	10.3589360	3
58	9.6413235	9.9537833	9.6875402	10.3124598	10.0462167	10.3586765	2
59	9.6415828	9.9537218	9.6878611	10.3121389	10.0462782	10.3584172	1
60	9.6418420	9.9536602	9.6881818	10.3118182	10.0463398	10.3581580	0
	L. Co-Sine.	*L Sine.*	*L. Co-Tang.*	*L. Tangent.*	*L.Co-Secant*	*L Secant.*	M

64 DEGREES.

26 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant.	
0	4383712	8987940	4877326	20503038	11126019	22811720	60
1	4386326	8986665	4880927	20487910	11127598	22798124	59
2	4388940	8985389	4884530	20472800	11129179	22784546	58
3	4391553	8984112	4888133	20457708	11130761	22770986	57
4	4394166	8982834	4891737	20442634	11132345	22757445	56
5	4396779	8981555	4895343	20427578	11133930	22743921	55
6	4399392	8980276	4898949	20412540	11135516	22730415	54
7	4402004	8978996	4902557	20397519	11137103	22716927	53
8	4404616	8977715	4906166	20382517	11138692	22703457	52
9	4407227	8976433	4909775	20367532	11140282	22690005	51
10	4409838	8975151	4913386	20352565	11141874	22676571	50
11	4412448	8973868	4916997	20337615	11143467	22663155	49
12	4415058	8972584	4920610	20322683	11145062	22649756	48
13	4417668	8971299	4924224	20307769	11146658	22636375	47
14	4420278	8970013	4927838	20292473	11148255	22623012	46
15	4422887	8968727	4931454	20277994	11149854	22609667	45
16	4425496	8967440	4935071	20263133	11151454	22596339	44
17	4428104	8966152	4938689	20248289	11153056	22583029	43
18	4430712	8964864	4942308	20233462	11154659	22569736	42
19	4433320	8963575	4945928	20218653	11156263	22556461	41
20	4435927	8962285	4949549	20203862	11157869	22543204	40
21	4438534	8960994	4953171	20189088	11159476	22529964	39
22	4441140	8959703	4956794	20174331	11161084	22516741	38
23	4443746	8958411	4960418	20159592	11162694	22503536	37
24	4446452	8957118	4964043	20144869	11164306	22490348	36
25	4448957	8955824	4967669	20130164	11165919	22477178	35
26	4451562	8954529	4971297	20115477	11167533	22464024	34
27	4454167	8953234	4974925	20100806	11169149	22450889	33
28	4456771	8951938	4978554	20086153	11170766	22437770	32
29	4459375	8950641	4982185	20071516	11172384	22424669	31
30	4461978	8949343	4985816	20056897	11174004	22411584	30
31	4464581	8948045	4989449	20042295	11175625	22398517	29
32	4467184	8946746	4993082	20027710	11177248	22385467	28
33	4469786	8945446	4996717	20013142	11178872	22372435	27
34	4472388	8944145	5000352	19998590	11180498	22359419	26
35	4474990	8942844	5003989	19984056	111[illegible]25	22346420	25
36	4477591	8941542	5007627	19969539	11183753	22333438	24
37	4480192	8940239	5011266	19955038	11185383	22320474	23
38	4482792	8938936	5014906	19940554	11187014	22307526	22
39	4485392	8937632	5018547	19926087	11188647	22294595	21
40	4487992	8936327	5022189	19911637	11190281	22281681	20
41	4490591	8935021	5025832	19897204	11191916	22268783	19
42	4493190	8933714	5029476	19882787	11193553	22255903	18
43	4495789	8932406	5033121	19868387	11195191	22243039	17
44	4498387	8921098	5036767	19854003	11196831	22230192	16
45	4500985	8929789	5040415	19839636	11198472	22217362	15
46	4503582	8928479	5044063	19825286	11200115	22204548	14
47	4506179	8927169	5047713	19810952	11201759	2219175	13
48	4508776	8925858	5051363	19796635	11203405	22178971	12
49	4511372	8924546	5055015	19782334	11205052	22166207	11
50	4513968	8923233	5058668	19768050	11206700	22153460	10
51	4516563	8921920	5062322	19753782	11208350	22140730	9
52	4519158	8920606	5065977	19739531	11210001	22128016	8
53	4521753	8919291	5069633	19725296	11211653	22115318	7
54	4524347	8917975	5073290	19711077	15213307	22102637	6
55	4526941	8916659	5076948	19696874	11214963	22089972	5
56	4529535	8915342	5080607	19682688	11216620	22077323	4
57	4532128	8914024	5084267	19668518	11218278	22064691	3
58	4534721	8912705	5087928	19654364	11219938	22052075	2
59	4537313	8911385	5091591	19640227	11221600	22039476	1
60	4539905	8910065	5095254	19626105	11223262	22026893	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant.	N. Secant.	M

63 DEGREES.

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26 DEGREES.

M	L. Sine.	L. Co-Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant	
0	9.6418420	9.9536602	9.6881818	10.3118182	10.0463398	10.3581580	60
1	9.6421009	9.9535985	9.6885023	10.3114977	10.0464015	10.3578991	59
2	9.6423596	9.9535369	9.6888227	10.3111773	10.0464631	10.3576404	58
3	9.6426182	9.9534751	9.6891430	10.3108570	10.0465249	10.3573818	57
4	9.6428765	9.9534134	9.6894631	10.3105369	10.0465866	10.3571235	56
5	9.6431347	9.9533515	9.6897831	10.3102169	10.0466485	10.3568653	55
6	9.6433926	9.9532898	9.6901030	10.3098970	10.0467103	10.3566074	54
7	9.6436504	9.9532278	9.6904226	10.3095774	10.0467722	10.3563496	53
8	9.6439080	9.9531658	9.6907422	10.3092578	10.0468342	10.3560920	52
9	9.6441654	9.9531038	9.6910616	10.3089384	10.0468962	10.3558346	51
10	9.6444226	9.9530418	9.6913809	10.3086191	10.0469582	10.3555774	50
11	9.6446796	9.9529797	9.6917000	10.3083000	10.0470203	10.3553204	49
12	9.6449365	9.9529175	9.6920189	10.3079811	10.0470825	10.3550635	48
13	9.6451931	9.9528553	9.6923378	10.3076622	10.0471447	10.3548069	47
14	9.6454496	9.9527931	9.6926565	10.3073435	10.0472069	10.3545504	46
15	9.6457058	9.9527308	9.6929750	10.3070250	10.0472692	10.3545942	45
16	9.6459619	9.9526685	9.6932934	10.3067066	10.0473315	10.3540381	44
17	9.6462178	9.9526061	9.6936117	10.3063883	10.0473939	10.3537822	43
18	9.6464735	9.9525437	9.6939298	10.3060702	10.0474563	10.3535265	42
19	9.6467290	9.9524813	9.6942478	10.3057522	10.0475187	10.3532710	41
20	9.6469844	9.9524188	9.6945656	10.3054344	10.0475812	10.3530156	40
21	9.6472395	9.9523562	9.6948833	10.3051167	10.0476438	10.3527605	39
22	9.6474945	9.9522936	9.6952009	10.3047991	10.0477064	10.3525055	38
23	9.6477492	9.9522310	9.6955183	10.3044817	10.0477690	10.3522508	37
24	9.6480038	9.9521683	9.6958355	10.3041645	10.0478317	10.3519962	36
25	9.6482582	9.9521055	9.6961527	10.3038473	10.0478945	10.3517418	35
26	9.6485124	9.9520428	9.6964697	10.3035303	10.0479572	10.3514876	34
27	9.6487665	9.9519799	9.6967865	10.3032135	10.0480201	10.3512335	33
28	9.6490203	9.9519171	9.6971032	10.3028968	10.0480829	10.3509797	32
29	9.6492740	9.9518541	9.6974198	10.3025802	10.0481459	10.3507260	31
30	9.6495274	9.9517912	9.6977363	10.3022637	10.0482088	10.3504726	30
31	9.6497807	9.9517282	9.6980526	10.3019474	10.0482718	10.3502193	29
32	9.6500338	9.9516651	9.6983687	10.3016313	10.0483349	10.3499662	28
33	9.6502868	9.9516020	9.6986847	10.3013153	10.0483980	10.3497132	27
34	9.6505395	9.9515389	9.6990006	10.3009994	10.0484611	10.3494605	26
35	9.6507920	9.9514757	9.6993164	10.3006836	10.0485243	10.3492080	25
36	9.6510444	9.9514124	9.6996320	10.3003680	10.0485876	10.3489556	24
37	9.6512966	9.9513492	9.6999474	10.3000526	10.0486508	10.3487034	23
38	9.6515486	9.9512858	9.7002628	10.2997372	10.0487142	10.3484514	22
39	9.6518004	9.9512224	9.7005780	10.2994220	10.0487776	10.3481996	21
40	9.6520521	9.9511590	9.7008930	10.2991070	10.0488410	10.3479479	20
41	9.6523035	9.9510956	9.7012080	10.2987920	10.0489044	10.3476965	19
42	9.6525548	9.9510320	9.7015227	10.2984773	10.0489680	10.3474452	18
43	9.6528059	9.9509685	9.7018374	10.2981626	10.0490315	10.3471941	17
44	9.6530568	9.9509049	9.7021519	10.2978481	10.0490951	10.3469432	16
45	9.6533075	9.9508412	9.7024663	10.2975337	10.0491588	10.3466925	15
46	9.6535581	9.9507775	9.7027805	10.2972195	10.0492225	10.3464419	14
47	9.6538084	9.9507138	9.7030946	10.2969054	10.0492862	10.3461916	13
48	9.6540586	9.9506500	9.7034086	10.2965914	10.0493500	10.3459414	12
49	9.6543086	9.9505861	9.7037225	10.2962775	10.0494139	10.3456914	11
50	9.6545584	9.9505223	9.7040362	10.2959638	10.0494777	10.3454416	10
51	9.6548081	9.9504583	9.7043497	10.2956503	10.0495417	10.3451919	9
52	9.6550575	9.9503944	9.7046632	10.2953368	10.0496056	10.3449425	8
53	9.6553068	9.9503303	9.7049765	10.2950235	10.0496697	10.3446932	7
54	9.6555559	9.9502663	9.7052897	10.2947103	10.0497337	10.3444441	6
55	9.6558048	9.9502022	9.7056027	10.2943973	10.0497978	10.3441952	5
56	9.6560536	9.9501380	9.7059156	10.2940844	10.0498620	10.3439404	4
57	9.6563021	9.9500738	9.7062284	10.2937716	10.0499262	10.3436979	3
58	9.6565505	9.9500095	9.7065410	10.2934590	10.0499905	10.3434495	2
59	9.6567987	9.9499452	9.7068535	10.2931465	10.0500548	10.3432013	1
60	9.6570468	9.9498809	9.7071659	10.2928341	10.0501191	10.3429532	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

63 DEGREES.

27 DEGREES.

M	N. Sine.	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	4539905	8910065	5095254	19626105	11223262	22026893	60
1	4542497	8908744	5098919	19612000	11224926	22014326	59
2	4545088	8907422	5102585	19597910	11226592	22001775	58
3	4547679	8906100	5106252	19583837	11228259	21989240	57
4	4550269	8904777	5109919	19569780	11229928	21976721	56
5	4552859	8903453	5113588	19555739	11231598	21964219	55
6	4555449	8902128	5117259	19541713	11233269	21951733	54
7	4558038	8900802	5120930	19527704	11234942	21939262	53
8	4560627	8899476	5124602	19513711	11236616	21926808	52
9	4563216	8898149	5128275	19499733	11238292	21914370	51
10	4565804	8896821	5131950	19485771	11239969	21901947	50
11	4568392	8895493	5135625	19471825	11241648	21889541	49
12	4570979	8894164	5139302	19457896	11243328	21877150	48
13	4573566	8892834	5142980	19443981	11245010	21864775	47
14	4576153	8891503	5146658	19430083	11246693	21852417	46
15	4578739	8890171	5150338	19416200	11248377	21840074	45
16	4581325	8888839	5154019	19402333	11250063	21827746	44
17	4583910	8887506	5157702	19388481	11251750	21815435	43
18	4586495	8886172	5161385	19374645	11253439	21803139	42
19	4589080	8884837	5165069	19360825	11255129	21790859	41
20	4591664	8883502	5168755	19347020	11256821	21778594	40
21	4594248	8882166	5172441	19333231	11258514	21766346	39
22	4596832	8880829	5176129	19319457	11260209	21754112	38
23	4599415	8879492	5179818	19305698	11261905	21741895	37
24	4601998	8878154	5183508	19291956	11263603	21729593	36
25	4604580	8876815	5187199	19278228	11265302	21717506	35
26	4607162	8875475	5190891	19264516	11267003	21705335	34
27	4609744	8874134	5194584	19250819	11268705	21693180	33
28	4612325	8872793	5198278	19237138	11270408	21681040	32
29	4614906	8871451	5201974	19223472	11272113	21668915	31
30	4617486	8870108	5205670	19209821	11273819	21656806	30
31	4620066	8868764	5209368	19196186	11275527	21644712	29
32	4622646	8867420	5213067	19182565	11277237	21632633	28
33	4625225	8866075	5216767	19168960	11278948	21620570	27
34	4627804	8864725	5220468	19155370	11280660	21608522	26
35	4630382	8863383	5224170	19141795	11282374	21596489	25
36	4632960	8862036	5227874	19128236	11284089	21584471	24
37	4635538	8860688	5231578	19114691	11285806	21572469	23
38	4638115	8859339	5235284	19101162	11287524	21560482	22
39	4640692	8857989	5238990	19087647	11289244	21548510	21
40	4643269	8856639	5242698	19074147	11290965	21536553	20
41	4645845	8855288	5246407	19060663	11292688	21524611	19
42	4648421	8853936	5250117	19047193	11294412	21512684	18
43	4650996	8852583	5253829	19033738	11296137	21500772	17
44	4653571	8851230	5257541	19020299	11297864	21488875	16
45	4656145	8849876	5261254	19006874	11299593	21476993	15
46	4658719	8848521	5264969	18993464	11301323	21465127	14
47	4661293	8847166	5268685	18980068	11303055	21453275	13
48	4663866	8845810	5272402	18966688	11304788	21441437	12
49	4666439	8844453	5276120	18953322	11306522	21429615	11
50	4669012	8843095	5279839	18939971	11308258	21417808	10
51	4671584	8841736	5283559	18926634	11309996	21406015	9
52	4674156	8840377	5287281	18913313	11311735	21394238	8
53	4676727	8839017	5291004	18900006	11313475	21382475	7
54	4679298	8837656	5294727	18886713	11315217	21370726	6
55	4681869	8836294	5298452	18873436	11316961	21358993	5
56	4684439	8834932	5302178	18860172	11318706	21347274	4
57	4687009	8833569	5305906	18846924	11320452	21335570	3
58	4689578	8832205	5309634	18833690	11322200	21323880	2
59	4692147	8830841	5313364	18820470	11323950	21312205	1
60	4694716	8829476	5317094	18807265	11325701	21200545	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co-Secant.	N. Secant.	M

62 DEGREES.

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27 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co Tang.	L. Secant.	L Co-Secant.	
0	9.6570468	9.9498809	9.7071659	10.2928341	10.0501191	10.3429532	60
1	9.6572946	9.9498165	9.7074781	10.2925219	10.0501835	10.3427054	59
2	9.6575423	9.9497521	9.7077902	10.2922098	10.0502479	10.3424577	58
3	9.6577898	9.9496876	9.7081022	10.2918978	10.0503124	10.3422102	57
4	9.6580371	9.9496230	9.7084141	10.2915859	10.0503770	10.3419629	56
5	9.6582842	9.9495585	9.7087258	10.2912742	10.0504415	10.3417158	55
6	9.6585312	9.9494938	9.7090374	10.2909626	10.0505062	10.3414688	54
7	9.6587780	9.9494292	9.7093488	10.2906512	10.0505708	10.3412220	53
8	9.6590246	9.9493645	9.7096601	10.2903399	10.0506355	10.3409754	52
9	9.6592710	9.9492997	9.7099713	10.2900287	10.0507003	10.3407290	51
10	9.6595173	9.9492349	9.7102824	10.2897176	10.0507651	10.3404827	50
11	9.6597634	9.9491700	9.7105933	10.2894067	10.0508300	10.3402367	49
12	9.6600093	9.9491051	9.7109041	10.2890959	10.0508949	10.3399907	48
13	9.6602550	9.9490402	9.7112148	10.2887852	10.0509598	10.3397450	47
14	9.6605005	9.9489752	9.7115254	10.2884746	10.0510248	10.3394995	46
15	9.6607459	9.9489101	9.7118358	10.2881642	10.0510899	10.3392541	45
16	9.6609911	9.9488450	9.7121461	10.2878539	10.0511500	10.3390089	44
17	9.6612361	9.9487799	9.7124562	10.2875435	10.0512201	10.3387639	43
18	9.6614810	9.9487147	9.7127662	10.2872338	10.0512853	10.3385190	42
19	9.6617257	9.9486495	9.7130761	10.2869239	10.0513505	10.3382743	41
20	9.6619701	9.9485842	9.7133859	10.2866141	10.0514158	10.3380298	40
21	9.6622145	9.9485189	9.7136956	10.2863044	10.0514811	10.3377855	39
22	9.6624586	9.9484535	9.7140051	10.2859949	10.0515465	10.3375414	38
23	9.6627026	9.9483881	9.7143145	10.2856855	10.0516119	10.3372974	37
24	9.6629464	9.9483227	9.7146237	10.2853763	10.0516773	10.3370536	36
25	9.6631900	9.9482572	9.7149329	10.2850671	10.0517428	10.3368100	35
26	9.6634335	9.9481916	9.7152419	10.2847581	10.0518084	10.3365665	34
27	9.6636768	9.9481260	9.7155508	10.2844492	10.0518740	10.3363232	33
28	9.6639199	9.9480604	9.7158595	10.2841405	10.0519396	10.3360801	32
29	9.6641628	9.9479947	9.7161682	10.2838318	10.0520053	10.3358372	31
30	9.6644056	9.9479289	9.7164767	10.2835233	10.0520711	10.3355944	30
31	9.6646482	9.9478631	9.7167851	10.2832149	10.0521369	10.3353518	29
32	9.6648906	9.9477973	9.7170933	10.2829067	10.0522027	10.3351094	28
33	9.6651329	9.9477314	9.7174014	10.2825986	10.0522686	10.3348671	27
34	9.6653749	9.9476655	9.7177094	10.2822906	10.0523345	10.3346251	26
35	9.6656168	9.9475995	9.7180173	10.2819827	10.0524005	10.3343832	25
36	9.6658586	9.9475335	9.7183251	10.2816749	10.0524665	10.3341414	24
37	9.6661001	9.9474674	9.7186327	10.2813673	10.0525326	10.3338999	23
38	9.6663415	9.9474013	9.7189402	10.2810598	10.0525987	10.3336585	22
39	9.6665828	9.9473352	9.7192476	10.2807524	10.0526648	10.3334172	21
40	9.6668238	9.9472689	9.7195549	10.2804451	10.0527311	10.3331762	20
41	9.6670647	9.9472027	9.7198620	10.2801380	10.0527973	10.3329353	19
42	9.6673054	9.9471364	9.7201690	10.2798310	10.0528636	10.3326946	18
43	9.6675459	9.9470700	9.7204759	10.2795241	10.0529300	10.3324541	17
44	9.6677863	9.9470036	9.7207827	10.2792173	10.0529964	10.3322137	16
45	9.6680265	9.9469372	9.7210893	10.2789107	10.0530628	10.3319735	15
46	9.6682665	9.9468707	9.7213958	10.2786042	10.0531293	10.3317335	14
47	9.6689064	9.9468042	9.7217022	10.2782978	10.0531958	10.3314936	13
48	9.6687461	9.9467376	9.7220085	10.2779915	10.0532624	10.3312539	12
49	9.6689856	9.9466710	9.7223147	10.2776853	10.0533290	10.3310144	11
50	9.6692250	9.9466043	9.7226207	10.2777393	10.0533957	10.3307750	10
51	9.6694642	9.9465376	9.7229266	10.2770734	10.0534624	10.3305358	9
52	9.6697032	9.9464708	9.7232324	10.2767676	10.0535292	10.3302968	8
53	9.6699420	9.9464040	9.7235381	10.2764619	10.0535960	10.3300580	7
54	9.6701807	9.9463371	9.7238436	10.2761564	10.0536629	10.3298193	6
55	9.6704192	9.9462702	9.7241490	10.2758510	10.0537298	10.3295808	5
56	9.6706576	9.9462032	9.7244543	10.2755457	10.0537968	10.3293424	4
57	9.6708958	9.9461362	9.7247595	10.2752405	10.0538638	10.3291042	3
58	9.6711338	9.9460692	9.7250646	10.2749354	10.0539308	10.3288662	2
59	9.6713716	9.9460021	9.7253695	10.2746305	10.0539979	10.3286284	1
60	9.6716093	9.9459349	9.7256744	10.2743256	10.0540651	10.3283907	0
	L. Co-Sine.	L Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

62 DEGREES.

28 DEGREES.

M	N. Sine	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	N. Co-Secant	
0	46947 6	8829476	5317094	18807265	11325701	21300545	60
1	4697284	8828110	5320826	18794074	11327453	21288599	59
2	4699852	8826743	5324559	18780898	11329207	21277267	58
3	4702419	8825375	5328293	18767736	11330962	21265651	57
4	4704986	8824007	5332029	18754588	11332719	21254048	56
5	4707553	8822638	5335765	18741455	11334478	21242460	55
6	4710119	8821268	5339503	18728336	11336238	21230587	54
7	4712685	8819898	5343242	18715231	11337999	21219328	53
8	4715250	8818527	5346982	18702141	11339762	21207783	52
9	4717815	8817155	5350723	18689064	11341527	21196253	51
10	4720380	8815782	5354465	18676203	11343293	21184737	50
11	4722944	8814409	5358208	18662955	11345090	21173235	49
12	4725508	8813035	5361953	18649921	11346829	21161748	48
13	4728071	8811660	5365699	18636902	11348600	21150274	47
14	4730634	8810284	5369446	18623896	11350372	21138815	46
15	4733197	8808907	5373194	18610905	11352146	21127371	45
16	4735759	8807530	5376943	18597928	11353921	21115940	44
17	4738321	8806152	5380694	18584965	11355698	21104523	43
18	4740882	8804773	5384445	18572015	11357476	21093121	42
19	4743443	8803394	5388198	18559080	11359255	21081733	41
20	4746004	8802014	5391952	18546159	11361036	21070359	40
21	4748564	8800633	5395707	18533252	11362819	21058998	39
22	4751124	8799251	5399464	18520358	11364603	21047652	38
23	4753683	8797869	5403221	18507479	11366389	21036320	37
24	4756242	8796486	5406980	18494613	11368176	21025002	36
25	4758801	8795102	5410740	18481761	11369965	21013698	35
26	4761359	8793717	5414501	18468923	11371755	21002408	34
27	4763917	8792332	5418263	18456099	11373547	20991131	33
28	4766474	8790946	5422027	18443289	11375340	20979869	32
29	4769031	8789559	5425791	18430492	11377135	20968620	31
30	4771588	8788171	5429557	18417709	11378932	20957355	30
31	4774144	8786783	5433324	18404939	11380730	20946164	29
32	4779700	8785294	5437092	18392184	11382529	20934957	28
33	4779255	8784004	5440862	18379442	11384330	20923764	27
34	4781810	8782613	5444632	18366713	11386133	20912584	26
35	4784364	8781222	5448404	18353999	11387937	20901418	25
36	4786918	8770830	5452177	18341297	11389743	20890265	24
37	4789472	8778437	5455951	18328610	11391550	20879127	23
38	4792026	8777043	5459726	18315936	11393359	20868002	22
39	4794579	8775649	5463503	18303275	11395169	20856890	21
40	4797171	8774254	5467281	18290628	11396981	20845792	20
41	4799683	8772858	5471060	18277994	11398795	20834708	19
42	4802235	8771461	5474840	18265374	11400609	20823637	18
43	4804786	8770064	5478621	18252767	11402425	20812580	17
44	4807337	8768666	5482404	18240173	11404243	20801536	16
45	4809888	8767267	5486188	18227593	11406062	20790506	15
46	4812438	8765868	5489973	18215026	11407883	20779489	14
47	4814988	8764468	5493759	18202473	11409706	20768476	13
48	4817537	8763067	5497546	18189932	11411530	20757496	12
49	4820086	8761665	5501335	18177405	11413356	20746519	11
50	4822634	8760262	5505125	18164892	11415183	20735556	10
51	4825182	8758859	5508916	18152391	11417012	20724606	9
52	4827730	8757455	5512708	18139904	11418842	20713670	8
53	4830277	8756050	5516502	18127430	11420674	20702746	7
54	4832824	8754645	5520257	18114969	11422507	20691836	6
55	4835370	8753239	5524093	18102521	11424342	20680940	5
56	4837916	8751832	5527890	18090086	11426179	20670056	4
57	4840462	8750424	5531688	18077664	11428017	20659186	3
58	4843007	8749016	5535488	18065256	11429857	20648328	2
59	4845552	8747607	5539288	18052860	11431698	20637484	1
60	4848096	8746197	5543090	18040478	11433541	20626653	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co Secant.	N. Secant.	M

61 DEGREES.

28 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant	
0	9.6716093	9.9459349	9.7256744	10.2743256	10.0540651	10.3283907	60
1	9.6718468	9.9458677	9.7259791	10.2740209	10.0541323	10.3281532	59
2	9.6720841	9.9458005	9.7262837	10.2737163	10.0541995	10.3279159	58
3	9.6723213	9.9457332	9.7265881	10.2734119	10.0542668	10.3276787	57
4	9.6725583	9.9456659	9.7268925	10.2731075	10.0543341	10.3274417	56
5	9.6727952	9.9455985	9.7271967	10.2728033	10.0544015	10.3272048	55
6	9.6730319	9.9455310	9.7275008	10.2724992	10.0544690	10.3269681	54
7	9.6732684	9.9454036	9.7278048	10.2721952	10.0545364	10.3267316	53
8	9.6735047	9.9453960	9.7281087	10.2718913	10.0546040	10.3264953	52
9	9.6737409	9.9453285	9.7284124	10.2715876	10.0546715	10.3262591	51
10	9.6739769	9.9452609	9.7287161	10.2712839	10.0547391	10.3260231	50
11	9.6742128	9.9451932	9.7290196	10.2709804	10.0548068	10.3257872	49
12	9.6744485	9.9451255	9.7293230	10.2706770	10.0348745	10.3255515	48
13	9.6746840	9.9450577	9.7296263	10.2703737	10.0549423	10.3253160	47
14	9.6749194	9.9449899	9.7299295	10.2700705	10.0550101	10.3250806	46
15	9.6751346	9.9449220	9.7302325	10.2697675	10.0550780	10.3248454	45
16	9.6753896	9.9448541	9.7305354	10.2694646	10.0551459	10.3246104	44
17	9.6756245	9.9447862	9.7308383	10.2691617	10.0552138	10.3243756	43
18	9.6758592	9.9447182	9.7311410	10.2688590	10.0552818	10.3241408	42
19	9.6760937	9.9446501	9.7314436	10.2685564	10.0553499	10.3239063	41
20	9.6763281	9.9445821	9.7317460	10.2682540	10.0554179	10.3236719	40
21	9.6765623	9.9445139	9.7320484	10.2679516	10.0554861	10.3234377	39
22	9.6767963	9.9444457	9.7323506	10.2670494	10.0555543	10.3232037	38
23	9.6770302	9.9443775	9.7326527	10.2673473	10.0556225	10.3229698	37
24	9.6772640	9.9443092	9.7329547	10.2570453	10.0556908	10.3227360	36
25	9.6774975	9.9442409	9.7332566	10.2667434	10.0557591	10.3225025	35
26	9.6777309	9.9441725	9.7335584	10.2664416	10.0558275	10.3222691	34
27	9.6779642	9.9441041	9.7338601	10.2661399	10.0558959	10.3220358	33
28	9.6781972	9.9440356	9.7341616	10.2658384	10.0559644	10.3218028	32
29	9.6784301	9.9439671	9.7344631	10.2655369	10.0560329	10.3215699	31
30	9.6786629	9.9438985	9.7347644	10.2652356	10.0561015	10.3213371	30
31	9.6788955	9.9438299	9.7350656	10.2649344	10.0561701	10.3211045	29
32	9.6791279	9.9437612	9.7353667	10.2646333	10.0562388	10.3208721	28
33	9.6793602	9.9436925	9.7356677	10.2643323	10.0563075	10.3206298	27
34	9.6795923	9.9436238	9.7359685	10.2640315	10.0563762	10.3204077	26
35	9.6798243	9.9435549	9.7362693	10.2537307	10.0564451	10.3201757	25
36	9.6800560	9.9434861	9.7365699	10.2634301	10.0565139	10.3199440	24
37	9.6802877	9.9434172	9.7368705	10.2631295	10.0565828	10.3197123	23
38	9.6805191	9.9433482	9.7371709	10.2628291	10.0566518	10.3194809	22
39	9.6807504	9.9431792	9.7374712	10.2625288	10.0567208	10.3192496	21
40	9.6809816	9.9432102	9.7377714	10.2622286	10.0567898	10.3190184	20
41	9.6812126	9.9431411	9.7380715	10.2619285	10.0568589	10.3187874	19
42	9.6814434	9.9430720	9.7383714	10.2616286	10.0569280	10.3185566	18
43	9.6816741	9.9430028	9.7386713	10.2613287	10.0569972	10.3183259	17
44	9.6819046	9.9429335	9.7389710	10.2610290	10.0570665	10.3180954	16
45	9.6821349	9.9428643	9.7392707	10.2607293	10.0571357	10.3178651	15
46	9.6823651	9.9427949	9.7395702	10.2604298	10.0572051	10.3176349	14
47	9.6825952	9.9427255	9.7398696	10.2601304	10.0572745	10.3174048	13
48	9.6828250	9.9426561	9.7401689	10.2598311	10.0573439	10.3171750	12
49	9.6830548	9.9425866	9.7404681	10.2595319	10.0574134	10.3169452	11
50	9.6832843	9.9425171	9.7407672	10.2592328	10.0574829	10.3167157	10
51	9.6835137	9.9424476	9.7410662	10.2589338	10.0575524	10.3164863	9
52	9.6837430	9.9423779	9.7413650	10.2586350	10.0576221	10.3162570	8
53	9.6839720	9.9423083	9.7416638	10.2583362	10.0576917	10.3160280	7
54	9.6842010	9.9422386	9.7419624	10.2580376	10.0577614	10.3157990	6
55	9.6844297	9.9421688	9.7422609	10.2577391	10.0578312	10.3155703	5
56	9.6846583	9.9420990	9.7425594	10.2574406	10.0579010	10.3153417	4
57	9.6848868	9.9420291	9.7428577	10.2561423	10.0579709	10.3151132	3
58	9.6851151	9.9419592	9.7431559	10.2568441	10.0580408	10.3148849	2
59	9.6853432	9.9418893	9.7434540	10.2565460	10.0581107	10.3146568	1
60	9.6855712	9.9418193	9.7437520	10.2562480	10.0581807	10.3144288	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

61 DEGREES.

29 DEGREES.

M	N. Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	4848096	8746197	5543090	18040478	11433541	20626653	60
1	4850640	8744786	5546894	18028108	11435385	20615836	59
2	4853184	8743375	5550698	18015751	11437231	20605031	58
3	4855727	8741963	5554504	18003408	11439078	20594239	57
4	4858270	8740550	5558311	17991077	11440927	20583460	56
5	4860812	8739136	5562119	17978759	11442778	20572695	55
6	4863354	8737722	5565929	17966454	11444630	20561942	54
7	4865895	8736307	5569739	17954162	11446484	20551203	53
8	4868436	8734891	5573551	17941883	11448339	20540476	52
9	4870977	8733475	5577364	17929616	11450196	20529762	51
10	4873517	8732058	5581179	17917362	11452055	20519061	50
11	4876057	8730640	5584994	17905121	11453915	20508373	49
12	4878597	8729221	5588811	17892893	11555776	20497698	48
13	4881136	8727801	5592629	17880678	11457639	20487036	47
14	4883674	8726381	5596448	17868475	11459504	20476386	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
19	4896361	8719269	5615564	17807651	11468852	20423330	41
20	4898897	8717844	5619391	17795524	11470726	20412757	40
21	4901433	8716419	5623219	17783409	11472602	20402197	39
22	4903968	8714993	5627048	17771307	11474479	20391649	38
23	4906503	8713566	5630879	17759218	11476358	20381114	37
24	4909037	8712138	5634710	17747141	11478239	20370592	36
25	4911571	8710710	5638543	17735076	11480121	20360082	35
26	4914105	8709281	5642378	17723024	11482005	20349585	34
27	4916638	8707851	5646213	17710985	11483890	20339100	33
28	4919171	8706420	5650050	17698958	11485777	20328627	32
29	4921704	8704989	5653888	17686943	11487665	20318168	31
30	4924236	8703557	5657728	17674910	11489555	20307720	30
31	4926767	8702124	5661568	17662950	11491447	20297286	29
32	4929298	8700690	5665410	17650972	11493340	20286863	28
33	4931829	8699256	5669253	17639007	11495235	20226453	27
34	4934359	8697821	5673098	17627053	11497132	20266056	26
35	4936889	8696385	5676944	17615112	11499030	20245670	25
36	4939419	8694949	5680791	17603183	11500930	20245292	24
37	4941948	8693512	5684639	17591267	11502831	20234937	23
38	4944477	8692074	5688488	17579362	11504734	20224589	22
39	4947005	8690635	5692339	17567470	11502638	20214258	21
40	4949533	8689196	5696191	17555590	11508544	20203929	20
41	4952060	8687756	5700045	17543722	11510452	20193617	19
42	4954587	8686315	5703899	17531866	11512361	20183318	18
43	4957113	8684873	5707755	17520023	11514272	20173031	17
44	4959639	8683431	5711612	17508191	11516185	20162756	16
45	4962165	8681988	5715471	17496371	11518099	20152494	15
46	4964690	8680544	5719331	17484564	11520015	20142243	14
47	4967215	8679100	5723192	17472768	11521932	20132005	13
48	4969740	8677655	5727054	17460984	11523851	20121779	12
49	4972264	8676209	5730918	17449213	11525772	20111564	11
50	4974787	8674762	5734783	17437453	11527694	20101362	10
51	4977310	8673314	5738649	17425705	11529618	20091172	9
52	4979833	8671866	5742516	17413969	11531543	20080994	8
53	4982355	8670417	5746385	17402245	11533470	20070828	7
54	4984877	8668967	5750255	17390533	11535399	20060674	6
55	4987399	8667517	5754126	17378833	11537329	20050532	5
56	4989920	8666066	5757999	17367144	11539261	20040402	4
57	4992441	8664614	5761873	17355468	11541195	20030283	3
58	4994961	8663161	5765748	17343803	11543130	20020177	2
59	4997481	8661708	5769625	17332149	11545067	20010083	1
60	5000000	8660254	5773503	17320508	11547005	20000000	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. CoSecant.	N. Secant.	M

60 DEGREES.

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29 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L Co-Secant	
0	9.6855712	9.9418193	9.7437520	10.2562480	10.0581807	10.3144288	60
1	9.6857991	9.9417492	9.7440499	10.2559501	10.0582508	10.3142009	59
2	9.6860267	9.9416791	9.7443476	10.2556524	10.0583209	10.3139733	58
3	9.6862542	9.9416090	9.7446453	10.2553547	10.0583910	10.3137458	57
4	9.68648 6	9.9415388	9.7449428	10.2550572	10.0584612	10.3135184	56
5	9.6867088	9.9414685	9.7452403	10.2547597	10.0585315	10.3132912	55
6	9.6869359	9.9413982	9.7455376	10.2544624	10.0586018	10.3130641	54
7	9.6871625	9.9413279	9.7458349	10.2541651	10.0586721	10.3128372	53
8	9.6873895	9.9412575	9.7461320	10.2538680	10.0587425	10.3126105	52
9	9.6876161	9.9411871	9.7464290	10.2535710	10.0588129	10.3123839	51
10	9.6878425	9.9411166	9.7467259	10.2532741	10.0588834	10.3121575	50
11	9.6880688	9.9410461	9.7470227	10.2529773	10.0589539	10.3119312	49
12	9.6882949	9.9409755	9.7473194	10.2526806	10.0590245	10.3117051	48
13	9.6885209	9.9409048	9.7476160	10.2523840	10.0590952	10.3114791	47
14	9.6887467	9.9408342	9.7479125	10.2520875	10.0591658	10.3112533	46
15	9.6889723	9.9407634	9.7482089	10.2517911	10.0592366	10.3110277	45
16	9.6891978	9.9406927	9.7485052	10.2514948	10.0593073	10.3108022	44
17	9.6894232	9.9406219	9.7488013	10.2511987	10.0593781	10.3105768	43
18	9.6896484	9.9405510	9.7490974	10.2509026	10.0594490	10.3103516	42
19	9.6898734	9.9404801	9.7493934	10.2506066	10.0595199	10.3101266	41
20	9.6900983	9.9404091	9.7496892	10.2503108	10.0595909	10.3099017	40
21	9.6903231	9.9403381	9.7499850	10.2500150	10.0596619	10.3096769	39
22	9.6905476	9.9402670	9.7502806	10.2497194	10.0597330	10.3094524	38
23	9.6907721	9.9401959	9.7505762	10.2494238	10.0598041	10.3092279	37
24	9.6909964	9.9401248	9.7508716	10.2491284	10.0598752	10.3090036	36
25	9.6912205	9.9400535	9.7511669	10.2488331	10.0599465	10.3087795	35
26	9.6914445	9.9399823	9.7514622	10.2485378	10.0600177	10.3085555	34
27	9.6916683	9.9399110	9.7517573	10.2482427	10.0600890	10.3083317	33
28	9.6918919	9.9398396	9.7520523	10.2479477	10.0601604	10.3081081	32
29	9.6921155	9.9397682	9.7523472	10.2476528	10.0602318	10.3078845	31
30	9.6923388	9.9396968	9.7526420	10.2473580	10.0603032	10.3076612	30
31	9.6925620	9.9396253	9.7529368	10.2470632	10.0603747	10.3074380	29
32	9.6927851	9.9395537	9.7532314	10.2467686	10.0604463	10.3072149	28
33	9.6930080	9.9394821	9.7535259	10.2464741	10.0605179	10.3069920	27
34	9.6932308	9.9394105	9.7538203	10.2461797	10.0605895	10.3067692	26
35	9.6934534	9.9393388	9.7541146	10.2458854	10.0606612	10.3065466	25
36	9.6936758	9.9392671	9.7544088	10.2455912	10.0607329	10.3063242	24
37	9.6938981	9.9391953	9.7547029	10.2452971	10.0608047	10.3061019	23
38	9.6941203	9.9391234	9.7549969	10.2450031	10.0608766	10.3058797	22
39	9.6943423	9.9390515	9.7552908	10.2447092	10.0609485	10.3056577	21
40	9.6945642	9.9389796	9.7555846	10.2444154	10.0610204	10.3054358	20
41	9.6947859	9.9389076	9.7558783	10.2441217	19.0610924	10.3052141	19
42	9.6950074	9.9388356	9.7561718	10.2438282	1,00611644	10.3049926	18
43	9.6952288	9.9387635	9.7564653	10.2435347	10.0612365	10.3047712	17
44	9.6954501	9.9386914	9.7567587	10.2432413	10.0613086	10.3045499	16
45	9.6956712	9.9386192	9.7570520	10.2429480	10.0613808	10.3043288	15
46	9.6958922	9.9385470	9.7573452	10.2426548	10.0614530	10.3041078	14
47	9.6961130	9.9384747	9.7576383	10.2423617	10.0615253	10.3038870	13
48	9.6963336	9.9384024	9.7579313	10.2420687	10.0615976	10.3036664	12
49	9.6965541	9.9383300	9.7582242	10.2417758	10.0616700	10.3034459	11
50	9.6967745	9.9382576	9.7585170	10.2414830	10.0617424	10.3032255	10
51	9.6969947	9.9381851	9.7582096	10.2411904	10.0618149	10.3030053	9
52	9.6972148	9.9381126	9.7591022	10.2408978	10.0618874	10.3027852	8
53	9.6974347	9.9380400	9.7593947	10.2406053	10.0619600	10.3025653	7
54	9.6976545	9.9379674	9.7596871	10.2403129	10.0620325	10.3023455	6
55	9.6978741	9.9378947	6.7599794	10.2400206	10.0621053	10.3021259	5
56	9.6980936	9.9378220	9.7602716	10.2397284	10.0621780	10.3019064	4
57	9.6983129	9.9377492	9.7605637	10.2394363	10.0622508	10.3016871	3
58	9.6985321	9.9376764	9.7608557	10.2391443	10.0623236	10.3014679	2
59	9.6987511	9.9376035	9.7611470	10.2388524	10.0623965	10.3012489	1
60	9.6989700	9.9375306	9.7614391	10.2385606	10.0624694	10.3010307	0
	L Co-Tang	L. Sine	L.Co-Sine	L. Tangent.	L.Co-Secant	L. Secant.	

60 DEGREES.

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30 DEGREES							
M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-tang.	N. Secant	N. Co-Secant	
0	5000000	8660254	5773503	17320508	1154 005	20000000	60
1	5002519	8658799	5777382	17308878	11548945	19989929	59
2	5005038	8657343	5781262	17297260	11550887	19979870	58
3	5007556	8655887	5785144	17285654	11552830	19969823	57
4	5010074	8654430	5789027	17274060	11554775	19959788	56
5	5012591	8652972	5792911	17262477	11556722	19949764	55
6	5015108	8651514	5796797	17250905	11558670	19939753	54
7	5017624	8650055	5800684	17239345	11560620	19929752	53
8	5020140	8648595	5804573	17227797	11562572	19919764	52
9	5022655	8647134	5808462	17216261	11564525	19909787	51
10	5025170	8645673	5812353	17204736	11566480	19899822	50
11	5027685	8644211	5816245	17193222	11568436	19889869	49
12	5030199	8642748	5820139	17181720	11570394	19879926	48
13	5032713	8641284	5824034	17170230	11572354	19869997	47
14	5035227	8639820	5827930	17158751	11574315	19860080	46
15	5037740	8638355	5831828	17147283	11576278	19850172	45
16	5040253	8636889	5835727	17135827	11578243	19840276	44
17	5042765	8635423	5839627	17124382	11580209	19830393	43
18	5045277	8633956	5843528	17112949	11582177	19820520	42
19	5047788	8632488	5847431	17101527	11584147	19810659	41
20	5050299	8631019	5851335	17090116	11586118	19800810	40
21	5052809	8629549	5855241	17078717	11588091	19790972	39
22	5055319	8628079	5859148	17067329	11590065	19781146	38
23	5057828	8626608	5863056	17055953	11592041	19771331	37
24	5060337	8625136	5866965	17044587	11594019	19761527	36
25	5062846	8623664	5870876	17033233	11595999	19751735	35
26	5065355	8622191	5874788	17021890	11597980	19741954	34
27	5067863	8620717	5878702	17010559	11599963	19732185	33
28	5070370	8619243	5882617	16999238	11601947	19722426	32
29	5072877	8617768	5889533	16987929	11603933	19712680	31
30	5075384	8616292	5890450	16976632	11605921	19702944	30
31	5077890	8614815	5894369	16965344	11607911	19693220	29
32	5080396	8613337	5898289	16954069	11609902	19683507	28
33	5082901	8611859	5902211	16942804	11611895	19673805	27
34	5085406	8610380	5906134	16931550	11613889	19664114	26
35	5087910	8608900	5910058	16920308	11615885	19654434	25
36	5590414	8607420	5913983	16909077	11617883	19644767	24
37	5092918	8605939	5917910	16897856	11619882	19635110	23
38	5095421	8604457	5921839	16886647	11621883	19625464	22
39	5097924	8602974	5925768	16875449	11623886	19615829	21
40	5100426	8601491	5929699	16864261	11625891	19606206	20
41	5102928	8600007	5933632	16853085	11627897	19596593	19
42	5105429	8598522	5937566	16841919	11629905	19586992	18
43	5107930	8597037	5941501	16830765	11631914	19577401	17
44	5110431	8595551	5945437	16819621	11633925	19567822	16
45	5112931	8594064	5949375	16808489	11635938	19558244	15
46	5115431	8592576	5953314	16797367	11637953	19548697	14
47	5117930	8591088	5957254	16786256	11639969	195 39150	13
48	5120429	8589599	5961196	16775156	11641987	195 29615	12
49	5122927	8588109	5965140	16764067	11644007	195 20091	11
50	5125425	8586618	5969084	16752988	11646028	195 10577	10
51	5127922	8585127	5973030	16741921	11648051	19501075	9
52	5130419	8583635	5976978	16730864	11650076	19491583	8
53	5132916	8582142	5980927	16719818	11652102	19482102	7
54	5135412	8580649	5984877	16708782	11654130	19472632	6
55	5137908	8579155	5988828	16697758	11656160	19463173	5
56	5140404	8577660	5992781	16686744	11658191	19453725	4
57	5142899	8576164	5996735	16675741	11660224	19444288	3
58	5145393	8574668	6000691	16664748	11662259	19434861	2
59	5147887	8573171	6004648	16653766	11664296	19425445	1
60	5150381	8571673	6008606	16642795	11666334	19416040	0
	N. Co-Sine	N. Sine.	N Co Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M
59 DEGREES							

30 DEGREES.

M	*L. Sine.*	*L. Co-Sine*	*L. Tangent*	*L. Co.Tang.*	*L. Secant.*	*L Co-Secant*	
0	9.6989700	9.9375306	9.7614394	10.2385606	10.0624694	10.3010300	60
1	9.6991887	9.9374577	9.7617311	10.2382689	10.0625423	10.3008113	59
2	9.6994073	9.9373847	9.7620227	10.2379773	10.0626153	10.3005927	58
3	9.6996258	9.9373116	9.7623142	10.2376858	10.0626884	10.3003742	57
4	9.6998441	9.9372385	9.7626056	10.2373944	10.0627615	10.3001559	56
5	9.7000622	9.9371653	9.7628969	10.2371031	10.0628347	10.2999378	55
6	9.7002802	9.9370921	9.7631881	10.2368119	10.0629079	10.2997198	54
7	9.7004981	9.9370189	9.7634792	10.2365208	10.0629811	10.2995019	53
8	9.7007158	9.9369456	9.7637702	10.2362298	10.0630544	10.2992842	52
9	9.7009334	9.9368722	9.7640612	10.2359388	10.0631278	10.2990666	51
10	9.7011508	9.9367988	9.7643520	10.2356480	10.0632012	10.2988492	50
11	9.7013681	9.9367254	9.7646427	10.2353573	10.0632746	10.2986319	49
12	9.7015852	9.9366519	9.7649334	10.2350666	10.0633481	10.2984148	48
13	9.7018022	9.9365783	9.7652239	10.2347761	10.0634217	10.2981978	47
14	9.7020190	9.9365047	9.7655143	10.2344857	10.0634953	10.2979810	46
15	9.7022387	9.9364311	9.7658047	10.2341953	10.0635689	10.2977663	45
16	9.7024523	9.9363574	9.7660949	10.2339051	10.0636426	10.2975477	44
17	9.7026687	9.9362836	9.7663851	10.2336149	10.0637164	10.2973413	43
18	9.7028849	9.9362098	9.7666751	10.2333249	10.0637902	10.2971151	42
19	9.7031011	9.9361360	9.7669651	10.2330349	10.0638640	10.2968989	41
20	9.7033170	9.9360621	9.7672550	10.2327450	10.0639379	10.2966830	40
21	9.7035329	9.9359881	9.7675448	10.2324552	10.0640119	10.2964671	39
22	9.7037486	9.9359141	9.7678344	10.2321656	10.0640859	10.2962514	38
23	9.7039641	9.9358401	9.7681240	10.2318760	10.0641599	10.2960359	37
24	9.7041795	9.9357660	9.7684135	10.2315865	10.0642340	10.2958205	36
25	9.7043947	9.9356918	9.7687029	10.2312971	10.0643082	10.2956052	35
26	9.7046099	9.9356177	9.7689922	10.2310078	10.0643823	10.2953901	34
27	9.7048248	9.9355434	9.7692814	10.2307186	10.0644566	10.2951752	33
28	9.7050397	9.9354691	9.7695705	10.2304295	10.0645309	10.2949603	32
29	9.7052543	9.9353948	9.7698596	10.2301404	10.0646052	10.2947457	31
30	9.7054689	9.9353204	9.7701485	10.2298515	10.0646796	10.2945311	30
31	9.7056833	9.9352459	9.7704373	10.2295627	10.0647541	10.2943167	29
32	9.7058975	9.9351715	9.7707261	10.2292739	10.0648285	10.2941025	28
33	9.7061116	9.9350969	9.7710147	10.2289853	10.0649031	10.2938884	27
34	9.7063256	9.9350223	9.7713033	10.2286967	10.0649777	10.2936744	26
35	9.7065394	9.9349477	9.7715917	10.2284083	10.0650523	10.2934606	25
36	9.7067531	9.9348730	9.7718801	10.2281199	10.0651270	10.2932469	24
37	9.7069667	9.9347983	9.7721684	10.2278316	10.0652017	10.2930333	23
38	9.7071801	9.9347235	9.7724566	10.2275434	10.0652765	10.2928199	22
39	9.7073933	9.9346486	9.7727447	10.2272553	10.0653514	10.2926067	21
40	9.7076064	9.9345738	9.7730327	10.2269673	10.0654262	10.2923936	20
41	9.7078194	9.9344988	9.7733206	10.2266794	10.0655012	10.2921806	19
42	9.7080323	9.9344238	9.7736084	10.2263916	10.0655762	10.2919677	18
43	9.7082450	9.9343488	9.7738961	10.2261039	10.0656512	10.2917550	17
44	9.7084575	9.9342737	9.7741838	10.2258162	10.0657263	10.2915425	16
45	9.7086699	9.9341986	9.7744713	10.2255287	10.0658014	10.2913301	15
46	9.7088822	9.9341234	9.7747588	10.2252812	10.0658766	10.2911178	14
47	9.7090943	9.9340482	9.7750462	10.2249738	10.0659518	10.2909057	13
48	9.7093063	9.9339729	9.7753334	10.2246665	10.0660271	10.2906937	12
49	9.7095182	9.9338976	9.7756206	10.2243794	10.0661024	10.2904818	11
50	9.7097299	9.9338222	9.7759077	10.2240923	10.0661778	10.2902701	10
51	9.7099415	9.9337467	9.7761947	10.2238053	10.0662533	10.2900585	9
52	9.7101529	9.9336713	9.7764816	10.2235184	10.0663287	10.2898471	8
53	9.7103642	9.9335957	9.7767685	10.2232315	10.0664043	10.2896358	7
54	9.7105753	9.9335201	9.7770552	10.2229448	10.0664799	10.2894247	6
55	9.7107863	9.9334445	9.7773418	10.2226582	10.0665555	10.2892137	5
56	9.7109972	9.9333688	9.7776284	10.2223716	10.0666312	10.2890028	4
57	9.7112080	9.9332931	9.7779149	10.2220851	10.0667069	10.2887920	3
58	9.7114186	9.9332173	9.7782022	10.2217988	10.0667827	10.2885814	2
59	9.7116290	9.9331415	9.7784875	10.2215125	10.0668585	10.2883710	1
60	9.7118393	9.9330656	9.7787737	10.2212265	10.0669344	10.2881607	0
	L Co Sine.	*L. Sine*	*L.Co-Tang.*	*L. Tangent.*	*L.Co-Secant*	*L. Secant.*	M

59 DEGREES.

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31 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant	N. Co-Secant	
0	5150381	8571673	6008606	16642795	11666334	19416040	60
1	5152874	8570174	6012566	16631834	11668374	19406646	59
2	5155367	8568675	6016527	16620884	11670416	19397262	58
3	5157859	8567175	6020490	16609945	11672459	19387889	57
4	5160351	8565674	6024454	16599016	11674504	19378527	56
5	5162842	8564173	6028419	16588097	11676551	19369176	55
6	5165333	8562671	6032386	16577189	11678599	19359835	54
7	5167824	8561168	6036354	16566292	11680649	19350505	53
8	5170314	8559664	6040323	16555405	11682701	19341185	52
9	5172804	8558160	6044294	16544529	11684755	19331876	51
10	5175293	8556655	6048266	16533663	11686810	19322578	50
11	5177782	8555149	6052240	16522808	11688867	19313290	49
12	5180270	8553642	6056215	16511963	11690926	19304013	48
13	5182758	8552135	6060192	16501128	11692986	19294746	47
14	5185246	8550627	6064170	16490304	11695048	19285490	46
15	5187733	8549118	6068149	16479490	11697112	19276244	45
16	5190219	8547609	6072130	16468686	11699178	19267009	44
17	5192705	8546099	6076112	16457893	11701245	19257784	43
18	5195191	8544588	6080095	16447111	11703314	19248570	42
19	5197676	8543076	6084080	16436338	11705385	19239366	41
20	5200161	8541564	6088067	16425576	11707457	19230173	40
21	5202646	8540051	6092054	16414824	11709531	19220990	39
22	5205130	8538537	6096043	16404082	11711607	19211817	38
23	5207613	8537023	6100034	16393351	11713685	19202655	37
24	5210096	8535508	6104026	16382630	11713314	19193503	36
25	5212579	8533992	6108019	16371919	11717845	19184362	35
26	5215061	8532475	6112014	16361218	11719928	19175230	34
27	5217543	8530958	6116011	16350528	11722013	19166109	33
28	5220024	8529440	6120008	16339847	11724099	19156999	32
29	5222505	8527921	6124007	16329177	11726187	19147899	31
30	5224986	8526402	6128008	16318517	11728277	19138809	30
31	5227466	8524881	6132010	16307867	11730369	19129729	29
32	5229945	8523360	6136013	16297227	11732462	19120659	28
33	5232424	8521838	6140018	16286597	11734557	19111600	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
38	5244813	8514219	6160064	16233599	11745058	19066456	22
39	5247290	8512693	6164077	16223029	11747164	19057457	21
40	5249766	8511166	6168092	16212469	11749271	19048469	20
41	5252241	8509639	6172108	16201920	11751380	19039491	19
42	5254716	8508111	6176126	16191380	11753491	19030522	18
43	5257191	8506582	6180145	16180850	11755603	19021564	17
44	5254665	8505052	6184166	16170330	11757717	19012616	16
45	5262135	8503522	6188188	16159820	11759833	19003678	15
46	5264612	8501991	6192211	16149320	11761951	18994710	14
47	5267085	8500459	6196236	16138829	11764070	18985832	13
48	5269558	8498927	6200263	16128349	11766191	18976924	12
49	5272030	8497394	6204291	16117878	11768314	18968026	11
50	5274502	8495860	6208320	16107417	11770439	18959138	10
51	5276973	8494325	6212351	16096966	11772566	18950259	9
52	5279444	8492790	6216383	16086525	11774694	18941391	8
53	5281914	8491254	6220417	16076094	11776824	18932532	7
54	5284384	8489717	6224452	16065672	11778956	18923684	6
55	5286853	8488179	6228488	16055260	11781090	18914845	5
56	5289322	8486641	6232526	16044858	11783225	18906016	4
57	5291790	8485102	6236566	16034465	11785362	18897197	3
58	5294258	8483562	6240607	16024082	11787501	18888388	2
59	5296726	8482022	6244650	16013709	11789642	18879589	1
60	5299193	8480481	6248694	16003345	11791784	18870799	0
	N. Co-Sine	N. Sine.	N Co Tang.	N. Tangent.	N.Co-Secant.	N. Secant	M

58 DEGREES.

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31 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co Tang.	L. Secant.	L. Co-Secant.	
0	9.7118393	9.9330656	9.7787737	10.2212263	10.0669344	10.2881607	60
1	9.7120495	9.9329897	9.7790599	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	9.7128889	9.9326854	9.7802034	10.2197966	10.0673146	10.2871111	55
6	9.7130983	9.9326092	9.7804891	10.2195109	10.0673908	10.2869017	54
7	9.7133077	9.9325330	9.7807747	10.2192253	10.0674670	10.2866923	53
8	9.7135169	9.9324567	9.7810602	10.2189398	10.0675433	10.2864531	52
9	9.7137260	9.9323804	9.7813456	10.2186544	10.0676196	10.2862640	51
10	9.7139349	9.9323040	9.7816309	10.2183691	10.0676960	10.2860651	50
11	9.7141437	9.9322276	9.7819162	10.2180838	10.0677724	10.2858563	49
12	9.7143524	9.9321511	9.7822013	10.2177987	10.0678489	10.2856476	48
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
19	9.7158092	9.9316143	9.7841949	10.2158051	10.0683857	10.2841908	41
20	9.7160168	9.9315374	9.7844794	10.2155206	10.0684626	10.2839832	40
21	9.7162243	9.9314605	9.7847638	10.2152362	10.0685395	10.2837757	39
22	9.7164316	9.9313835	9.7850481	10.2149519	10.0686165	10.2835684	38
23	9.7166387	9.9313065	9.7853323	10.2146677	10.0686935	10.2833613	37
24	9.7168458	9.9312294	9.7856164	10.2143836	10.0687706	10.2831542	36
25	9.7170526	9.9311522	9.7859004	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	9.7864682	10.2135318	10.0690022	10.2825340	33
28	9.7176725	9.9309205	9.7867520	10.2132480	10.0690795	10.2823275	32
29	9.7178789	9.9308432	9.7870357	10.2129643	10.0691568	10.2821211	31
30	9.7180851	9.9307658	9.7373193	10.2126807	10.0692342	10.2819149	30
31	9.7182912	9.9306883	9.7876028	10.2123972	10.0693117	10.2817088	29
32	9.7184971	9.9306109	9.7878863	10.2121137	10.0693891	10.2815029	28
33	9.7187030	9.9305333	9.7881696	10.2118304	10.0694667	10.2812970	27
34	9.7189086	9.9304557	9.7884529	10.2115471	10.0695443	10.2810914	26
35	9.7191142	9.9303781	9.7887361	10.2112639	10.0696219	10.2808858	25
36	9.7193196	9.9303004	9.7890192	10.2109808	10.0696996	10.2806804	24
37	9.7195249	9.9302226	9.7893023	10.2106977	10.0697774	10.2804751	23
38	9.7197300	9.9301448	9.7895852	10.2104148	10.0698552	10.2802700	22
39	9.7199350	9.9300670	9.7898681	10.2101319	10.0699330	10.2800650	21
40	9.7201399	9.9299891	9.7901508	10.2098492	10.0700109	10.2798601	20
41	9.7203447	9.9299112	9.7904335	10.2095665	10.0700888	10.2796553	19
42	9.7205493	9.9298332	9.7907161	10.2092839	10.0701668	10.2794507	18
43	9.7207538	9.9297551	9.7909987	10.2090013	10.0702449	10.2792462	17
44	9.7209581	9.9296770	9.7912811	10.2087189	10.0703230	10.2790419	16
45	9.7211623	9.9295989	9.7915635	10.2084365	10.0704011	10.2788377	15
46	9.7213664	9.9295207	9.7918458	10.2081542	10.0704793	10.2786336	14
47	9.7215704	9.9294424	9.7921280	10.2078720	10.0705576	10.2784296	13
48	9.7217742	9.9293641	9.7924101	10.2075899	10.0706359	10.2782258	12
49	9.7219779	9.9292857	9.7926921	10.2073079	10.0707143	10.2780221	11
50	9.7221814	9.9292073	9.7929741	10.2070259	10.0707927	10.2778186	10
51	9.7223848	9.9291289	9.7932560	10.2067440	10.0708711	10.2776152	9
52	9.7225881	9.9290504	9.7935378	10.2064622	10.0709496	10.2774119	8
53	9.7227913	9.9289718	9.7938195	10.2061805	10.0710283	10.2772087	7
54	9.7229943	9.9289932	9.7941011	10.2058989	10.0711068	10.2770057	6
55	9.7231972	9.9288145	9.7943827	10.2056173	10.0711855	10.2768028	5
56	9.7234000	9.9287358	9.7946641	10.2053359	10.0712643	10.2766030	4
57	9.7236026	9.9286571	9.7949455	10.2050545	10.0713429	10.2763974	3
58	9.7238051	9.9285783	9.7952268	10.2047732	10.0714217	10.2761949	2
59	9.7240075	9.9284994	9.7955081	10.2044919	10.0715006	10.2759925	1
60	9.7242097	9.9284205	9.7957892	10.2042108	10.0715795	10.2757903	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co Secant.	L. Secant.	M

58 DEGREES.

32 DEGREES.

M	N. Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	5299193	8480481	6248694	16003345	11791784	18870799	60
1	5301659	8478939	6252739	15992991	11793928	18862019	59
2	5304125	8477376	6256786	15982647	11796074	18853249	58
3	5306591	8475853	6260834	15972312	11798222	18844489	57
4	5309056	8474309	6264884	15961987	11800372	18835738	56
5	5311521	8472764	6268935	15951672	11802523	18826997	55
6	5313986	8471219	6272988	15941366	11804676	18818266	54
7	5316450	8469673	6277042	15931070	11806831	18809545	53
8	5318913	8468126	6281098	15920783	11808988	18800833	52
9	5321376	8466578	6285156	15910505	11811147	18792131	51
10	5323839	8465030	6289215	15900238	11813307	18783438	50
11	5326301	8463481	6293275	15889979	11815469	18784755	49
12	5328763	8461931	6297336	15879730	11817633	18766082	48
13	5331224	8460381	6301399	15869491	11819799	18757418	47
14	5333685	8458830	6305464	15859261	11821966	18748764	46
15	5336145	8457278	6309530	15849041	11824135	18740120	45
16	5338605	8455725	6313598	15838830	11826306	18731485	44
17	5341064	8454172	6317667	15828628	11828479	18722859	43
18	5343523	8452618	6321738	15818436	11830654	18714243	42
19	5345982	8451063	6325810	15808653	11832830	18705637	41
20	5348440	8449508	6329883	15798079	11835008	18697040	40
21	5350898	8447952	6333958	15787915	11837188	18688453	39
22	5353355	8446395	6338035	15777760	11839370	18679875	38
23	5355812	8444837	6342113	15767615	11841554	18671306	37
24	5358268	8443279	6346193	15757479	11843740	18662747	36
25	5360724	8441720	6350274	15747352	11845927	18654197	35
26	5363179	8440160	6354357	15737234	11848116	18645657	34
27	5365634	8438600	6358441	15727126	11850307	18637126	33
28	5368088	8437039	6362527	15717026	11852500	18628605	32
29	5370542	8435477	6366614	15706936	11854694	18620093	31
30	5372996	8433914	6370703	15696856	11856891	18611590	30
31	5375449	8432351	6374793	15686784	11859089	18003096	29
32	5377902	8430787	6378835	15676722	11861289	18594612	28
33	5380354	8429222	6382978	15666669	11863491	18536138	27
34	5382806	8427657	6387073	15656625	11865695	18577672	26
35	5385257	8426091	6391169	15646590	11867900	18569216	25
36	5387708	8424524	6395267	15636564	11870107	18560769	24
37	5390158	8422956	6399366	15626548	11872316	18552331	23
38	5392608	8421388	6403467	15616540	11874527	18543903	22
39	5395058	8419819	6407569	15606542	11876740	18535483	21
40	5397507	8418249	6411673	15596552	11878955	18527073	20
41	5399955	8416679	6415779	15586572	11881171	18518672	19
42	5402403	8415108	6419886	15576601	11883389	18510281	18
43	5404851	8413536	6423995	15566639	11885609	18501898	17
44	5407298	8411963	6428105	15556685	11887831	18493525	16
45	5409745	8410390	6432216	15546741	11890055	18485161	15
46	5412191	8408816	6436329	15536806	11892281	18476805	14
47	5414637	8407341	6440444	15526880	11894508	18468459	13
48	5417082	8405666	6444560	15516963	11896737	18460123	12
49	5419527	8404090	6448678	15507054	11898968	18451795	11
50	5421971	8402513	6452797	15497155	11901201	18443476	10
51	5424415	8400935	6456918	15487264	11903436	18435166	9
52	5426859	8399357	6461041	15477383	11905673	18426866	8
53	5429302	8397778	6465165	15467510	11907912	18418574	7
54	5431744	8396198	6469290	15457646	11910151	18410292	6
55	5434186	8394618	6473417	15447792	11912394	18402018	5
56	5436628	8393037	6477546	15437946	11914638	18393753	4
57	5439069	8391455	6481676	15428108	11916884	18385498	3
58	5441510	8389873	6485808	15418280	11919132	18377251	2
59	5443950	8388290	6489941	15408460	11921382	18369013	1
60	5446390	8386706	6494076	15398650	11923633	18360784	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. CoSecant.	N. Secant.	M

57 DEGREES.

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32 DEGREES.

M	*L. Sine.*	*L. Co.Sine.*	*L. Tangent*	*L. Co Tang.*	*L. Secant.*	*L Co-Secant.*	
0	9.7242097	9.9284205	9.7957892	10.2042108	10.0715795	10.2757903	60
1	9.7244118	9.9283415	9.7960703	10.2039297	10.0716585	10.2755882	59
2	9.7246138	9.9282625	9.7963513	10.2036487	10.0717375	10.2753862	58
3	9.7248156	9.9281834	9.7966322	10.2033678	10.0718166	10.2751844	57
4	9.7250174	9.9281043	9.7969130	10.2030870	10.0718957	10.2749826	56
5	9.7252189	9.9280251	9.7971938	10.2028062	10.0719749	10.2747811	55
6	9.7254204	9.9279459	9.7974745	10.2025255	10.0720541	10.2745796	54
7	9.7256217	9.9278666	9.7977551	10.2022449	10.0721334	10.2743783	53
8	9.7258229	9.9277873	9.7980356	10.2019644	10.0722167	10.2741771	52
9	9.7260240	9.9277079	9.7983160	10.2016840	10.0722921	10.2739760	51
10	9.7262249	9.9276285	9.7985964	10.2014036	10.0723715	10.2737751	50
11	9.7264257	9.9275490	9.7988767	10.2011233	10.0724510	10.2735743	49
12	9.7266264	9.9274695	9.7991569	10.2008431	10.0725305	10.2733736	48
13	9.7268269	9.9273899	9.7994370	10.2005630	10.0726101	10.2731731	47
14	9.7270273	9.9273103	9.7997170	10.2002830	10.0726897	10.2729727	46
15	9.7272276	9.9272306	9.7999970	10.2000030	10.0727694	10.2727724	45
16	9.7274278	9.9271509	9.8002769	10.1997231	10.0728491	10.2725722	44
17	9.7276278	9.9270711	9.8005567	10.1994433	10.0729289	10.2723722	43
18	9.7278277	9.9269913	9.8008365	10.1991635	10.0730087	10.2721723	42
19	9.7280275	9.9269114	9.8011161	10.1988839	10.0730886	10.2719725	41
20	9.7282271	9.9268314	9.8013957	10.1986043	10.0731686	10.2717729	40
21	9.7284267	9.9267514	9.8016752	10.1983248	10.0732486	10.2715733	39
22	9.7286260	9.9266714	9.8019546	10.1980454	10.0733286	10.2713740	38
23	9.7288253	9.9265913	9.8022340	10.1977660	10.0734087	10.2711747	37
24	9.7290244	9.9265112	9.8025133	10.1974867	10.0734888	10.2709756	36
25	9.7292234	9.9264310	9.8027925	10.1972075	10.0735690	10.2707766	35
26	9.7294223	9.9263507	9.8030716	10.1959284	10.0736493	10.2705777	34
27	9.7296211	9.9262704	9.8033506	10.1966494	10.0737296	10.2703790	33
28	9.7298197	9.9261901	9.8036296	10.1963704	10.0738099	10.2701803	32
29	9.7300182	9.9261096	9.8039085	10.1956915	10.0738904	10.2699818	31
30	9.7302165	9.9260292	9.8041873	10.1958127	10.0739708	10.2697835	30
31	9.7304148	9.9259487	9.8044661	10.1955339	10.0740513	10.2695852	29
32	9.7306129	9.9258681	9.8047447	10.1952553	10.0741319	10.2693871	28
33	9.7308109	9.9257875	9.8050233	10.1949767	10.0742125	10.2691891	27
34	9.7310087	9.9257069	9.8053019	10.1946981	10.0742931	10.2689913	26
35	9.7312064	9.9256261	9.8055803	10.1944197	10.0743739	10.2687936	25
36	9.7314040	9.9255454	9.8058587	10.1941413	10.0744546	10.2685960	24
37	9.7316015	9.9254646	9.8061370	10.1938630	10.0745354	10.2683985	23
38	9.7317989	9.9253837	9.8064152	10.1935848	10.0746163	10.2682011	22
39	9.7319961	9.9253028	9.8066933	10.1933067	10.0746972	10.2680039	21
40	9.7321932	9.9252218	9.8069714	10.1930286	10.0747782	10.2678068	20
41	9.7323902	9.9251408	9.8072494	10.1927506	10.0748592	10.2676098	19
42	9.7322870	9.9250597	9.8075273	10.1924727	10.0749403	10.2674130	18
43	9.7327837	9.9249786	9.8078052	10.1921948	10.0750214	10.2672163	17
44	9.7329803	9.9248974	9.8080829	10.1919171	10.0751026	10.2670197	16
45	9.7331768	9.9248161	9.8083606	10.1916394	10.0751839	10.2665232	15
46	9.7333731	9.9247349	9.8086383	10.1913617	10.0752651	10.2666269	14
47	9.7335693	9.9246535	9.8089158	10.1910842	10.0753465	10.2564307	13
48	9.7337654	9.9245721	9.8091933	10.1908067	10.0754279	10.2662346	12
49	9.7339614	9.9244907	9.8094707	10.1905293	10.0755093	10.2660386	11
50	9.7341572	9.9244092	9.8097480	10.1902520	10.0755908	10.2658428	10
51	9.7343529	9.9243277	9.8100253	10.1899747	10.0756723	10.2656471	9
52	9.7345485	9.9242461	9.8103025	10.1896975	10.0757539	10.2654515	8
53	9.7347440	9.9241644	9.8105796	10.1894204	10.0758356	10.2652560	7
54	9.7349393	9.9240827	9.8108566	10.1891434	10.0759173	10.2650607	6
55	9.7351345	9.9240010	9.8111336	10.1888664	10.0759990	10.2648655	5
56	9.7353296	9.9239191	9.8114105	10.1885895	10.0760809	10.2646704	4
57	9.7355246	9.9238373	9.8116873	10.1883127	10.0761627	10.2644754	3
58	9.7357195	9.9237554	9.8119641	10.1880359	10.0762446	10.2642805	2
59	9.7359142	9.9236734	9.8122408	10.1877592	10.0763266	10.2640858	1
60	9.7361088	9.9235914	9.8125174	10.1874826	10.0764086	10.2638912	0
	L. Co-Sine.	*L Sine.*	*L. Co-Tang.*	*L. Tangent.*	*L. Co-Secant*	*L. Secant.*	M

57 DEGREES.

33 DEGREES.

M	N. Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	5446390	8386706	6494076	15398650	11923633	18360784	60
1	5448830	8385121	6498212	15388848	11925886	18352564	59
2	5451269	8383536	6502350	15379055	11938141	18344353	58
3	5453707	8381950	6506490	15369270	11930398	18336151	57
4	5456145	8380363	6510631	15359494	11932657	18327958	56
5	5458583	8378775	6514774	15349727	11934918	18319774	55
6	5461020	8377187	6518918	15339969	11937181	18311599	54
7	5463456	8375598	6523064	15330220	11939446	18203432	53
8	5465892	8374008	6527211	15320479	11941712	18295274	52
9	5468328	8372418	6531360	15310747	11943980	18287125	51
10	5470763	8370827	6535511	15301023	11946250	18278985	50
11	5473198	8369235	6539663	15291308	11948522	18270854	49
12	5475632	8367634	6543817	15281602	11950796	18262731	48
13	5478066	8366050	6547972	15271904	11953072	18254617	47
14	5480499	8364456	6552129	15262215	11955350	18246512	46
15	5482932	8362861	6556287	15252535	11957630	18238416	45
16	5485365	8361266	6560447	15242863	11959911	18230328	44
17	5487797	8359670	6564609	15233200	11962194	18222249	43
18	5490228	8358073	6568772	15223545	11964479	18214179	42
19	5492659	8356476	6572937	15213899	11966766	18206118	41
20	5495090	8354878	6577103	15204261	11969055	18198065	40
21	5497520	8353279	6581271	15194632	11971346	18190021	39
22	5499950	8351680	6585441	15185012	11973639	18181985	38
23	5502379	8350080	6589612	15175400	11975934	18173958	37
24	5504808	8348479	6593785	15165796	11978231	18165940	36
25	5507236	8346877	6597959	15156201	11980529	18157930	35
26	5509664	8345275	6602135	15146614	11982829	18149929	34
27	5512091	8343672	6606313	15137036	11985131	18141937	33
28	5514518	8342068	6610492	15127466	11987435	18133953	32
29	5516944	8340463	6614673	15117905	11989741	18125977	31
30	5519370	8338858	6618856	15108352	11992049	18118010	30
31	5521795	8337252	6623040	15098807	11994359	18110052	29
32	5524220	8335645	6627226	15089271	11996671	18102102	28
33	5526645	8334038	6631413	15079743	11998985	18094161	27
34	5529069	8332430	6635602	15070224	12001301	18086228	26
35	5531492	8330821	6639792	15060713	12003619	18078304	25
36	5533915	8329212	6643984	15051210	12005938	18070388	24
37	5536338	8327602	6648178	15041716	12008259	18062481	23
38	5538760	8325991	6652373	15032230	12010582	18054582	22
39	5541182	8324380	6656570	15022752	12012907	18046691	21
40	5543603	8322768	6660769	15013282	12015234	18038809	20
41	5546024	8321155	6664969	15003820	12017563	18030935	19
42	5548444	8319541	6669171	14994367	12019894	18023070	18
43	5550864	8317927	6673375	14984922	12022227	18015213	17
44	5553283	8316312	6677580	14975486	12024562	18007365	16
45	5555702	8314696	6681787	14966058	12026899	17999525	15
46	5558121	8313079	6685995	14956638	12029237	17991693	14
47	5560539	8311462	6690205	14947226	12031577	17983869	13
48	5562956	8309844	6694417	14937822	12033919	17976054	12
49	5565373	8308226	6698630	14928426	12036264	17968247	11
50	5567790	8306607	6702845	14919038	12038610	17960448	10
51	5570206	8304987	6707062	14909659	12040958	17952658	9
52	5572621	8303366	6711280	14900288	12043308	17944876	8
53	5575036	8301745	6715500	14890925	12045660	17937102	7
54	5577451	8300123	6719721	14881570	12048014	17929337	6
55	5579865	8298500	6723944	14872223	12050370	17921580	5
56	5582279	8296876	6728169	14862884	12052728	17913831	4
57	5584692	8295252	6732396	14853553	12055088	17906090	3
58	5587105	8297627	6736624	14844230	12057450	17898358	2
59	5589517	8292002	6740854	14834916	12059814	17890633	1
60	5591929	8290376	6745085	14825610	12062180	17882916	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. CoSecant.	N. Secant.	M

56 DEGREES.

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33 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L. Co-Secant	
0	9.7361088	9.9235914	9.8125174	10.1874826	10.0764086	10.2638912	60
1	9.7363032	9.9235093	9.8127939	10.1872061	10.0764907	10.2636968	59
2	9.7364976	9.9234272	9.8130704	10.1869296	10.0765728	10.2635024	58
3	9.7366918	9.9233450	9.8133468	10.1866532	10.0766550	10.2633082	57
4	9.7368859	9.9232628	9.8136231	10.1863769	10.0767372	10.2631141	56
5	9.7370799	9.9231805	9.8138993	10.1861007	10.0768195	10.2629201	55
6	9.7372737	9.9230982	9.8141755	10.1858245	10.0769018	10.2627263	54
7	9.7374675	9.9230158	9.8144516	10.1855484	10.0769842	10.2625325	53
8	9.7376641	9.9229334	9.8147277	10.1852723	10.0770666	10.2623389	52
9	9.7378516	9.9228509	9.8150036	10.1849964	10.0771491	10.2621454	51
10	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
13	9.7386273	9.9225205	9.8161068	10.1838932	10.0774795	10.2613727	47
14	9.7388201	9.9224377	9.8163824	10.1836176	10.0775623	10.2611799	46
15	9.7390129	9.9223549	9.8166580	10.1833420	10.0776451	10.2609871	45
16	9.7392055	9.9222721	9.8169335	10.1830665	10.0777279	10.2607945	44
17	9.7393980	9.9221891	9.8172089	10.1827911	10.0778109	10.2606020	43
18	9.7395904	9.9221062	9.8174842	10.1825158	10.0778938	10.2604096	42
19	9.7397827	9.9220232	9.8177595	10.1822405	10.0779768	10.2602173	41
20	9.7399748	9.9219401	9.8180347	10.1819653	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	10.0782262	10.2596413	38
23	9.7405505	9.9216906	9.8188599	10.1811401	10.0783094	10.2594495	37
24	9.7407421	9.9216073	9.8191348	10.1808652	10.0783927	10.2592579	36
25	9.7409337	9.9215240	9.8194096	10.1805904	10.0784760	10.2590663	35
26	9.7411251	9.9214406	9.8196844	10.1803156	10.0785594	10.2588749	34
27	9.7413164	9.9213572	9.8199592	10.1800408	10.0786428	10.2586836	33
28	9.7415075	9.9212737	9.8202338	10.1797662	10.0787663	10.2584925	32
29	9.7416986	9.9211902	9.8205084	10.1794916	10.0788098	10.2583014	31
30	9.7418895	9.9211066	9.8207829	10.1792171	10.0788934	10.2581105	30
31	9.7420803	9.9210229	9.8210574	10.1789426	10.0789771	10.2579197	29
32	9.7422710	9.9209393	9.8213317	10.1786683	10.0790607	10.2577290	28
33	9.7424616	9.9208555	9.8216060	10.1783940	10.0791445	10.2575384	27
34	9.7426520	9.9207717	9.8218803	10.1781197	10.0792283	10.2573480	26
35	9.7428423	9.9206878	9.8221545	10.1778455	10.0793122	10.2571577	25
36	9.7430325	9.9206039	9.8224286	10.1775714	10.0793961	10.2569675	24
37	9.7432226	9.9205200	9.8227026	10.1772974	10.0794800	10.2567774	23
38	9.7434126	9.9204360	9.8229766	10.1770234	10.0795640	10.2565874	22
39	9.7436024	9.9203519	9.8232505	10.1767495	10.0796481	10.2563976	21
40	9.7437921	9.9202678	9.8235244	10.1764756	10.0797322	10.2562079	20
41	9.7439817	9.9201836	9.8237981	10.1762019	10.0798164	10.2560186	19
42	9.7441712	9.9200994	9.8240719	10.1759281	10.0799006	10.2558288	18
43	9.7443606	9.9200151	9.8243455	10.1756545	10.0799849	10.2556394	17
44	9.7445498	9.9199308	9.8246191	10.1753809	10.0800692	10.2554502	16
45	9.7447390	9.9198464	9.8248926	10.1751074	10.0801536	10.2552610	15
46	9.7449280	9.9197619	9.8251660	10.1748340	10.0802381	10.2550720	14
47	9.7451169	9.9196775	9.8254394	10.1745606	10.0803225	10.2548831	13
48	9.7453056	9.9195939	9.8257127	10.1742873	10.0804071	10.2546944	12
49	9.7454943	9.9195083	9.8259860	10.1740140	10.0804917	10.2545057	11
50	9.7456828	9.9194237	9.8262592	10.1737408	10.0805763	10.2543172	10
51	9.7458712	9.9193390	9.8265323	10.1734677	10.0806610	10.2541288	9
52	9.7460590	9.9192542	9.8268053	10.1731947	10.0807458	10.2539405	8
53	9.7462477	9.9191694	9.8270783	10.1729217	10.0808306	10.2537523	7
54	9.7464358	9.9190845	9.8273513	10.1726487	10.0809155	10.2535642	6
55	9.7466237	9.9189996	6.8276241	10.1723759	10.0810004	10.2533763	5
56	9.7468115	9.9189146	9.8278969	10.1721031	10.0810854	10.2531885	4
57	9.7469992	9.9188296	9.8281696	10.1718304	10.0811704	10.2530008	3
58	9.7471868	9.9187445	9.8284423	10.1715577	10.0812555	10.2528132	2
59	9.7473743	9.9186594	9.8287149	10.1712851	10.0813406	10.2526257	1
60	9.7475617	9.9185742	9.8289874	10.1710126	10.0814258	10.2524383	0
	L. Co-Sine.	L. Sine	L. Co Tang.	L. Tangent	L. Co-Secant	L. Secant.	M

56 DEGREES.

34 DEGREES

M	N. Sine	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant	N. Co-Secant	
0	5591929	8290376	6745085	14825610	12062180	1788 916	60
1	5594340	8288749	6749318	14816311	12064548	17875208	59
2	5596751	8287121	6753553	14807011	12066918	17867508	58
3	5599161	8285493	6757790	14797738	12069289	17859817	57
4	5601571	8283864	6762028	14788463	12071662	17852133	56
5	5603981	8282234	6766268	14779197	12074037	17844457	55
6	5606390	8280603	6770509	41769938	12076414	17836790	54
7	5608798	8278972	6774752	14760688	12078793	17829131	53
8	5611206	8277340	6778997	14751445	12081175	17821479	52
9	5613614	8275707	6783244	14742210	12083559	17813836	51
10	5616021	8274074	6787492	14732983	12085944	17806201	50
11	5618428	8272440	6791742	14723764	12088331	17798574	49
12	5620834	8270805	6795993	14714553	12090720	17790955	48
13	5623239	8269170	6800246	14705350	12093112	17783343	47
14	5625644	8267534	6804501	14696155	12095505	17775740	46
15	5628049	8265897	6808758	14686967	12097900	17768145	45
16	5630453	8264260	6813016	14677787	12100297	17760558	44
17	5632857	8262622	6817276	14668616	12102696	17752979	43
18	5635260	8260983	6821538	14659452	12105097	17745408	42
19	5637663	8259343	6825801	14650296	12107500	17737845	41
20	5640065	8257703	6830066	14641147	12109905	17730290	40
21	5642467	8256062	6834333	14632007	12112312	17722743	39
22	5644869	8254420	6838601	14622874	12114721	17715204	38
23	5647270	8252778	6842871	14613749	12117132	17707673	37
24	5649670	8251135	6847143	14604632	12119545	17700149	36
25	5652070	8249491	6851417	14595522	12121960	17692633	35
26	5654469	8247847	6855692	14586420	12124377	17685125	34
27	5656868	8246202	6859969	14577326	12126796	17677625	33
28	5659267	8244556	6864247	14568240	12129217	17670133	32
29	5661665	8242909	6868527	14559161	12131640	17662649	31
30	5664062	8241262	6872810	14550090	12134064	17655173	30
31	5666459	8239614	6877094	14541027	12136491	17647704	29
32	5668856	8237965	6881379	14531971	12138920	17640243	28
33	5671252	8236316	6885666	14522923	12141351	17632791	27
34	5673648	8234666	6889955	14513883	12143783	17625345	26
35	5676043	8233015	6894246	14504850	12146218	17617908	25
36	5678437	8231364	6898538	14495825	12148655	17610478	24
37	5680831	8229712	6902832	14486808	12151094	17603056	23
38	5683225	8228059	6907128	14477798	12153535	17595642	22
39	5685618	8226405	6911425	14468796	12155978	17588236	21
40	5688011	8224751	6915724	14459801	12158423	17580837	20
41	5690403	8223096	6920025	14450814	12160870	17573446	19
42	5692795	8221440	6924328	14441834	12163319	17566063	18
43	5695186	8219784	6928633	14432862	12165770	17558087	17
44	5697577	8218127	6932939	14423897	12168223	17551319	16
45	5699968	8216469	6937247	14414940	12170678	17543959	15
46	5702358	8214811	6941557	14405951	12173135	17536607	14
47	5704747	8213152	6945868	14397049	12175594	17529252	13
48	5707136	8211492	6950181	14388114	12178055	17521924	12
49	5709524	8209831	6954496	14379187	12180518	17514594	11
50	5711912	8208170	6958813	14370268	12182983	17507273	10
51	5714299	8206508	6963131	14361356	12185450	17499958	9
52	5716686	8204846	6967451	14352451	12187919	17492651	8
53	5719073	8203183	6971773	14343554	12190390	17485352	7
54	5721459	8201519	6976097	14334664	12192864	17478060	6
55	5723844	8199854	6980422	14325781	12195339	17470776	5
56	5726229	8198189	6984749	14316906	12197816	17463499	4
57	5728614	8196523	6989078	14308039	12200296	17456230	3
58	5730998	8194856	6993409	14299178	12202777	17448969	2
59	5733381	8193189	6997741	14290326	12205260	17441715	1
60	5735764	8191521	7002075	14281480	12207746	17434468	0
	N. Co-Sine	N. Sine.	N Co Tang.	N. Tangent.	N. Co-Secant.	N. Secant	M

55 DEGREES.

34 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L Co-Secant	
0	9.7475617	9.9185742	9.8289874	10.1710126	10.0814258	10.2524383	60
1	9.7477489	9.9184890	9.8292599	10.1707401	10.0815110	10.2522511	59
2	9.7479360	9.9184037	9.8295323	10.1704677	10.0815963	10.2520640	58
3	9.7481230	9.9183183	9.8298047	10.1701953	10.0816817	10.2518770	57
4	9.7483099	9.9182329	9.8300769	10.1699231	10.0817671	10.2516901	56
5	9.7484967	9.9181475	9.8303492	10.1696508	10.0818525	10.2515033	55
6	9.7486833	9.9180620	9.8306213	10.1693787	10.0813380	10.2513167	54
7	9.7488698	9.9179764	9.8308934	10.1691066	10.0820236	10.2511302	53
8	9.7490562	9.9178908	9.8311654	10.1688346	10.0821092	10.2509438	52
9	9.7492425	9.9178051	9.8314374	10.1685626	10.0821949	10.2507575	51
10	9.7494287	9.9177194	9.8317093	10.1682907	10.0822806	10.2505713	50
11	9.7496148	9.9176336	9.8319811	10.1680189	10.0823664	10.2503852	49
12	9.7498007	9.9175478	9.8322529	10.1677471	10.0824522	10.2501993	48
13	9.7499866	9.9174619	9.8325246	10.1674754	10.0825381	10.2500134	47
14	9.7501723	9.9173760	9.8327963	10.1672037	10.0826240	10.2498277	46
15	9.7503579	9.9172900	9.8330679	10.1669321	10.0827100	10.2496421	45
16	9.7505434	9.9172040	9.8333394	10.1666606	10.0827960	10.2494566	44
17	9.7507287	9.9171179	9.8336109	10.1663891	10.0828821	10.2492713	43
18	9.7509140	9.9170317	9.8338823	10.1661177	10.0829683	10.2490860	42
19	9.7510991	9.9169455	9.8341536	10.1658464	10.0830545	10.2489009	41
20	9.7512842	9.9168593	9.8344249	10.1655751	10.0831407	10.2487158	40
21	9.7514691	9.9167730	9.8346961	10.1653039	10.0832270	10.2485309	39
22	9.7516538	9.9166866	9.8349673	10.1650327	10.0833134	10.2483462	38
23	9.7518385	9.9166002	9.8352384	10.1647616	10.0833998	10.2481615	37
24	9.7520231	9.9165137	9.8355094	10.1644906	10.0834863	10.2479769	36
25	9.7522075	9.9164272	9.8357804	10.1642196	10.0835728	10.2477925	35
26	9.7523919	9.9163406	9.8360513	10.1639487	10.0836594	10.2476081	34
27	9.7525761	9.9162539	9.8363221	10.1636779	10.0837461	10.2474239	33
28	9.7527602	9.9161673	9.8365929	10.1634071	10.0838327	10.2472398	32
29	9.7529442	9.9160805	9.8368636	10.1631364	10.0839195	10.2470558	31
30	9.7531280	9.9159937	9.8371343	10.1628657	10.0840063	10.2468720	30
31	9.7533118	9.9159069	9.8374049	10.1625951	10.0840931	10.2466882	29
32	9.7534954	9.9158200	9.8376755	10.1623245	10.0841800	10.2465046	28
33	9.7536790	9.9157330	9.8379460	10.1620540	10.0842670	10.2463210	27
34	9.7538624	9.9156460	9.8382164	10.1617836	10.0843540	10.2461376	26
35	9.7540457	9.9155589	9.8384867	10.1615133	10.0844412	10.2459343	25
36	9.7542288	9.9154718	9.8387571	10.1612429	10.0845282	10.2457712	24
37	9.7544119	9.9153846	9.8390273	10.1609727	10.0846154	10.2455881	23
38	9.7545949	9.9152974	9.8392975	10.1607025	10.0847026	10.2454051	22
39	9.7547777	9.9152101	9.8395676	10.1604324	10.0847899	10.2452223	21
40	9.7549604	9.9151228	9.8398377	10.1601623	10.0848772	10.2450396	20
41	9.7551431	9.9150354	9.8401077	10.1598923	10.0849646	10.2448569	19
42	9.7553256	9.9149479	9.8403776	10.1596224	10.0850521	10.2446744	18
43	9.7555080	9.9148604	9.8406475	10.1593525	10.0851396	10.2444920	17
44	9.7556902	9.9147729	9.8409174	10.1590826	10.0852271	10.2443098	16
45	9.7558724	9.9146852	9.8411871	10.1588129	10.0853148	10.2441276	15
46	9.7560544	9.9145976	9.8414569	10.1585431	10.0854024	10.2439456	14
47	9.7562364	9.9145099	9.8417265	10.1582735	10.0854901	10.2437636	13
48	9.7564182	9.9144221	9.8419961	10.1580039	10.0855779	10.2435818	12
49	9.7565999	9.9143342	9.8422657	10.1577343	10.0856658	10.2434001	11
50	9.7567815	9.9142464	9.8425351	10.1574645	10.0857536	10.2432185	10
51	9.7569630	9.9141584	9.8428046	10.1571954	10.0858416	10.2430370	9
52	9.7571444	9.9140704	9.8430739	10.1569261	10.0859296	10.2428556	8
53	9.7573256	9.9139824	9.8433432	10.1566568	10.0860176	10.2426741	7
54	9.7575068	9.9138943	9.8436125	10.1563875	10.0861057	10.2424932	6
55	9.7576878	9.9138061	6.8438817	10.1561183	10.0861939	10.2423122	5
56	9.7578587	9.9137179	9.8441508	10.1558492	10.0862821	10.2421313	4
57	9.7580495	9.9136296	9.8444199	10.1555801	10.0863704	10.2419505	3
58	9.7582302	9.9135413	9.8446889	10.1553111	10.0864587	10.2417698	2
59	9.7584108	9.9134530	9.8449579	10.1550421	10.0865471	10.2415892	1
60	9.7585913	9.9133645	9.8452268	10.1547732	10.0866355	10.2414037	0
	L Co-Tang	L. Sine	L.Co-Sine.	L. Tangent.	L.Co-Secant	L. Secant.	M

55 DEGREES.

35 DEGREES

M	N. Sine	N.Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant.	NCo-Secant	
0	5735764	8191521	7002075	14281480	12207746	17434468	60
1	5738147	8189852	7006411	14272642	12210233	17427229	59
2	5740529	8188182	7010749	14263811	12212723	17419997	58
3	5742911	8186512	7015089	14254987	12215215	17412773	57
4	5245292	8184841	7019430	14246171	12217708	17405556	56
5	5747672	8183169	7023773	14237362	12220204	17398347	55
6	5750052	8181497	7028118	14228561	12222702	17391145	54
7	5752432	8179824	7032465	14219766	12225202	17383951	53
8	5754811	8178150	7036813	14210979	12227703	17376764	52
9	5757190	8176476	7041163	14202200	12230207	17369585	51
10	5759568	8174801	7045515	14193422	12232713	17362413	50
11	5761946	8173125	7049869	14184662	12235221	17355247	49
12	5764323	8171449	7054224	14175904	12237732	17348090	48
13	5766700	8169772	7058581	14167153	12240244	17340941	47
14	5769076	8168094	7062940	14158409	12242758	17333798	46
15	5771452	8166415	7067301	14149673	12245274	17326663	45
16	5773827	8164736	7071664	14140943	12247793	17319535	44
17	5776202	8163056	7076029	14132221	12250313	17312414	43
18	5778576	8161376	7080395	14123506	12252836	17305301	42
19	5780950	8159695	7084763	14114799	12255361	17298195	41
20	5783323	8158013	7089133	14106098	12257887	17291096	40
21	5785696	8156330	7093505	14097405	12260416	17284005	39
22	5788068	8154647	7097878	14088718	12262947	17276921	38
23	5790440	8152963	7102253	14080039	12265480	17269844	37
24	5792852	8151278	7106630	14071367	12268015	17262774	36
25	5795183	8149593	7111009	14062702	12270552	17255712	35
26	5797553	8147906	7115390	14054944	12273091	17248657	34
27	5799923	8146219	7119773	14045393	12275633	17241609	33
28	5802292	8144532	7124157	14036749	12278176	17234568	32
29	5804661	8142844	7128543	14028113	12280721	17227534	31
30	5807030	8141155	7132931	14019483	12283269	17220508	30
31	5809398	8139465	7137321	14010860	12285819	17213489	29
32	5811765	8137775	7141713	14002245	12288371	17206477	28
33	5814132	8136084	7146106	13993636	12290925	17199472	27
34	5816498	8134393	7150501	13985034	12293481	17192475	26
35	5819864	8132701	7154898	13976440	12296039	17185484	25
36	5821230	8131008	7159297	13967852	12298599	17178501	24
37	5823595	8129314	7163698	13959272	12301161	17171525	23
38	5825959	8127620	7168101	13950698	12303725	17164556	22
39	5828323	8125925	7172505	13942131	12306292	17157594	21
40	5830687	8124229	7176911	13933571	12308861	17150639	20
41	5833050	8122532	7181319	13925018	12311431	17143691	19
42	5835412	8120835	7185729	13916473	12314005	17136750	18
43	5837774	8119137	7190141	13907934	12316580	17129817	17
44	5840136	8117439	7194551	13899401	12319157	17122890	16
45	5842497	8115740	7198970	13890876	12321736	17115970	15
46	5844857	8114040	7203387	13882358	12324317	17109058	14
47	5847217	8112339	7207806	13873846	12326900	17102152	13
48	5849577	8110638	7212227	13865342	12329486	17095254	12
49	5851936	8108936	7216650	13856844	12332074	17088362	11
50	5854394	8107233	7221075	13848353	12334664	17081478	10
51	5856652	8105530	7225502	13839869	12337256	17074600	9
52	5859010	8103826	7229931	13831392	12339850	17067730	8
53	5861367	8102121	7234361	13822922	12342446	17060866	7
54	5863724	8100416	7238793	13814458	12345044	17054010	6
55	5866080	8098710	7243227	13806001	12347645	17047160	5
56	5868435	8097003	7247663	13797551	12350248	17040318	4
57	5870790	8095296	7252101	13789108	12352852	17033482	3
58	5873145	8093588	7256541	13780672	12355459	17026653	2
59	5875499	8091870	7260983	13772242	12358068	17019831	1
60	5877853	8090170	7265426	13763819	12360680	17013016	0
	N. Co-Sine	N. Sine.	N Co Tang.	N. Tangent.	N.Co-Secant.	N. Secant	M

54 DEGREES.

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35 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co-Tang.	L. Secant.	L. Co-Secant.	
0	9.7585913	9.9133645	9.8452268	10.1547732	10.0866353	10.2414087	60
1	9.7587717	9.9132760	9.8454956	10.1545044	10.0867240	10.2412283	59
2	9.7589519	9.9131875	9.8457644	10.1542356	10.0868125	10.2410481	58
3	9.7591321	9.9130989	9.8460332	10.1539668	10.0869011	10.2408679	57
4	9.7593121	9.9130102	9.8463018	10.1536982	10.0869898	10.2406879	56
5	9.7594920	9.9129215	9.8465705	10.1534295	10.0870785	10.2405080	55
6	9.7596718	9.9128328	9.8468390	10.1531610	10.0871672	10.2403282	54
7	9.7598515	9.9127440	9.8471075	10.1528925	10.0872560	10.2401485	53
8	9.7600311	9.9126551	9.8473760	10.1526240	10.0873449	10.2399689	52
9	9.7602106	9.9125662	9.8476444	10.1523556	10.0874338	10.2397894	51
10	9.7603899	9.9124772	9.8479127	10.1520873	10.0875228	10.2396101	50
11	9.7605692	9.9123882	9.8481810	10.1518190	10.0876118	10.2394308	49
12	9.7607483	9.9122991	9.8484492	10.1515508	10.0877009	10.2392517	48
13	9.7609274	9.9122099	9.8487174	10.1512826	10.0877901	10.2390726	47
14	9.7611063	9.9121207	9.8489855	10.1510145	10.0878793	10.2388937	46
15	9.7612851	9.9120315	9.8492536	10.1507464	10.0879685	10.2387149	45
16	9.7614638	9.9119422	9.8495216	10.1504784	10.0880578	10.2385362	44
17	9.7616424	9.9118528	9.8497896	10.1502104	10.0881472	10.2383576	43
18	9.7618208	9.9117634	9.8500575	10.1499424	10.0882366	10.2381792	42
19	9.7619992	9.9116739	9.8503253	10.1496747	10.0883261	10.2380008	41
20	9.7621775	9.9115844	9.8505931	10.1494069	10.0884156	10.2378225	40
21	9.7623556	9.9114948	9.8508608	10.1491392	10.0885052	10.2376444	39
22	9.7625337	9.9114051	9.8511285	10.1488715	10.0885949	10.2374663	38
23	9.7627116	9.9113155	9.8513961	10.1486039	10.0886845	10.2372884	37
24	9.7628894	9.9112257	9.8516637	10.1483363	10.0887743	10.2371106	36
25	9.7630671	9.9111359	9.8519312	10.1480688	10.0888641	10.2369329	35
26	9.7632447	9.9110460	9.8521987	10.1478013	10.0889540	10.2367553	34
27	9.7634222	9.9109561	9.8524661	10.1475339	10.0890439	10.2365778	33
28	9.7635996	9.9108661	9.8527335	10.1472665	10.0891339	10.2364004	32
29	9.7637769	9.9107761	9.8530008	10.1469992	10.0892239	10.2362231	31
30	9.7639540	9.9106860	9.8532680	10.1467320	10.0893140	10.2360460	30
31	9.7641311	9.9105959	9.8535352	10.1464648	10.0894041	10.2358689	29
32	9.7643080	9.9105057	9.8538023	10.1461977	10.0894943	10.2356920	28
33	9.7644849	9.9104155	9.8540694	10.1459306	10.0895846	10.2355151	27
34	9.7646616	9.9103255	9.8543365	10.1456635	10.0896749	10.2353384	26
35	9.7648382	9.9102348	9.8546014	10.1453965	10.0897652	10.2351618	25
36	9.7650147	9.9101444	9.8548704	10.1451296	10.0898556	10.2349853	24
37	9.7651911	9.9100539	9.8551372	10.1448638	10.0899461	10.2348089	23
38	9.7653674	9.9099634	9.8554041	10.1445959	10.0900366	10.2346326	22
39	9.7655436	9.9098728	9.8556708	10.1443292	10.0901272	10.2344964	21
40	9.7657197	9.9097821	9.8559376	10.1440624	10.0902179	10.2342803	20
41	9.7658957	9.9096915	9.8562042	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	10.0904901	10.2337527	17
44	9.7664229	9.9094190	9.8570039	10.1429951	10.0905810	10.2335771	16
45	9.7665985	9.9093281	9.8572704	10.1427296	10.0906719	10.2334015	15
46	9.7667739	9.9092371	9.8575368	10.1424632	10.0907629	10.2332261	14
47	9.7669492	9.9091461	9.8578031	10.1421969	10.0908539	10.2330508	13
48	9.7671244	9.9090550	9.8580694	10.1419306	10.0909450	10.2328756	12
49	9.7672996	9.9089639	9.8583357	10.1416643	10.0910361	10.2327004	11
50	9.7674746	9.9088727	9.8586019	10.1413981	10.0911273	10.2325254	10
51	9.7676494	9.9087814	9.8588680	10.1411320	10.0912186	10.2323506	9
52	9.7678242	9.9086901	9.8591341	10.1408659	10.0913099	10.2321758	8
53	9.7679989	9.9085988	9.8594002	10.1405998	10.0914012	10.2320011	7
54	9.7681735	9.9085073	9.8596661	10.1403339	10.0914927	10.2318265	6
55	9.7683480	9.9084159	9.8599321	10.1400679	10.0915841	10.2316520	5
56	9.7685223	9.9083243	9.8601980	10.1398020	10.0916757	10.2314777	4
57	9.7686966	9.9082327	9.8604638	10.1395362	10.0917673	10.2313034	3
58	9.7688707	9.9081411	9.8607296	10.1392704	10.0918589	10.2311293	2
59	9.7690448	9.9080494	9.8609954	10.1390046	10.0919506	10.2309553	1
60	9.7692187	9.9089575	9.8612610	10.1387390	10.0920424	10.2307813	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

54 DEGREES.

36 DEGREES

M	N. Sine	N.Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant	NCo-Secant	
0	5877853	8090170	7265426	13763819	12360680	17013016	60
1	5880206	8088460	7269871	13755403	12363294	17006205	59
2	5882558	8086749	7274318	13746994	12365909	16999407	58
3	5884910	8085037	7278767	13738591	12368526	16992612	57
4	5887262	8083325	7283218	13730195	12371148	16985825	56
5	5889613	8081612	7287671	13721805	12373768	16979044	55
6	5891964	8079899	7292126	13713422	12376393	16972271	54
7	5894314	8078185	7296582	13705047	12379019	16965504	53
8	5896663	8076470	7301040	13696678	12381647	16958743	52
9	5899012	8074754	7305501	13688315	12384278	16951990	51
10	5901361	8073038	7309963	13679959	12386911	16945244	50
11	5903709	8071321	7314427	13671610	12389546	16938504	49
12	5906057	8069603	7318894	13663267	12392183	16931771	48
13	5908404	8067885	7323362	13654931	12394822	16925045	47
14	5910750	8066166	7327831	13646602	12397464	16918326	46
15	5913096	8064446	7332303	13638279	12400108	16911613	45
16	5915442	8062726	7336777	13629963	12402754	16904907	44
17	5917787	8061005	7341253	13621653	12405402	16898208	43
18	5920132	8059283	7345730	13613350	12408052	16891516	42
19	5922476	8057560	7350210	13605054	12410704	16884830	41
20	5924819	8055837	7354691	13596764	12413359	16878151	40
21	5927162	8054113	7359174	13588481	12416016	16871479	39
22	5929505	8052389	7363660	13580204	12418675	16864814	38
23	5931847	8050664	7368147	13571934	12421336	16858155	37
24	6934189	8048938	7372636	13563670	12423999	16851503	36
25	5936530	8047211	7377127	13555413	12426665	16844857	35
26	5938871	8045484	7381620	13547162	12429333	16838218	34
27	5941211	8043756	7386115	13538918	12432003	16831586	33
28	5943550	8042028	7390611	13530680	12434675	16824961	32
29	5945889	8040299	7395110	13522449	12437349	16818342	31
30	5948228	8038569	7399611	13514224	12440026	16811730	30
31	5950566	8036838	7404114	13506006	12442705	16805124	29
32	5952903	8035107	7408618	13497794	12445386	16798525	28
33	5955240	8033375	7413124	13489589	12448069	16791933	27
34	5957577	8031642	7417633	13481390	12450754	16785347	26
35	5959913	8029909	7422143	13473197	12453442	16778768	25
36	5962249	8028175	7426655	13465011	12456131	16772195	24
37	5964584	8026440	7431170	13456832	12458823	16765629	23
38	5966918	8024705	7435686	13448658	12461518	16759070	22
39	5969252	8022969	7440204	13440492	12464214	16752517	21
40	5971586	8021232	7444724	13432331	12466913	16745970	20
41	5973919	8019494	7449246	13424177	12469614	16739430	19
42	5976251	8017756	7453770	13416029	12472317	16732897	18
43	5978583	8016017	7458296	13407888	12475022	16726370	17
44	5980915	8014278	7462824	13399753	12477730	16719850	16
45	5983246	8012538	7467354	13391624	12480440	16713336	15
46	5985576	8010797	7471886	13383502	12483152	16706828	14
47	5987906	8009056	7476420	13375386	12485866	16700328	13
48	5990236	8007314	7480956	13367276	12488583	16693833	12
49	5992565	8005571	7485494	13359172	12491302	16687345	11
50	5994893	8003827	7490033	13351075	12494023	16680864	10
51	5997221	8002083	7494575	13342984	12496746	16674389	9
52	5999549	8000338	7499119	13334900	12499471	16667920	8
53	6001876	7998593	7503665	13326822	12502199	16661458	7
54	6004202	7996847	7508212	13318749	12504929	16655002	6
55	6006528	7995100	7512762	13310684	12507661	16648552	5
56	6008853	7993352	7517314	13302624	12510396	16642109	4
57	6011178	7991604	7521867	13294571	12513133	16635673	3
58	6013503	7989855	7526423	13286524	12515872	16629243	2
59	6015827	7988105	7530981	13278483	12518613	16622819	1
60	6018150	7986355	7535540	13270448	12521357	16616401	0
	N Co-Sine.	N. Sine.	N. Co Tang	N. Tangent.	N. Co-Secant.	N. Secant	M

53 DEGREES.

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36 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L Co-Secant	
0	9.7692187	9.9079576	9.8612610	10.1387390	10.0920424	10.2307813	60
1	9.7693925	9.9078656	9.8615267	10.1384733	10.0921342	10.2306075	59
2	9.7695662	9.9077740	9.8617923	10.1382077	10.0922260	10.2304338	58
3	9.7697398	9.9076820	9.8620578	10.1379422	10.0923180	10.2302602	57
4	9.7699134	9.9075901	9.8623233	10.1376767	10.0924099	10.2300866	56
5	9.7700868	9.9074980	9.8625887	10.1374113	10.0925020	10.2299130	55
6	9.7702601	9.9074059	9.8628541	10.1371459	10.0925941	10.2297399	54
7	9.7704332	9.9073138	9.8631195	10.1368805	10.0926862	10.2295668	53
8	9.7706063	9.9072216	9.8633848	10.1366152	10.0927784	10.2293937	52
9	9.7707793	9.9071293	9.8636500	10.1363500	10.0928707	10.2292207	51
10	9.7709522	9.9070370	9.8639152	10.1360848	10.0929630	10.2290478	50
11	9.7711249	9.9069446	9.8641803	10.1358197	10.0930554	10.2288751	49
12	9.7712976	9.9068522	9.8644454	10.1355546	10.0931478	10.2287024	48
13	9.7714702	9.9067597	9.8647105	10.1352895	10.0932403	10.2285298	47
14	9.7716426	9.9066671	9.8649755	10.1350245	10.0933329	10.2283574	46
15	9.7718150	9.9065745	9.8652404	10.1347596	10.0934255	10.2281850	45
16	9.7719872	9.9064819	9.8655053	10.1344947	10.0935181	10.2280128	44
17	9.7721593	9.9063892	9.8657702	10.1342298	10.0936108	10.2278407	43
18	9.7723314	9.9062964	9.8660350	10.1339650	10.0937036	10.2276686	42
19	9.7725033	9.9062036	9.8662997	10.1337003	10.0937964	10.2274967	41
20	9.7726751	9.9061107	9.8665644	10.1334356	10.0938893	10.2273249	40
21	9.7728468	9.9060177	9.8668291	10.1331709	10.0939823	10.2271532	39
22	9.7730185	9.9059247	9.8670937	10.1329063	10.0940753	10.2269815	38
23	9.7731990	9.9058317	9.8673583	10.1326417	10.0941683	10.2268100	37
24	9.7733614	9.9057386	9.8676228	10.1323772	10.0942614	10.2266386	36
25	9.7735327	9.9056454	9.8678873	10.1321127	10.0943546	10.2264673	35
26	9.7737039	9.9055522	9.8681517	10.1318483	10.0944478	10.2262961	34
27	9.7738749	9.9054589	9.8684160	10.1315840	10.0945411	10.2261251	33
28	9.7740459	9.9053656	9.8686804	10.1313196	10.0946344	10.2259541	32
29	9.7742168	9.9052722	9.8689446	10.1310554	10.0947278	10.2257832	31
30	9.7743876	9.9051787	9.8692089	10.1307911	10.0948213	10.2256124	30
31	9.7745583	9.9050852	9.8694731	10.1305269	10.0949148	10.2254417	29
32	9.7747288	9.9049916	9.8697372	10.1302628	10.0950084	10.2252712	28
33	9.7748993	9.9048980	9.8700013	10.1299987	10.0951020	10.2251007	27
34	9.7750697	9.9048043	9.8702653	10.1297347	10.0951957	10.2249303	26
35	9.7752399	9.9047106	9.8705293	10.1294707	10.0952894	10.2247601	25
36	9.7754101	9.9046168	9.8707933	10.1292067	10.0953832	10.2245899	24
37	9.7755801	9.9045230	9.8710572	10.1289428	10.0954770	10.2244199	23
38	9.7757501	9.9044291	9.8713210	10.1286790	10.0955709	10.2242499	22
39	9.7759199	9.9043351	9.8715848	10.1284152	10.0956649	10.2240801	21
40	9.7760897	9.9042411	9.8718486	10.1281514	10.0957589	10.2239103	20
41	9.7762593	9.9041470	9.8721123	10.1278877	10.0958530	10.2237407	19
42	9.7764289	9.9040529	9.8723760	10.1276240	10.0959471	10.2235711	18
43	9.7765983	9.9039587	9.8726396	10.1273604	10.0960413	10.2234017	17
44	9.7767676	9.9038644	9.8729032	10.1270968	10.0961356	10.2232324	16
45	9.7769369	9.9037701	9.8731668	10.1268332	10.0962299	10.2230631	15
46	9.7771060	9.9036757	9.8734332	10.1265698	10.0963243	10.2228940	14
47	9.7772750	9.9035813	9.8736937	10.1263063	10.0964187	10.2227250	13
48	9.7774439	9.9034868	9.8739571	10.1260429	10.0965132	10.2225561	12
49	9.7776128	9.9033923	9.8742204	10.1257796	10.0966077	10.2223872	11
50	9.7777815	9.9032977	9.8744838	10.1255162	10.0967023	10.2222185	10
51	9.7779501	9.9032031	9.8747470	10.1252530	10.0967969	10.2220499	9
52	9.7781186	9.9031084	9.8750102	10.1249898	10.0968916	10.2218814	8
53	9.7782870	9.9030136	9.8752734	10.1247266	10.0969864	10.2217130	7
54	9.7784553	9.9029188	9.8755365	10.1244635	10.0970812	10.2215447	6
55	9.7786235	9.9028239	9.8757996	10.1242004	10.0971761	10.2213756	5
56	9.7787916	9.9027289	9.8760627	10.1239373	10.0972711	10.2212084	4
57	9.7789596	9.9026339	9.8763257	10.1236743	10.0973661	10.2210404	3
58	9.7791275	9.9025389	9.8765886	10.1234114	10.0974611	10.2208725	2
59	9.7792953	9.9024438	9.8768515	10.1231485	10.0975562	10.2207047	1
60	9.7794630	9.9023486	9.8771144	10.1228856	10.0976514	10.2205370	0
	L. Co-Sine	L. Sine	L. Co-Tang.	L. Tangent.	L.Co-Secant	L. Secant.	M

53 DEGREES.

37 DEGREES.

M	N. Sine.	N. Co-Sine	N. Tangent	N. Co-Tang.	N. Secant.	N Co-Secant	
0	6018150	7986355	7535540	13270448	12521357	16016401	60
1	6020473	7984604	7540102	13262420	12524102	16609990	59
2	6022795	7982852	7544666	13254397	12526850	16603585	58
3	6025117	7981100	7549232	13246381	12539601	16597187	57
4	6027439	7979347	7553799	13238371	12532353	16590795	56
5	6029760	7977593	7558569	13230368	12535108	16584409	55
6	6032080	7975839	7562941	13222270	12537865	16578030	54
7	6034400	7974084	7567514	13214379	12540625	16571657	53
8	6036719	7972328	7572090	13206393	12543387	16565290	52
9	6039038	7970572	7576668	13198414	12546151	16558929	51
10	6041356	7968815	7581248	13190441	12548917	16552575	50
11	6043674	7967057	7585824	13182471	12551685	16546227	49
12	6045991	7965299	7590413	13174513	12554456	16539885	48
13	6048308	7963540	7594999	13166559	12557229	16533550	47
14	6050624	7961780	7599587	13158610	12560005	16527221	46
15	6052940	7960020	7604177	13150668	12562782	16520898	45
16	6055255	7958259	7608769	13142731	12565562	16514581	44
17	6057570	7956497	7613363	13134801	12568345	16508270	43
18	6059884	7954735	7617959	13126876	12571129	16501966	42
19	6062198	7952972	7622557	13118958	12573916	15495668	41
20	6064511	7951208	7627157	13111046	12576705	16489376	40
21	6066823	7949443	7631759	13103140	12579497	16483090	39
22	6069135	7947678	7636363	13095239	12582291	16476811	38
23	6071447	7945912	7640969	13087345	12585087	16470537	37
24	6073758	7944146	7645577	13079457	12587885	16464270	36
25	6076069	7942379	7650188	13071575	12590686	16458009	35
26	6078379	7940611	7654800	13063699	12593489	16451754	34
27	6080689	7938843	7659414	13055828	12596294	16445506	33
28	6082998	7937074	7664031	13047964	12599102	16439263	32
29	6085306	7935304	7668649	13040106	12601912	16433027	31
30	6087614	7933533	7673270	13032254	12604724	16426796	30
31	6089922	7931762	7677893	13024407	12607539	16420572	29
32	6092229	7929990	7682517	13016567	12610356	16414354	28
33	6094535	7928218	7687144	13008732	12613175	16408142	27
34	6096841	7926445	7691773	13000904	12615997	16401936	26
35	6099147	7924671	7696404	12993081	12618820	16395736	25
36	6101452	7922896	7701037	12985265	12621646	16389542	24
37	6103756	7921121	7705672	12977454	12624475	19383355	23
38	6106060	7919345	7710309	12969649	12627306	16377173	22
39	6108363	7917569	7714948	12961850	12630140	16370997	21
40	6110666	7915792	7719589	12954057	12932975	16364828	20
41	6112968	7914014	7724233	12946269	12635813	16358664	19
42	6115270	7912235	7728879	12938488	12638653	16352507	18
43	6117572	7910456	7733526	12930712	12641496	16346355	17
44	6119873	7908676	7738175	12922943	12644341	16340210	16
45	6122173	7906896	7742827	12915179	12647188	16334070	15
46	6124473	7905115	7747481	12907421	12650037	16327937	14
47	6126772	7903333	7752137	12898629	12652890	16321809	13
48	6129071	7901550	7756795	12891922	12655745	16315688	12
49	6131369	7899767	7761455	12884182	12658601	16309572	11
50	6133666	7897983	7766117	12876447	12661460	16303462	10
51	6135963	7896198	7770782	12868718	12664322	16297359	9
52	6138260	7894413	7775448	12860995	12667186	16291261	8
53	6140556	7892627	7780117	12853277	12670052	16285169	7
54	6142852	7890841	7784788	12845565	12672021	16279083	6
55	6145147	7889054	7789460	12837860	12675792	16273003	5
56	6147442	7887266	7794135	12830160	12678665	16266929	4
57	6149736	7885477	7798812	12822466	12681541	16260861	3
58	6152029	7883688	7803492	12814776	12684419	16254799	2
59	6154322	7881898	7808173	12807093	12687299	16248743	1
60	6156615	7880107	7812856	12799416	12690182	16242692	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. CoSecant.	N. Secant.	M

52 DEGREES.

37 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co. Tang.	L. Secant.	L. Co-Secant	
0	9.7794630	9.9023486	9.8771144	10.1228856	10.0976514	10.2205370	60
1	9.7796306	9.9022534	9.8773772	10.1226228	10.0977466	10.2203694	59
2	9.7797981	9.9021581	9.8776400	10.1223600	10.0978419	10.2201019	58
3	9.7799655	9.9020628	9.8779027	10.1220973	10.0979372	10.2200345	57
4	9.7801328	9.9019674	9.8781654	10.1218346	10.0980326	10.2198672	56
5	9.7803000	9.9018719	9.8784281	10.1215719	10.0981281	10.2197000	55
6	9.7804671	9.9017764	9.8786907	10.1213093	10.0982236	10.2195329	54
7	9.7806341	9.9016808	9.8789533	10.1210467	10.0983192	10.2193659	53
8	9.7808010	9.9015852	9.8792158	10.1207842	10.0984148	10.2191990	52
9	9.7809677	9.9014895	9.8794782	10.1205218	10.0985105	10.2190323	51
10	9.7811344	9.9013938	9.8797407	10.1202593	10.0986062	10.2188656	50
11	9.7813010	9.9012980	9.8800031	10.1199969	10.0987020	10.2186990	49
12	9.7814675	9.9012021	9.8802654	10.1197346	10.0987979	10.2185325	48
13	9.7816339	9.9011062	9.8805277	10.1194723	10.0988938	10.2183661	47
14	9.7818002	9.9010102	9.8807900	10.1192100	10.0989898	10.2181998	46
15	9.7819664	9.9009142	9.8810522	10.1189478	10.0990858	10.2180336	45
16	9.7821324	9.9008181	9.8813144	10.1186856	10.0991819	10.2178676	44
17	9.7822984	9.9007219	9.8815765	10.1184235	10.0992781	10.2177016	43
18	9.7824643	9.9006257	9.8818386	10.1181614	10.0993743	10.2175357	42
19	9.7826301	9.9005294	9.8821007	10.1178993	10.0994708	10.2173699	41
20	9.7827958	9.9004331	9.8823627	10.1176373	10.0995669	10.2172042	40
21	9.7829614	9.9003367	9.8826246	10.1173754	10.0996633	10.2170386	39
22	9.7831268	9.9002403	9.8828856	10.1171134	10.0997597	10.2168732	38
23	9.7832922	9.9001438	9.8831484	10.1168516	10.0998562	10.2167078	37
24	9.7834575	9.9000472	9.8834103	10.1165897	10.0999528	10.2165425	36
25	9.7836227	9.8999506	9.8836721	10.1163279	10.1000494	10.2163773	35
26	9.7837878	9.8998539	9.8839338	10.1160662	10.1001461	10.2162122	34
27	9.7839528	9.8997572	9.8841956	10.1158044	10.1002428	10.2160472	33
28	9.7841177	9.8996604	9.8844572	10.1155428	10.1003396	10.2158823	32
29	9.7842824	9.8995636	9.8847189	10.1152811	10.1004364	10.2157176	31
30	9.7844471	9.8994667	9.8849805	10.1150195	10.1005333	10.2155529	30
31	9.7846117	9.8993697	9.8852420	10.1147580	10.1006303	10.2153883	29
32	9.7847762	9.8992727	9.8855035	10.1144965	10.1007273	10.2152238	28
33	9.7849406	9.8991756	9.8857650	10.1142350	10.1008244	10.2150594	27
34	9.7851049	9.8990784	9.8860264	10.1139736	10.1009216	10.2148951	26
35	9.7852691	9.8989812	9.8862878	10.1137122	10.1010188	10.2147309	25
36	9.7854232	9.8988840	9.8865492	10.1134508	10.1011160	10.2145668	24
37	9.7855972	9.8987867	9.8868105	10.1131895	10.1012133	10.2144028	23
38	9.7857611	9.8986893	9.8870718	10.1129282	10.1013107	10.2142389	22
39	9.7859249	9.8985919	9.8873330	10.1126670	10.1014081	10.2140751	21
40	9.7860886	9.8984944	9.8875942	10.1124058	10.1015056	10.2139114	20
41	9.7862522	9.8983968	9.8878554	10.1121446	10.1016032	10.2137478	19
42	9.7864157	9.8982992	9.8881165	10.1118835	10.1017008	10.2135843	18
43	9.7865791	9.8982015	9.8883775	10.1116225	10.1017985	10.2134209	17
44	9.7867424	9.8981038	9.8886386	10.1113614	10.1018962	10.2132576	16
45	9.7869056	9.8980060	9.8888996	10.1111004	10.1019940	10.2130944	15
46	9.7870687	9.8979082	9.8891605	10.1108395	10.1020918	10.2129313	14
47	9.7872317	9.8978103	9.8894214	10.1105786	10.1021897	10.2127683	13
48	9.7873946	9.8977123	9.8896823	10.1103177	10.1022877	10.2126054	12
49	9.7875574	9.8976143	9.8899432	10.1100568	10.1023857	10.2124426	11
50	9.7877202	9.8975162	9.8902040	10.1097960	10.1024838	10.2122798	10
51	9.7878828	9.8974181	9.8904647	10.1095353	10.1025819	10.2121172	9
52	9.7880453	9.8973199	9.8907254	10.1092746	10.1026801	10.2119547	8
53	9.7882077	9.8972216	9.8909861	10.1090139	10.1027784	10.2117923	7
54	9.7883701	9.8971233	9.8912468	10.1087532	10.1028767	10.2116299	6
55	9.7885323	9.8970249	6.8915074	10.1084926	10.1029751	10.2114677	5
56	9.7886944	9.8969265	9.8917679	10.1082321	10.1030735	10.2113056	4
57	9.7888565	9.8968280	9.8920285	10.1079715	10.1031720	10.2111435	3
58	9.7890184	9.8967294	9.892289[illegible]	10.1077110	10.1032706	10.2109816	2
59	9.7891802	9.8966308	9.892549[illegible]	10.1074505	10.1033692	10.2108198	1
60	9.7893420	9.8965321	9.8928[illegible]9	10.1071902	10.1034679	10.2106580	0
	L. Co-Sine	L. Sine	L. Co-Tang.	L. Tangent	L. Co-Secant	L. Secant.	M

52 DEGREES.

38 DEGREES.

M	N. Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	6156615	7880107	7812856	12799416	12690182	16242692	60
1	6158967	7878316	7817542	12791745	12693067	16236648	59
2	6161198	7876523	7822229	12784079	12695955	16230609	58
3	6163489	7874732	7826919	12776419	12698845	16224576	57
4	6165779	7872939	7831611	12768764	12701737	16218549	56
5	6168069	7871145	7836305	12761116	12704632	16212528	55
6	6170359	7869350	7841002	12753473	12707529	16206513	54
7	6172648	7867555	7845700	12745836	12710429	16200504	53
8	6174936	7865759	7850400	12738204	12713331	16194500	52
9	6177224	7863962	7855103	12730578	12716235	16188502	51
10	6179511	7862165	7859808	12722957	12719142	16182510	50
11	6181798	7860367	7864515	12715342	12722051	16176524	49
12	6184084	7858569	7869224	12707733	12724963	16170544	48
13	6186370	7856770	7873935	12700130	12727877	16164569	47
14	6188655	7854970	7878649	12692532	12730794	16158600	46
15	6190940	7853169	7883364	12684939	12733712	16152637	45
16	6193224	7851368	7888082	12677353	12736634	16140680	44
17	6195507	7849566	7892802	12669772	12739557	16146728	43
18	6197790	7847764	7897524	12662196	12742484	16134783	42
19	6200073	7845961	7902248	12654626	12745412	16128843	41
20	6202355	7844157	7906975	12647062	12748343	16122908	40
21	6204636	7842352	7911703	12639503	12751276	16116980	39
22	6206917	7840547	7916434	12631950	12754212	16111057	38
23	6209198	7838741	7921167	12624402	12757150	16105140	37
24	6211478	7836935	7925902	12615860	12760091	16099228	36
25	6213757	7835128	7930640	12609323	12763034	16093323	35
26	6216036	7833320	7935379	12601792	12765980	16087423	34
27	6218314	7831511	7940121	12594267	12768928	16081528	33
28	6220592	7829702	7944865	12586747	12771878	16075640	32
29	6222869	7827892	7949611	12579232	12774831	16069757	31
30	6225146	7826082	7954359	12571723	12777787	16063879	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	7818833	7973374	12541742	12789632	16040426	26
35	6236522	7817019	7978134	12534260	12792600	16034577	25
36	6238796	7815205	7982895	12526784	12795570	16028734	24
37	6241069	7813390	7987659	12519313	12798543	16022896	23
38	6243342	7811574	7992425	12511848	12801518	15017064	22
39	6245614	7809757	7997193	12504388	12804495	16011237	21
40	6247885	7807940	8001963	12496932	12807475	16005416	20
41	6250156	7806122	8006736	12481484	12810457	15999600	19
42	6252426	7804304	8011511	12482040	12813442	15993790	18
43	6254696	7802485	8016288	12474602	12816430	15987986	17
44	6256966	7800665	8021067	12467169	12810420	15982187	16
45	6259235	7798845	8025848	12459742	12822412	15976394	15
46	6261503	7797024	8030632	12452320	12825407	15970606	14
47	6263771	7795202	8035418	12444903	12828404	15964824	13
48	6266038	7793380	8040206	12437492	12831404	15959047	12
49	6268305	7791557	8044997	12430086	12834406	15953276	11
50	6270571	7789733	8049790	12482685	12837411	15947511	10
51	6272837	7787908	8054585	12415290	12840418	15941751	9
52	6275102	7786083	8059382	12407900	12843428	15935996	8
53	6277366	7784257	8064181	12400515	12846440	15930247	7
54	6279630	7782431	8068983	12393136	12849455	15924504	6
55	6281894	7780604	8073787	12385762	12852472	15918766	5
56	6284157	7778777	8078593	12378393	12855492	15913033	4
57	6286420	7776949	8083401	12371030	12858514	15907306	3
58	6288682	7775120	8088212	12363672	12861539	15901584	2
59	6290943	7773290	8093025	12356319	12864566	15895868	1
60	6293204	7771460	8097840	12348972	12867596	15890157	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. CoSecant.	N. Secant.	M

51 DEGREES.

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38 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co Tang.	L. Secant.	L. Co-Secant.	
0	9.7893420	9.8965321	9.8928098	10.1071902	10.1034679	10.2106580	60
1	9.7895036	9.8964334	9.8930702	10.1069298	10.1035666	10.2104964	59
2	9.7896652	9.8963346	9.8933306	10.1066694	10.1036654	10.2103348	58
3	9.7898266	9.8962358	9.8935909	10.1064091	10.1037642	10.2101734	57
4	9.7899880	9.8961369	9.8938511	10.1061489	10.1038631	10.2100120	56
5	9.7901493	9.8960379	9.8941114	10.1058886	10.1039621	10.2098507	55
6	9.7903104	9.8959389	9.8943715	10.1056285	10.1040611	10.2096896	54
7	9.7904715	9.8958398	9.8946317	10.1053683	10.1041602	10.2095285	53
8	9.7906325	9.8957406	9.8948918	10.1051082	10.1042594	10.2093675	52
9	9.7907933	9.8956414	9.8951519	10.1048481	10.1043586	10.2092067	51
10	9.7909541	9.8955422	9.8954119	10.1045881	10.1044578	10.2090459	50
11	9.7911148	9.8954429	9.8956719	10.1043281	10.1045572	10.2088852	49
12	9.7912754	9.2953435	9.8959319	10.1040681	10.1046565	10.2087246	48
13	9.7914359	9.8952440	9.8961918	10.1038082	10.1047560	10.2085641	47
14	9.7915963	9.8951445	9.8964517	10.1035483	10.1048555	10.2084037	46
15	9.7917566	9.8950450	9.8967116	10.1032884	10.1049550	10.2082434	45
16	9.7919168	9.8949453	9.8969714	10.1030286	10.1050547	10.2080832	44
17	9.7920769	9.8948457	9.8972312	10.1027688	10.1051543	10.2079231	43
18	9.7922369	9.8947459	9.8974910	10.1025090	01.1052541	10.2077631	42
19	9.7923968	9.8946461	9.8977507	10.1022493	10.1053539	10.2076032	41
20	9.7925560	9.8945463	9.8980104	10.1019896	10.1054537	10.2074434	40
21	9.7927163	9.8944461	9.8982700	10.1017300	10.1054537	10.2072837	39
22	9.7928760	9.8943464	9.8985296	10.1014704	10.1056536	10.2071240	38
23	9.7930355	9.8942463	9.8984892	10.1012108	10.1057537	10.2069645	37
24	9.7931949	9.8941462	9.8990487	10.1009513	10.1058538	10.2068051	36
25	9.7933543	9.8940461	9.8993082	10.1006918	10.1059539	10.2056457	35
26	9.7935135	9.8939458	9.8995677	10.1004323	10.1060542	10.2064865	34
27	9.7936727	9.8938456	9.8998271	10.1001729	10.1061544	10.2063273	33
28	9.7938317	9.8937452	9.9000865	10.0999135	10.1062548	10.2061683	32
29	9.7939907	9.8936448	9.9003459	10.0996541	10.1063552	10.2060093	31
30	9.7941496	9.8935444	9.9006052	10.0993948	10.1064556	10.2058504	30
31	9.7943083	9.8934439	9.9008645	10.0991355	10.1065561	10.2056917	29
32	9.7944670	9.8933433	9.9011237	10.0938763	10.1066567	10.2055330	28
33	9.7946250	9.8932426	9.9013830	10.0986170	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	10.0980987	10.1069588	10.2050575	25
36	9.7951008	9.8929404	9.9021604	10.0978396	10.1070596	10.2048992	24
37	9.7952590	9.8928395	9.9024195	10.0975805	10.1071605	10.2047410	23
38	9.7954171	9.8927385	9.9026786	10.0973214	10.1072615	10.2045829	22
39	9.7955751	9.8926375	9.9029376	10.0970624	10.1073625	10.2044249	21
40	9.7957330	9.8925365	9.9031966	10.0958034	10.1074635	10.2042670	20
41	9.7958909	9.8924354	9.9034555	10.0965445	10.1075646	10.2041091	19
42	9.7960486	9.8923342	9.9037144	10.0962856	10.1076658	10.2039514	18
43	9.7962062	9.8922329	9.9039733	10.0960267	10.1077671	10.2037638	17
44	9.7963638	9.8921316	9.9042321	10.0957679	10.1078684	10.2036362	16
45	9.7965212	9.8920303	9.9044910	10.0955090	10.1079697	10.2034788	15
46	9.7966786	9.8919289	9.9047497	10.0952503	10.1080711	10.2033214	14
47	9.7968359	9.8918274	9.9050085	10.0949915	10.1081726	10.2031641	13
48	9.7969930	9.8917258	9.9052672	10.0947328	10.1082742	10.2030070	12
49	9.7971501	9.8916242	9.9055259	10.0944741	10.1083758	10.2028499	11
50	9.7973071	9.8915226	9.9057845	10.0942155	10.1084774	10.2026929	10
51	9.7974640	9.8914208	9.9060431	10.0939569	10.1085792	10.2025360	9
52	9.7976208	9.8913191	9.9063017	10.0936983	10.1086809	10.2023792	8
53	9.7977775	9.8912172	9.9065603	10.0934397	10.1087828	10.2022225	7
54	9.7979341	9.8911153	9.9068188	10.0931812	10.1088847	10.2020659	6
55	9.7980906	9.8910133	9.9070773	10.0929227	10.1089867	10.2019094	5
56	9.7982470	9.8909113	9.9073357	10.0926643	10.1090887	10.2017530	4
57	9.7984034	9.8908092	9.9075941	10.0924059	10.1091908	10.2015966	3
58	9.7985596	9.8907071	9.9078525	10.0921475	10.1092929	10.2014404	2
59	9.7987158	9.8906049	9.9081109	10.0918891	10.1093951	10.2012842	1
60	9.7988718	9.8905026	9.9083692	10.0916308	10.1094974	10.2011282	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

51 DEGREES.

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39 DEGREES

M	N. Sine	N.Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant	NCo-Secant	
0	6293204	7771460	8097840	12348972	12867596	15890125	60
1	6295464	7769629	8102658	12341629	12870628	15884452	59
2	6297724	7767797	8107478	12334292	12873663	15878752	58
3	6299983	7765965	8112300	12326961	12876700	15873058	57
4	6302242	7764132	8117124	12319634	12879740	15867369	56
5	6304500	7762298	8121951	12312313	12882782	15861685	55
6	6306758	7760464	8126780	12304997	12885827	15856007	54
7	6309015	7758629	8131611	12297687	12888875	15850334	53
8	6311272	7756794	8136444	12290381	12891925	15844667	52
9	6313528	7754958	8141280	12283081	12894977	15839005	51
10	6315784	7753121	8146118	12275786	12898032	15833348	50
11	6318039	7751283	8150958	12268496	12901090	15827697	49
12	6320293	7749445	8155801	12261211	12904150	15822051	48
13	6322547	7747606	8160646	12253932	12907213	15816411	47
14	6324800	7745767	8165493	12246658	12910278	15810776	46
15	6327053	7743927	8170343	12239389	12913346	15805146	45
16	6329305	7742086	8175195	12232125	12916416	15799521	44
17	6331557	7740244	8180049	12224866	12919489	15793902	43
18	6333808	7738402	8184905	12217613	12922564	15788289	42
19	6336059	7736559	8189764	12210364	12924642	15782680	41
20	6338309	7734716	8194625	12203121	12928723	15777077	40
21	6340559	7732872	8199488	12195883	12931806	15771479	39
22	6342808	7731027	8204354	12188650	12934892	15765887	38
23	6345057	7729182	8209222	12181422	12937980	15760300	37
24	6347305	7727336	8214093	12174199	12941071	15754718	36
25	6349553	7725489	8218965	12166982	12944[illegible]64	15749141	35
26	6351800	7723642	8223840	12159769	12947260	15743570	34
27	6354046	7721794	8228718	12152562	12950359	15738004	33
28	6356292	7719945	8233597	12145359	12953460	15732443	32
29	6358537	7718096	8238479	12138152	12956564	15726887	31
30	6360782	7716246	8243364	12130970	12959670	15721337	30
31	6363026	7714395	8248251	12123783	12962779	15715792	29
32	6365270	7712544	8253140	12116601	12965890	15710252	28
33	6367513	7710692	8258030	12109414	12969004	15704717	27
34	6369756	7708839	8262925	12102252	12972121	15699188	26
35	6371998	7706986	8207821	12095085	12975240	15693664	25
36	6374240	7705132	8272719	12087923	12978362	15688145	24
37	6376481	7703278	8277620	12080767	12981487	15682631	23
38	6378721	7701423	8282523	12073615	12984614	15677123	22
39	6380961	7699567	8287429	12066465	12987744	15671619	21
40	6383201	7697710	8292337	12059327	12990876	15666121	20
41	6385440	7695853	8297247	12052190	12994011	15660628	19
42	6387678	7693995	8302160	12045058	12997148	15655141	18
43	6389916	7692137	8307075	12037931	13000288	15649658	17
44	6392153	7690278	8311992	12030810	13003431	15644181	16
45	6394390	7688418	8316912	12023693	13006576	15638708	15
46	6396626	7686558	8321834	12016581	13009724	15633241	14
47	6398862	7684697	8326759	12009475	13012875	15627779	13
48	6401097	7682835	8331686	12002373	13016028	15622322	12
49	6403332	7680973	8336615	11995276	13019184	15616870	11
50	6405566	7679110	8341547	11988184	13022343	15611424	10
51	6407799	7677246	8346481	11981097	13025504	15605982	9
52	6410032	7675382	8351418	11974015	13028668	15600546	8
53	6412264	7673517	8356357	11966938	13031834	15595115	7
54	6414496	7671651	8361298	11959866	13035003	15589689	6
55	6416727	7669785	8366242	11952799	13038175	15584267	5
56	6418958	7667918	8371188	11945736	13041349	15578851	4
57	6421188	7666051	8376136	11938679	13044526	15573441	3
58	6423418	7664183	8381087	11931626	13047706	15568035	2
59	6425647	7662314	8386040	11924179	13050888	15562634	1
60	6427876	7660444	8390996	11917536	13054073	15557238	0
	N'Co Sine.	N. Sine.	N Co Tang.	N. Tangent.	N Co-Secant.	N. Secant	M

50 DEGREES.

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39 DEGREES.

M	*L. Sine.*	*L. Co-Sine*	*L. Tangent*	*L. Co.Tang.*	*L. Secant.*	*L Co-Secant*	
0	9.7988718	9.8905026	9.9083629	10.0916371	10.1094974	10.2011282	60
1	9.7990278	9.8904003	9.9086275	10.0913725	10.1095997	10.2009722	59
2	9.7991836	9.8902979	9.9088858	10.0911142	10.1097021	10.2008164	58
3	9.7993394	9.8901954	9.9091440	10.0908560	10.1098046	10.2006606	57
4	9.7994951	9.8900929	9.9094022	10.0905978	10.1099071	10.2005049	56
5	9.7996507	9.8899903	9.9096603	10.0903397	10.1100097	10.2003493	55
6	9.7998062	9.8898877	9.9099185	10.0900815	10.1101123	10.2001938	54
7	9.7999616	9.8897850	9.9101766	10.0898234	10.1102150	10.2000384	53
8	9.8001169	9.8896822	9.9104347	10.0895653	10.1103178	10.1998831	52
9	9.8002721	9.8895794	9.9106927	10.0893073	10.1104206	10.1997279	51
10	9.8004272	9.8894765	9.9109507	10.0890493	10.1105235	10.1995728	50
11	9.8005823	9.8893736	9.9112087	10.0887913	10.1106264	10.1994177	49
12	9.8007372	9.8892706	9.9114666	10.0885334	10.1107294	10.1992628	48
13	9.8008921	9.8891675	9.9117245	10.0882755	10.1108325	10.1991079	47
14	9.8010468	9.8890644	9.9119824	10.0880176	10.1109356	10.1989532	46
15	9.8012015	9.8889612	9.9122403	10.0877597	10.1110388	10.1987985	45
16	9.8013561	9.8888580	9.9124981	10.0875019	10.1111420	10.1986439	44
17	9.8013106	9.8887547	9.9127559	10.0872441	10.1112453	10.1984894	43
18	9.8016649	9.8886513	9.9130137	10.0869863	10.1113487	10.1983351	42
19	9.8018192	9.8885479	9.9132714	10.0867286	10.1114521	10.1981808	41
20	9.8019735	9.8884444	9.9135291	10.0864709	10.1115556	10.1980265	40
21	9.8021276	9.8883408	9.9137808	10.0862132	10.1116592	10.1978724	39
22	9.8022816	9.8882372	9.9140444	10.0859556	10.1117627	10.1977184	38
23	9.8024355	9.8881335	9.9143070	10.0856980	10.1118665	10.1975645	37
24	9.8025894	9.8880298	9.9145596	10.0854404	10.1119702	10.1974106	36
25	9.8027431	9.8879260	9.9148171	10.0851829	10.1120740	10.1972569	35
26	9.8028968	9.8878221	9.9150747	10.0849253	10.1121779	10.1971032	34
27	9.8030504	9.8877182	9.9153322	10.0846678	10.1122818	10.1969496	33
28	9.8032038	9.8876142	9.9155896	10.0844104	10.1123858	10.1967962	32
29	9.8033572	9.8875102	9.9158471	10.0841529	10.1124898	10.1966428	31
30	9.8035105	9.8874061	9.9161045	10.0838955	10.1125939	10.1964895	30
31	9.8036637	9.8873019	9.9163618	10.0836382	10.1126981	10.1963363	29
32	9.8038168	9.8871977	9.9166192	10.0833808	10.1128023	10.1961832	28
33	9.8039699	9.8870934	9.9168765	10.0831239	10.1129066	10.1960301	27
34	9.8041228	9.8869890	9.9171338	10.0828662	10.1130110	10.1958772	26
35	9.8042757	9.8868846	9.9173911	10.0826089	10.1131154	10.1957243	25
36	9.8044284	9.8867801	9.9176483	10.0823517	10.1132199	10.1955716	24
37	9.8045811	9.8866756	9.9179055	10.0820945	10.1133244	10.1954189	23
38	9.8047336	9.8865710	9.9181627	10.0818373	10.1134290	10.1952664	22
39	9.8048861	9.8804663	9.9184198	10.0815802	10.1135337	10.1951139	21
40	9.8050385	9.8863616	9.9186769	10.0813231	10.1136384	10.1949615	20
41	9.8051908	9.8862568	9.9189340	10.0810660	10.1137432	10.1948092	19
42	9.8053430	9.8861519	9.9191911	10.0808089	10.1138481	10.5946570	18
43	9.8054951	9.8860470	9.9194481	10.0805519	10.1139530	10.1945049	17
44	9.8056472	9.8859420	9.9197051	10.0802949	10.1140580	10.1943528	16
45	9.8057991	9.8858370	9.9199621	10.0800379	10.1141630	10.1942008	15
46	9.8059510	9.8857319	9.9202191	10.0797809	10.1142681	10.1940490	14
47	9.8061027	9.8856267	9.9204760	10.0795240	10.1143733	10.1938973	13
48	9.8062544	9.8855215	9.9207329	10.0792671	10.1144785	10.1937456	12
49	9.8064060	9.8854162	9.9209898	10.0790102	10.1145838	10.1935940	11
50	9.8065575	9.8853109	9.9212466	10.0787534	10.1146891	10.1934425	10
51	9.8067089	9.8852055	9.9215034	10.0784966	10.1147945	10.1932911	9
52	9.8068602	9.8851000	9.9217602	10.0782398	10.1149000	10.1931398	8
53	9.8070114	9.8849945	9.9220170	10.0779830	10.1150055	10.1929886	7
54	9.8071626	9.8848889	9.9222737	10.0777263	10.1151111	10.1928374	6
55	9.8073136	9.8847832	9.9225304	10.0774696	10.1152168	10.1926864	5
56	9.8074646	9.8846775	9.9227871	10.0772129	10.1153225	10.1925354	4
57	9.8076154	9.8845717	9.9230437	10.0769563	10.1154283	10.1923846	3
58	9.8077662	9.8844659	9.9233004	10.0766996	10.1155341	10.1922338	2
59	9.8079169	9.8843599	9.9235570	10.0764430	10.1156401	10.1920831	1
60	9.8080675	9.8842540	9.9238135	10.0761865	10.1157460	10.1919325	0
	L Co-Sine	*L. Sine*	*L. Co-Tang*	*L. Tangent*	*L.Co-Secant*	*L. Secant.*	M

50 DEGREES.

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40 DEGREES

M	N. Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	6427876	7660444	8390996	11917536	13054073	15557238	60
1	6430104	7658574	8395954	11910498	13057261	15551848	59
2	6432332	7656703	8400915	11903465	13060451	15546462	58
3	6434559	7654832	8405878	11896437	13063644	15541081	57
4	6436785	7652960	8410844	11889414	13066839	15535706	56
5	6439011	7651087	8415812	11882395	13070037	15530335	55
6	6441236	7649214	8420782	11875382	13073238	15524970	54
7	6443461	7647340	8425755	11868373	13076442	15519609	53
8	6445685	7645465	8430730	11861369	13079649	15514254	52
9	6447909	7643590	8435708	11854370	13082858	15508904	51
10	6450132	7641714	8440688	11847376	13086070	15503558	50
11	6452355	7639837	8445670	11840387	13089284	15498218	49
12	6454577	7637960	8450655	11833402	13092501	15492882	48
13	6456798	7636082	8455643	11826422	13095721	15487552	47
14	6459019	7634204	8460633	11819447	13098943	15482226	46
15	6461240	7632325	8465625	11812477	13102168	15476906	45
16	6463460	7630445	8470620	11805512	13105396	15471590	44
17	6465679	7628564	8475617	11798551	13108626	15466280	43
18	6467898	7626683	8480617	11791595	13111859	15460974	42
19	6470116	7624801	8485619	11784644	13115095	15455673	41
20	6472334	7622919	8490624	11777698	13118334	15450378	40
21	6474551	7621036	8495631	11770756	13121575	15445087	39
22	6476767	7619152	8500640	11763820	13124819	15439801	38
23	6478983	7617268	8505652	11756888	13128066	15434520	37
24	6481199	7615383	8510667	11749960	13131316	15429244	36
25	6483414	7613497	8515684	11743038	13134568	15423973	35
26	6485628	7611611	8520704	11736120	13137823	15418706	34
27	6487842	7609724	8525726	11729207	13141081	15413445	33
28	6490055	7607837	8530750	11722298	13144341	15408189	32
29	6492268	7605949	8535777	11715395	13147604	15402937	31
30	6494480	7604060	8540807	11708496	13150870	15397690	30
31	6496692	7602170	8545839	11701601	13154139	15392449	29
32	6498903	7600280	8550873	11694712	13157410	15387212	28
33	6501114	7598389	8555910	11687827	13160684	15381980	27
34	6503324	7596498	8560950	11680947	13163961	15376752	26
35	6505533	7594606	8565992	11674071	13167241	15371530	25
36	6507742	7592713	8571037	11667200	13170523	15366312	24
37	6509950	7590820	8576084	11660334	13173808	15361100	23
38	6512158	7588926	8581133	11653472	13177096	15355892	22
39	6514365	7587031	8586185	11646615	13180386	15350689	21
40	6516572	7585136	8591240	11639763	13183679	15345491	20
41	6518778	7583240	8596297	11632916	13186975	15340297	19
42	6520984	7581343	8601357	11626073	13190274	15335109	18
43	6523189	7579446	8606419	11619234	13193576	15329925	17
44	6525394	7577548	8611484	11612400	13196881	15324746	16
45	6527598	7575650	8616551	11605571	13200188	15319572	15
46	6529801	7573751	8621621	11598747	13203498	15314403	14
47	6532004	7571851	8626693	11591927	13206811	15309238	13
48	6534206	7569950	8631768	11585111	13210126	15304078	12
49	6536408	7568049	8636846	11578401	13213444	15298923	11
50	6538609	7566147	8641926	11571495	13216765	15293773	10
51	6540810	7564245	8647009	11564693	13220089	15288627	9
52	6543010	7562342	8652094	11557896	13223416	15283487	8
53	6545209	7560439	8657181	11551104	13226745	15278351	7
54	6547408	7558535	8662271	11544316	13230077	15273219	6
55	6549606	7556630	8667364	11537532	13233412	15268093	5
56	6551804	7554724	8672460	11530754	13236750	15262971	4
57	6554001	7552818	8677558	11523979	13240091	15257854	3
58	6556198	7550911	8682659	11517210	13243435	15252741	2
59	6558294	7549004	8687762	11510445	13246781	15247634	1
60	6560590	7547096	8692868	11503684	13250130	15242531	0
	N. Co-Sine	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co Secant.	N. Secant.	M

49 DEGREES.

40 DEGREES.

M	L. Sine.	L. Co-Sine	L. Tangent	L. Co.Tang	L. Secant.	Lo C-Secant.	
0	9.8080675	9.8842540	9.9228135	10.0761807	10.1157460	10.1919325	60
1	9.8082180	9.8841479	9.9240701	10.0759299	10.1158521	10.1917820	59
2	9.8083684	9.8840418	9.9243266	10.0756734	10.1159582	10.1916316	58
3	9.8085188	9.8839357	9.9245831	10.0754169	10.1160643	10.1914812	57
4	9.0086690	8.8838294	9.9248396	10.0751604	10.1161706	10.1913310	56
5	9.8088192	9.8837232	9.9250960	10.0749040	10.1162768	10.1911808	55
6	9.8089692	9.8836168	9.9253524	10.0746476	10.1163832	10.1910308	54
7	9.8091192	9.8835104	9.9256088	10.0743912	10.1164896	10.1908808	53
8	9.8092691	9.8834039	9.9258652	10.0741348	10.1165961	10.1907309	52
9	9.8094189	9.8832974	9.9261215	10.0738785	10.1167026	10.1905811	51
10	9.8095686	9.8831908	9.9263778	10.0736222	10.1168092	10.1904314	50
11	9.8097182	9.8830841	9.9266341	10.0733659	10.1169159	10.1902818	49
12	9.8098678	9.8829774	9.9268904	10.0731096	10.1170226	10.1901322	48
13	9.8100172	9.8828706	9.9271466	10.0728534	10.1171294	10.1899828	47
14	9.8101666	9.8827638	9.9274028	10.0725972	10.1172362	10.1898334	46
15	9.8103159	9.8826568	9.9276599	10.0723410	10.1173432	10.1896841	45
16	9.8104650	9.8825499	9.9279152	10.0720848	10.1174501	10.1895350	44
17	9.8106141	9.8824428	9.9281713	10.0718287	10.1175572	10.1893859	43
18	9.8107631	9.8823357	9.9284274	10.0715726	10.1176643	10.1892369	42
19	9.8109121	9.8822285	9.9286835	10.0713165	10.1177715	10.1890879	41
20	9.8110609	9.8821213	9.9289396	10.0710604	10.1178787	10.1889391	40
21	9.8112096	9.8820140	9.9291956	10.0708044	10.1179860	10.1887904	39
22	9.8113583	9.8819067	9.9294516	10.0705484	10.1180933	10.1886417	38
23	9.8115069	9.8817992	9.9297076	10.0702924	10.1182008	10.1884931	37
24	9.8116554	9.8816918	9.9299636	10.0700364	10.1183082	10.1883446	36
25	9.8118038	9.8815842	9.9302195	10.0697805	10.1184158	10.1881962	35
26	9.8119521	9.8814766	9.9304755	10.0695245	10.1185234	10.1880479	34
27	9.8121003	9.8813689	9.9307314	10.0692686	10.1186311	10.1878997	33
28	9.8122484	9.8812612	9.9309872	10.0690128	10.1187388	10.1877516	32
29	9.8123965	9.8811534	9.9312431	10.0687569	10.1188466	10.1876035	31
30	9.8125444	9.8810455	9.9314989	10.0685011	10.1189545	10.1874556	30
31	9.8126923	9.8809376	9.9317547	10.0682453	10.1190624	10.1873077	29
32	9.8128401	9.8808296	9.9320105	10.0679895	10.1191704	10.1871599	28
33	9.8129878	9.8807215	9.9322662	10.0677338	10.1192785	10.1870122	27
34	9.8131354	9.8806134	9.9325220	10.0674780	10.1193866	10.1868646	26
35	9.8132829	9.8805052	9.9327777	10.0672223	10.1194948	10.1867171	25
36	9.8134303	9.8803970	9.9330334	10.0669666	10.1196030	10.1865697	24
37	9.8135777	9.8802887	9.9332890	10.0667110	10.1197113	10.1864223	23
38	9.8137250	9.8801803	9.9335446	10.0664554	10.1198197	10.1862750	22
39	9.8138721	9.8800719	9.9338003	10.0661997	10.1199281	10.1861279	21
40	9.8140192	9.8799634	9.9340559	10.0659441	10.1200366	10.1859804	20
41	9.8141662	9.8798548	9.9343114	10.0656886	10.1201452	10.1858338	19
42	9.8143131	9.8797462	9.9345670	10.0554330	10.1202538	10.1856869	18
43	9.8144600	9.8796375	9.9348225	10.0651775	10.1203625	10.1855400	17
44	9.8146067	9.8795287	9.9350780	10.0649220	10.1204713	10.1853933	16
45	9.8147534	9.8794199	9.9353335	10.0646665	10.1205801	10.1852466	15
46	9.8148999	9.8793110	9.9355889	10.0644111	10.1206890	10.1851001	14
47	9.8150464	9.8792021	9.9358444	10.0641556	10.1207979	10.1849536	13
48	9.8151928	9.8790930	9.9360996	10.0639002	10.1209070	10.1848072	12
49	9.8153391	9.8789840	9.9363552	10.0636448	10.1210160	10.1846609	11
50	9.8154854	9.8788748	9.9366105	10.0633895	10.1211252	10.1845146	10
51	9.8156315	9.8787656	9.9368659	10.0631341	10.1212344	10.1843685	9
52	9.8157776	9.8786563	9.9371212	10.0628788	10.1213437	10.1842224	8
53	9.8159235	9.8785470	9.9373765	10.0626235	10.1214530	10.1840765	7
54	9.8160694	9.8784376	9.9376318	10.0623682	10.1215624	10.1839306	6
55	9.8162152	9.8783282	9.9378871	10.0621129	10.1216719	10.1837848	5
56	9.8163609	9.8782189	9.9381423	10.0618577	10.1217814	10.1836391	4
57	9.8165066	9.8781090	9.9383975	10.0616025	10.1218910	10.1834934	3
58	9.8166521	9.8779994	9.9386527	10.0613473	10.1220006	10.1833479	2
59	9.8167975	9.8778896	9.9389079	10.0610921	10.1221104	10.1832025	1
60	9.8169429	9.8777799	9.9391631	10.0608369	10.1222301	10.1830571	0
	L. Co-Sine	L. Sine	L. Co-Tang	L. Tangent	L.Co-Secant	L. Secant.	M

49 DEGREES.

41 DEGREES

M	N. Sine.	N. Co-Sine	N. Tangent.	N. Co-Tang.	N. Secant.	N Co-Secant	
0	6560590	7547096	8692868	11503684	13250130	15242531	60
1	6562785	7545187	8697976	11496928	13253452	15237433	59
2	6564980	7543278	8703087	11490176	13256837	15232339	58
3	6567174	7541368	8708200	11483429	13260194	15227250	57
4	6569367	7539457	8713316	11476687	13263554	15222165	56
5	6571560	7537546	8718435	11469949	13266918	15217087	55
6	6573752	7535634	8723556	11463215	13270284	15212012	54
7	6575944	7533721	8728680	11456486	13273653	15206942	53
8	6578135	7531808	8733806	11449762	13277025	15201876	52
9	6580326	7529894	8738935	11443041	13280399	15196815	51
10	6582516	7527980	8744067	11436326	13283776	15191759	50
11	6584706	7526065	8749201	11429615	13287156	15186708	49
12	6586895	7524149	8754338	11422908	13290539	15181661	48
13	6589083	7522233	8759478	11416206	13293925	15176619	47
14	6591271	7520316	8764620	11409508	13297314	15171581	46
15	6593458	7518398	8769765	11402815	13300706	15166548	45
16	6595645	7516480	8774912	11396126	13304100	15161520	44
17	6597831	7514561	8780062	11389441	13307497	15156496	43
18	6600017	7512641	8785215	11382761	13310897	15151477	42
19	6602202	7510721	8790370	11376085	13314300	15146462	41
20	6604386	7508800	8795528	11369414	13317706	15141452	40
21	6606570	7506879	8800689	11362747	13321115	15136447	39
22	6608753	7504950	8805852	11356085	13324527	15131446	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	13338202	15111489	34
27	6619662	7495337	8831707	11322839	13341628	15106511	33
28	6621842	7493411	3836886	11316203	13345057	15101538	32
29	6624022	7491484	8842068	11309571	13348489	15096569	31
30	6626201	7489557	8847253	11302944	13351924	15091605	30
31	6628379	7487629	8852440	11296321	13355362	15086645	29
32	6630557	7485781	8857630	11289702	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	7477981	8878416	11263271	13372594	15061915	24
37	6641437	7476049	8883620	11256674	13376049	15056982	23
38	6643611	7474117	8888826	11250081	13379507	15052054	22
39	6645785	7472184	8894034	11243493	13382968	15047121	21
40	6647959	7470251	8899245	11236909	13386432	15042211	20
41	6650132	7468317	8904459	11230329	13389899	15037297	19
42	6652304	7466382	8909675	11223754	13393369	15032387	18
43	6654475	7464446	8914894	11217183	13396842	15027481	17
44	6656646	7462510	8920116	11210616	13400317	15022580	16
45	6658817	7460574	8925341	11204053	13403795	15017683	15
46	6660987	7458637	8930569	11197495	13407276	15012791	14
47	6663156	7456699	8935799	11190941	13410761	15007903	13
48	6665325	7454760	8941032	11184391	13414248	15003020	12
49	6667493	7452821	8946268	11177846	13417738	14998141	11
50	6669661	7450881	8951506	11171305	13421232	14993267	10
51	6671828	7448940	8956747	11164768	13424728	14988397	9
52	6673994	7446999	8961991	11158235	13428227	14983531	8
53	6676160	7445057	8967238	11151706	13431729	14978670	7
54	6678326	7443115	8972487	11145182	13435234	14973813	6
55	6680491	7441172	8977739	11138662	13438742	14968961	5
56	6682655	7439229	8982994	11132146	13442253	14964113	4
57	6684818	7437285	8988252	11125635	13445767	14959270	3
58	6686981	7435340	8993512	11119127	13449284	14954430	2
59	6689144	7433394	8998775	11112624	13452804	14949596	1
60	6691306	7431448	9004041	11106125	13456327	14944765	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent	N. Co Secant.	N. Secant.	M

48 DEGREES.

41 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co Tang.	L. Secant.	Co-Secant	
0	9.8169429	9.8777799	9.9391631	10.0608369	10.1222201	10.1830571	60
1	9.8170882	9.8776700	9.9394182	10.0605818	10.1223300	10.1829118	59
2	9.8172334	9.8775601	9.9396733	10.0603267	10.1224399	10.1827666	58
3	9.8173785	9.8774501	9.9399284	10.0600716	10.1225499	10.1826215	57
4	9.8175235	9.8773401	9.9401835	10.0598165	10.1226599	10.1824765	56
5	9.8176685	9.8772300	9.9404385	10.0595615	10.1227700	10.1823315	55
6	9.8178133	9.8771198	9.9406936	10.0593064	10.1228802	10.1821867	54
7	9.8179581	9.8770096	9.9409486	10.0590514	10.1229904	10.1820419	53
8	9.8181028	9.8768993	9.9412036	10.0587964	10.1231007	10.1818972	52
9	9.8182474	9.8767889	9.9414585	10.0585415	10.1232111	10.1817526	51
10	9.8183919	9.8766785	9.9417135	10.0582865	10.1233215	10.1816081	50
11	9.8185364	9.8765680	9.9419684	10.0580316	10.1234320	10.1814636	49
12	9.8186807	9.8764574	9.9422233	10.0577767	10.1235426	10.1813193	48
13	9.8188250	9.8763468	9.9424782	10.0575218	10.1236532	10.1811750	47
14	9.8189692	9.8762361	9.9427331	10.0572669	10.1237639	10.1810308	46
15	9.8191133	9.8761253	9.9429879	10.0570121	10.1238747	10.1808867	45
16	9.8192573	9.8760145	9.9432428	10.0567572	10.1239855	10.1807427	44
17	9.8194012	9.8759036	9.9434976	10.0565024	10.1240964	10.1805988	43
18	9.8195450	9.8757927	9.9437524	10.0562476	01.1242073	10.1804550	42
19	9.8196888	9.8756816	9.9440072	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	9.9445166	10.0554834	10.1245406	10.1800239	39
22	9.8201196	9.8753482	9.9447714	10.0552286	10.1246518	10.1798804	38
23	9.8202630	9.8752369	9.9450261	10.0549739	10.1247631	10.1797370	37
24	9.8204063	9.8751256	9.9452807	10.0547193	10.1248744	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	9.9465539	10.0534461	10.1254321	10.1788783	31
30	9.8212646	9.8744561	9.9468084	10.0531916	10.1255439	10.1787354	30
31	9.8214073	9.8743443	9.9470630	10.0529370	10.1256557	10.1785927	29
32	9.8215500	9.8742325	9.9473175	10.0526825	10.1257675	10.1784500	28
33	9.8216926	9.8741205	9.9475720	10.0524280	10.1258795	10.1783074	27
34	9.8218351	9.8740095	9.9478265	10.0521735	10.1259915	10.1781649	26
35	9.8219775	9.8738953	9.9480810	10.0519190	10.1261035	10.1780225	25
36	9.3221198	9.8737844	9.9483355	10.0516645	10.1262156	10.1778802	24
37	9.8222621	9.8736722	9.9485899	10.0514101	10.1263278	10.1777379	23
38	9.8224042	9.8735599	9.9488443	10.0511557	10.1264401	10.1775958	22
39	9.8225463	9.8734476	9.9490987	10.0509013	10.1265524	10.1774537	21
40	9.8226883	9.8733352	9.9493531	10.0506469	10.1266648	10.1773117	20
41	9.8228301	9.8732227	9.9496075	10.0503925	10.1267773	10.1771698	19
42	9.8229721	9.8731102	9.9498619	10.0501381	10.1268898	10.1770279	18
43	9.8231138	9.8729976	9.9501162	10.0498838	10.1270024	10.1776862	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	9.8235386	9.8726594	9.9508791	10.0491209	10.1273406	10.1764614	14
47	9.8236800	9.8725466	9.9511334	10.0488666	10.1274534	10.1763200	13
48	9.8238213	9.8724337	9.9513876	10.0486124	10.1275663	10.1761787	12
49	9.8239626	9.8723207	9.9516419	10.0483581	10.1276793	10.1760374	11
50	9.8241037	9.8722076	9.9518961	10.0481039	19.1277924	10.1758963	10
51	9.8242448	9.8720945	9.9521503	10.0478497	10.1279055	10.1757552	9
52	9.8243858	9.8719813	9.9524045	10.0475955	10.1280187	10.1756142	8
53	9.8245267	9.8718681	9.9526587	10.0473413	10.1281319	10.1754733	7
54	9.8246676	9.8717548	9.9529128	10.0470872	10.1282452	10.1753324	6
55	9.8248083	9.8716414	9.9531670	10.0468330	10.1283586	10.1751917	5
56	9.8249490	9.8715279	9.9534211	10.0465789	10.1284721	10.1750510	4
57	9.8250896	9.8714144	9.9536752	10.0463248	10.1285856	10.1749104	3
58	9.8252301	9.8713008	9.9539293	10.0460707	10.1286992	10.1747699	2
59	9.8253705	9.8711872	9.9541834	10.0458166	10.1288128	10.1746295	1
60	9.8255109	9.8710735	9.9544374	10.0455626	10.1289265	10.1744891	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

48 DEGREES.

42 DEGREES

M	N. Sine	N. Co-Sine.	N. Tangent.	N. Co-Tang.	N. Secant	N. Co-Secant	
0	6691306	7431448	9004041	11106121	13456327	14944765	60
1	6692467	7429501	9009309	11099630	13459853	14639940	59
2	6695628	7427554	9014580	11093140	13463382	14635118	58
3	6697788	7425606	9019854	11086653	13466914	14630301	57
4	6699948	7423657	9025131	11080171	13470449	14625488	56
5	6702107	7421708	9030411	11073693	13473987	14625680	55
6	6704266	7419758	9035694	11067219	13477528	14615875	54
7	6706424	7417808	9040979	11060750	13481072	14911076	53
8	6708582	7415857	9046267	11054284	13484619	14906280	52
9	6710739	7413905	9051558	11047823	13488169	14901489	51
10	6712895	7411953	9056851	11041365	13491721	14896703	50
11	6715051	7410000	9062147	11034912	13495277	14891920	49
12	6717206	7408046	9067446	11028463	13498836	14887142	48
13	6719361	7406092	9072748	11022019	13502398	14882369	47
14	6721515	7404137	9078053	11015578	13505963	14877599	46
15	6723668	7402181	9083360	11009141	13509531	14872834	45
16	6725821	7400225	9088671	11002709	13513102	14868073	44
17	6727973	7398268	9093984	10996281	13516676	14863317	43
18	6730125	7396311	9099300	10989856	13520254	14858565	42
19	6732276	7394353	9104619	10983436	13523834	14853817	41
20	6734427	7392394	9109941	10977020	13527417	14849073	40
21	6736577	7390435	9115265	10970608	13531003	14844334	39
22	6738727	7388475	9120592	10964201	13534593	14839599	38
23	6740876	7386515	9125922	10957797	13538186	14834868	37
24	6743024	7384554	9131255	10951397	13541781	14830142	36
25	6745172	7382592	9136591	10945002	13545379	14825420	35
26	6747319	7380629	9141929	10938610	13548980	14820702	34
27	6749466	7378665	9147270	10932223	13552585	14815988	33
28	6751612	7376702	9152615	10925840	13556193	14811278	32
29	6753757	7374738	9157962	10919460	13559803	14806573	31
30	6755902	7372773	9163312	10913085	13563417	14801872	30
31	6758046	7370808	9168665	10906714	13567034	14797176	29
32	6760190	7368842	9174020	10900347	13570654	14792483	28
33	6762333	7366875	9179379	10893983	13574277	14787795	27
34	6764476	7364907	9184740	10887624	13577903	14783111	26
35	6766618	7362939	9190104	10881269	13581532	14778431	25
36	6768760	7360971	9195471	10874918	13585164	14773755	24
37	6770901	7359002	9200841	10868571	13588800	14769084	23
38	6773041	7357032	9206214	10862228	13592438	14764417	22
39	6775181	7355061	9211590	10855889	13596080	14759754	21
40	6777320	7353090	9216968	10849554	13599725	14755095	20
41	6779459	7351118	9222350	10843223	13603372	14750440	19
42	6781597	7349146	9227734	10836896	13607023	14745790	18
43	6783734	7347173	9233122	10830573	13610677	14741144	17
44	6785871	7345199	9238512	10824254	13614334	14736501	16
45	6788007	7343225	9243905	10817939	13617995	14731864	15
46	6790143	7341250	9249301	10811628	13621658	14727230	14
47	6792278	7339275	9254700	10805321	13625324	14722600	13
48	6794413	7337299	9260101	10799018	13628994	14717975	12
49	6796547	7335322	9265506	10792718	13632667	14713353	11
50	6798681	7333345	9270914	10786423	13636343	14708736	10
51	6800814	7331367	9276324	10780132	13640022	14704123	9
52	6802946	7329388	9281738	10773844	13643704	14699514	8
53	6805078	7327409	9287154	10767561	13647389	14694910	7
54	6807209	7325429	9292573	10761282	13651078	14690309	6
55	6809339	7323448	9297996	10755006	13654770	14685713	5
56	6811469	7321467	9303421	10748734	13658464	14681120	4
57	6813599	7319485	9308846	10742467	13662162	14676532	3
58	6815728	7317503	9314280	10736203	13665863	14671948	2
59	6817856	7315520	9319714	10729943	13669567	14667368	1
60	6819984	7313537	9325151	10723687	13673275	14662792	0
	N. Co-Sine.	N. Sine.	N. Co-Tang.	N. Tangent.	N. Co-Secant	N. Secant.	M

47 DEGREES.

42 DEGREES.

M	L. Sine.	L. Co.Sine.	L. Tangent	L. Co Tang.	L. Secant.	L. Co-Secant.	
0	9.8255109	9.8710735	9.9544374	10.0455626	10.1289265	10.1744891	60
1	9.8256512	9.8709597	9.9546915	10.0453085	10.1290403	10.1743408	59
2	9.8257913	9.8708458	9.9549455	10.0450545	10.1291542	10.1742087	58
3	9.8259314	9.8707319	9.9551995	10.0448005	10.1292681	10.1740686	57
4	9.8260715	9.8706179	9.9554535	10.0445465	10.1293821	10.1739285	56
5	9.8262114	9.8705039	9.9557075	10.0442925	10.1294961	10.1737886	55
6	9.8263512	9.8703898	9.9559615	10.0440385	10.1296102	10.1736488	54
7	9.8264910	9.8702756	9.9562154	10.0437846	10.1297244	10.1735090	53
8	9.8266307	9.8701613	9.9564694	10.0435306	10.1298387	10.1733693	52
9	9.8267703	9.8700470	9.9567233	10.0432767	10.1299530	10.1732297	51
10	9.8269098	9.8699326	9.9569772	10.0430228	10.1300674	10.1730902	50
11	9.8270493	9.8698182	9.9572311	10.0427689	10.1301818	10.1729507	49
12	9.8271887	9.8697037	9.9574850	10.0425150	10.1302963	10.1728113	48
13	9.8273279	9.8695891	9.9577389	10.0422611	10.1304109	10.1726721	47
14	9.8274671	9.8694744	9.9579927	10.0420073	10.1305256	10.1725329	46
15	9.8276063	9.8693597	9.9582465	10.0417535	10.1306403	10.1723937	45
16	9.8277453	9.8692449	9.9585004	10.0414996	10.1307551	10.1722547	44
17	9.8278843	9.8691301	9.9587542	10.0412458	10.1308699	10.1721157	43
18	9.8280231	9.8690152	9.9590080	10.0409920	10.1309848	10.1719769	42
19	9.8281619	9.8689002	9.9592618	10.0407382	10.1310998	10.1718381	41
20	9.8283006	9.8687851	9.9595155	10.0404845	10.1312149	10.1716994	40
21	9.8284393	9.8686700	9.9597693	10.0402307	10.1313300	10.1715607	39
22	9.8285778	9.8685548	9.9600230	10.0399770	10.1314452	10.1714222	38
23	9.8287163	9.8684396	9.9602767	10.0397233	10.1315604	10.1712837	37
24	9.8288547	9.8682242	9.9605305	10.0394695	10.1316758	10.1711453	36
25	9.8289930	9.8682088	9.9607842	10.0392158	10.1317912	10.1710070	35
26	9.8291312	9.8680934	9.9610378	10.0389622	10.1319066	10.1708688	34
27	9.8292694	9.8679779	9.9612915	10.0387085	10.1320221	10.1707306	33
28	9.8294075	9.8678623	9.9615452	10.0384548	10.1321377	10.1705925	32
29	9.8295454	9.8677466	9.9617988	10.0382012	10.1322534	10.1704546	31
30	9.8296833	9.8676309	9.9620525	10.0379475	10.1323691	10.1703167	30
31	9.8298212	9.8675151	9.9623061	10.0376939	10.1324849	10.1701788	29
32	9.8299589	9.8673992	9.9625597	10.0374403	10.1326008	10.1700411	28
33	9.8300966	9.8672833	9.9628133	10.0371867	10.1327167	10.1699034	27
34	9.8302342	9.8671673	9.9630669	10.0369331	10.1328327	10.1697658	26
35	9.8303717	9.8670512	9.9633204	10.0366796	10.1329488	10.1696283	25
36	9.8305091	9.8669351	9.9635740	10.0364260	10.1330649	10.1694909	24
37	9.8306464	9.8668189	9.9638275	10.0361725	10.1331811	10.1693536	23
38	9.8307837	9.8667026	9.9640811	10.0359189	10.1332974	10.1692163	22
39	9.8309209	9.8665863	9.9643346	10.0356654	10.1334137	10.1690791	21
40	9.8310580	9.8664699	9.9645881	10.0354119	10.1335301	10.1689420	20
41	9.8311950	9.8663534	9.9648416	10.0351584	10.1336466	10.1588050	19
42	9.8313320	9.8662369	9.9650951	10.0349049	10.1337631	10.1686680	18
43	9.8314688	9.8661203	9.9653486	10.0346514	10.1338797	10.1685312	17
44	9.8316056	9.8660036	9.9656020	10.0343980	10.1339964	10.1683944	16
45	9.8317423	9.8658868	9.9658555	10.0341445	10.1341132	10.1682577	15
46	9.8318789	9.8657700	9.9661089	10.0338911	10.1342300	10.1681211	14
47	9.8320155	9.8656531	9.9663623	10.0336377	10.1343469	10.1679845	13
48	9.8321519	9.8655362	9.9666157	10.0333843	10.1344638	10.1678481	12
49	9.8322883	9.8654192	9.9668692	10.0331308	10.1345808	10.1677117	11
50	9.8324246	9.8653021	9.9671225	10.0328775	10.1346979	10.1675754	10
51	9.8325609	9.8651849	9.9673759	10.0326241	10.1348151	10.1674391	9
52	9.8326970	9.8650677	9.9676293	10.0323707	10.1349323	10.1673030	8
53	9.8328321	9.8649504	9.9678827	10.0321173	10.1350496	10.1671669	7
54	9.8329691	9.8648331	9.9681360	10.0318640	10.1351669	10.1670309	6
55	9.8331050	9.8647156	9.9683893	10.0316107	10.1352844	10.1668950	5
56	9.8332408	9.8645981	9.9686427	10.0313573	10.1354019	10.1667592	4
57	9.8333766	9.8644806	9.9688960	10.0311040	10.1355194	10.1666234	3
58	9.8335122	9.8643629	9.9691493	10.0308507	10.1356371	10.1664878	2
59	9.8336478	9.8642452	9.9694026	10.0305974	10.1357548	10.1663522	1
60	9.8337833	9.8641275	9.9696559	10.0303441	10.1358725	10.1662167	0
	L. Co-Sine.	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L. Secant.	M

47 DEGREES.

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43 DEGREES

M	N. Sine	N. Co-Sine	N. Tangent	N. Co-Tang.	N. Secant	N. Co-Secant	
0	6819984	7313537	9325151	10723687	13673275	14662792	60
1	6822111	7311553	9330591	10717435	13676985	14658220	59
2	6824237	7309568	9336034	10711187	13680699	14653652	58
3	6826363	7307583	9341479	10704943	13684416	14649088	57
4	6828488	7305597	9346928	10698702	13688136	14644529	56
5	6830613	7303610	9352380	10692466	13691859	14639973	55
6	6832737	7301623	9357834	10686233	13695586	14635422	54
7	6834861	7299635	9363292	10680004	13699316	14630875	53
8	6836984	7297646	9368753	10673779	13703048	14626331	52
9	6839107	7295657	9374216	10667558	13706784	14621792	51
10	6841229	7293657	9379683	10661341	13710523	14617257	50
11	6843350	7291677	9385152	10655128	13714266	14612726	49
12	6845471	7289686	9390625	10648918	13718011	14608198	48
13	6847591	7287694	9396101	10642713	13721760	14603675	47
14	6849711	7285702	9401579	10636511	13725512	14599156	46
15	6851830	7283709	9407061	10630313	13729268	14594641	45
16	6853948	7281716	9412545	10624119	13733026	14590130	44
17	6856066	7279722	9418033	10617929	13736788	14585623	43
18	6858183	7277727	9423523	10611742	13740553	14581120	42
19	6860300	7275732	9429017	10605560	13744321	14576621	41
20	6862416	7273736	9434513	10599381	13748092	14572127	40
21	6864532	7271740	9440013	10593206	13751867	14567636	39
22	6866647	7269743	9445516	10587034	13755645	14563149	38
23	6868761	7267745	9451021	10580867	13759426	14558666	37
24	6870875	7265747	9456530	10574703	13763210	14554187	36
25	6872988	7263748	9462042	10568544	13766998	14549712	35
26	6875101	7261748	9467556	10562388	13770789	14545241	34
27	6877213	7259748	9473074	10556235	13774583	14540774	33
28	6879324	7257747	9478595	10550087	13778380	14536311	32
29	6881435	7255746	9484119	10543942	13782181	14531852	31
30	6883545	7253744	9489646	10537801	13785985	14527397	30
31	6885655	7251741	9495176	10531664	13789792	14522946	29
32	6887764	7249738	9500709	10525531	13793602	14518498	28
33	6889873	7247734	9506245	10519401	13797416	14514055	27
34	6891981	7245729	9511784	10513275	13801233	14509616	26
35	6894089	7243724	9517326	10507153	13805053	14505181	25
36	6896196	7241718	9522871	10501034	13808877	14500749	24
37	6898302	7239712	9528420	10494920	13812704	14496322	23
38	6900407	7237705	9533971	10488809	13816534	14491898	22
39	6902512	7235698	9539526	10482702	13820367	14487478	21
40	6904617	7233690	6545083	10476598	13824204	14483063	20
41	6906721	7231681	9550644	10470498	13828044	14478651	19
42	6918824	7229671	9556208	10464402	13831887	14474243	18
43	6910927	7227661	9561774	10458310	13835734	14469839	17
44	6913029	7225651	9567344	10452221	13839584	14465439	16
45	6915131	7223640	9572917	10446136	13843437	14461043	15
46	6917232	7221628	9578494	10440055	13847294	14456651	14
47	6919332	7219615	9584073	10433977	13851154	14452262	13
48	6921432	7217602	9589655	10427904	13855017	14447878	12
49	6923531	7215588	9595241	10421833	13858883	14443497	11
50	6925630	7213574	9600829	10415767	13862753	14439120	10
51	6927728	7211559	9606421	10409704	13866626	14434748	9
52	6929825	7209544	9612016	10403645	13870503	14430379	8
53	6931922	7207528	9617614	10397589	13874383	14426013	7
54	6934018	7205511	9623215	10391537	13878266	14421652	6
55	6936114	7203494	9628819	10385489	13882153	14417295	5
56	6938209	7201476	9634427	10379445	13886042	14412941	4
57	6940304	7199457	9640037	10373404	13889936	14408591	3
58	6942398	7197438	9645651	10367367	13893832	14404246	2
59	6944491	7195418	9651268	10361333	13897732	14399904	1
60	6946584	7193398	9656888	10355303	13901636	14395565	0
	N Co-Sine.	N. Sine.	N. Co Tang	N. Tangent.	N. Co-Secant	N. Secant.	M

46 DEGREES.

43 DEGREES.

M	L. Sine.	L Co.-Sine	L. Tangent	L. Co.Targ.	L. Secant.	Co L. Secant	
0	9.8337833	9.8641275	9.9696559	10.0303441	10.1358725	10.1662167	60
1	9.8339188	9.8640096	9.9699091	10.0300909	10.1359904	10.1660812	59
2	9.8340541	9.8638917	9.9701624	10.0298376	10.1361083	10.1659459	58
3	9.8341894	9.8637737	9.9704157	10.0295843	10.1362263	10.1658106	57
4	9.8343246	9.8636557	9.9706689	10.0293311	10.1363443	10.1656754	56
5	9.8344597	9.8635376	9.9709221	10.0290779	10.1364624	10.1655403	55
6	9.8345948	9.8634194	9.9711754	10.0288246	10.1365806	10.1654052	54
7	9.8347297	9.8633011	9.9714286	10.0285714	10.1366989	10.1652703	53
8	9.8348646	9.8631828	9.9716818	10.0283182	10.1368172	10.1651354	52
9	9.8349994	9.8630644	9.9719350	10.0280650	10.1369356	10.1650006	51
10	9.8351341	9.8629460	9.9721882	10.0278114	10.1370540	10.1648559	50
11	9.8352688	9.8628274	9.9724413	10.0275587	10.1371726	10.1647312	49
12	9.8354033	9.8627088	9.9726945	10.0273055	10.1372912	10.1645967	48
13	9.8355378	9.8625902	9.9729477	10.0270523	10.1374098	10.1644622	47
14	9.8356722	9.8624714	9.9732008	10.0267992	10.1375286	10.1643278	46
15	9.8358066	9.8623526	9.9734539	10.0265461	10.1376474	10.1641934	45
16	9.8359408	9.8622338	9.9737071	10.0262929	10.1377662	10.164059	44
17	9.8360750	9.8621148	9.9739602	10.0260398	10.1378852	10.1639250	43
18	9.8362091	9.8619958	9.9742133	10.0257867	10.1380042	10.1637909	42
19	9.8363431	9.861876	9.9744664	10.0255336	10.1381233	10.1636569	41
20	9.8364771	9.8617576	9.9747195	1.00252805	10.1382424	10.1635229	40
21	9.8366109	9.8616383	9.9749726	10.0250274	10.1383617	10.1633891	39
22	9.8367447	9.8615190	9.9752257	10.0247743	10.1384810	10.1632553	38
23	9.8368784	9.8613997	9.9754787	10.0245213	10.1386003	10.1631216	37
24	9.8370121	9.8612803	9.9757318	10.0242682	10.1387197	10.1629879	36
25	9.8371456	9.8611608	9.9759849	10.0240151	10.1388392	10.1628541	35
26	9.8372791	9.8610412	9.9762379	10.0237621	10.1389588	10.1627209	34
27	9.8374125	9.8609215	9.9764909	10.0237621	10.1390785	10.1625875	33
28	9.8375458	9.8608018	9.9767440	10.0237560	10.1391982	10.1624542	32
29	9.8376790	9.8606821	9.9769970	10.0230030	10.1393179	10.1623210	31
30	9.8378122	9.8605622	9.9772500	10.0227500	10.1394378	10.1621878	30
31	9.8379453	9.8604423	9.9775030	10.0224970	10.1395577	10.1620547	29
32	9.8380783	9.8603223	9.9777560	10.0222440	10.1396777	10.1619217	28
33	9.8382112	9.8602022	9.9780090	10.0219910	10.1397978	10.1617888	27
34	9.8383441	9.8600821	9.9782620	10.0217380	10.1399179	10.1616559	26
35	9.8384769	9.8599619	9.9785149	10.0214851	10.1400381	10.1615231	25
36	9.8386096	9.8598416	9.9787679	10.0212321	10.1401584	10.1613904	24
37	9.8387422	9.8597213	9.9790209	10.0209791	10.1402787	10.1612578	23
38	9.8388747	9.8596009	9.9792738	10.0207262	10.1403991	10.1611253	22
39	9.8390072	9.8594804	9.9795268	10.0204732	10.1405196	10.1609928	21
40	9.8391399	9.8593599	9.9797797	10.0202203	10.1406401	10.1608604	20
41	9.8392719	9.8592393	9.9800326	10.0199674	10.1407607	10.1607281	19
42	9.8394041	9.8591186	9.9802856	10.0197144	10.1408814	10.1605959	18
43	9.8395353	9.8589978	9.9805385	10.0194615	10.1410022	10.1604637	17
44	9.8396684	9.8588770	9.9807914	10.0192086	10.1411230	10.1603316	16
45	9.8398004	9.8587561	9.9810443	10.0189557	10.1412439	10.1601995	15
46	9.8399323	9.8586351	9.9812972	1.00187028	10.1413649	10.1600677	14
47	9.8400642	9.8585141	9.9815501	1.00184499	10.1414859	10.1599358	13
48	9.8401959	9.8583929	9.9818030	10.0181970	10.1416071	10.1598041	12
49	9.8403276	9.8582718	9.9820559	10.0179441	10.1417282	10.1595724	10
50	9.8404593	9.8581505	9.9823087	10.0176913	10.1418495	10.1595407	11
51	9.8405908	9.8580292	9.9825616	10.0174384	10.1419708	10.1594092	9
52	9.8407223	9.8579078	9.9828145	10.0171855	10.1420922	10.1592777	8
53	9.8408537	9.8577863	9.9830673	10.0169327	10.1422137	10.1591463	7
54	9.8409850	9.8576648	9.9833202	10.0166798	10.1423352	10.1590150	6
55	9.8411162	9.8575432	9.9835730	10.0164270	10.1424568	10.1588838	5
56	9.8412474	9.8574215	9.9838259	10.0161741	10.1425785	10.1587520	4
57	9.8413785	9.8572998	9.9840787	10.0159213	10.1427002	10.1586215	3
58	9.8415095	9.8571779	9.9843315	10.0156685	10.1428221	10.1584905	2
59	9.8416404	9.8570561	9.9845844	10.0154156	10.1429439	10.1583596	1
60	9.8417713	9.8579341	9.9848372	1.00151628	10.1420659	10.1582287	0
	L Co-Sine	L. Sine.	L. Co-Tang.	L. Tangent.	L. Co-Secant	L Secant	M

46 DEGREES.

44 DEGREES.

M	N. Sine	N.Co.Sine.	N. Tangent	N.Co-Tang.	N. Secant.	N. Co-Secant.	
0	6946584	7193398	9656888	10355303	13901636	14395565	60
1	6948676	7191377	9662511	10349277	13905543	14391231	59
2	6950767	7189355	9668137	10343254	13909453	14386900	58
3	6952858	7187333	9673767	10337235	13913366	14382574	57
4	6954949	7185310	9679400	10331220	13917283	14378251	56
5	6957039	7183287	9685035	10325208	13921203	14373932	55
6	6959128	7181263	9690674	10319199	13925127	14369616	54
7	6961217	7179238	9696316	10313195	13929054	14365305	53
8	6963305	7177213	9701962	10307194	13932985	14360997	52
9	6965392	7175187	9707610	10301196	13936918	14356693	51
10	6967479	7173161	9713262	10295203	13940856	14352393	50
11	6969565	7171134	9718917	10289212	13944796	14348097	49
12	6971651	7169106	9724575	10283226	13948740	14343805	48
13	6973736	7167078	9730236	10277243	13952688	14339516	47
14	6975821	7165049	9735901	10271263	13956639	14335231	46
15	6977905	7163019	9741569	10265287	13960593	14330950	45
16	6979988	7160989	9747240	10259315	13964551	14326672	44
17	6982071	7158958	9752914	10253346	13968512	14322399	43
18	6984153	7156927	9758591	10247381	13972477	14318129	42
19	6986234	7154895	9764272	10241419	13976445	14313863	41
20	6988315	7152863	9769956	10235461	13980416	14309600	40
21	6990396	7150830	9775643	10229506	13984391	14305342	39
22	6992476	7148796	9781333	10223455	13988369	14301087	38
23	6994555	7146763	9787027	10217608	13992351	14296836	37
24	6996633	7144727	9792724	10211664	13996336	14292588	36
25	6998711	7142691	9798424	10205723	14000325	14288344	35
26	7000789	7140655	9804127	10199786	14004317	14284104	34
27	7002866	7138618	9809833	10193853	14008313	14279868	33
28	7004942	7136581	9815543	10187923	14012312	14275636	32
29	7007018	7134543	9821256	10181997	14016315	14271407	31
30	7009093	7132505	9826973	10176074	14020321	14267182	30
31	7011167	7130466	9832692	10170155	14024330	14262961	29
32	7013241	7128426	9838415	10164239	14028343	14258743	28
33	7015314	7126385	9844141	10158326	14032360	14254929	27
34	7017387	7124344	9849871	10152417	14036380	14250319	26
35	7019459	7122302	9855603	10146512	14040403	14246112	25
36	7021530	7120260	9861339	10140610	14044430	14241909	24
37	7023601	7118217	9867079	10134712	14048460	14237710	23
38	7025671	7116174	9872821	10128817	14052494	14233514	22
39	7027741	7114130	9878567	10122925	14056532	14229323	21
40	7029810	7112086	9884316	10117037	14060573	14225134	20
41	7031879	7110041	9890069	10111153	14064617	14220950	19
42	7033947	7107995	9895825	10105272	14068665	14216769	18
43	7036014	7195948	9901584	10099394	14072717	14212592	17
44	7038081	7103901	9907346	10093520	14076772	14208418	16
45	7040147	7101854	9913112	10087649	14080831	14204248	15
46	7042213	7099806	9918881	10081782	14084893	14200082	14
47	7044278	7097757	9924654	10075918	14088958	14195919	13
48	7046342	7095707	9930429	10070058	14093028	14191761	12
49	7048406	7093657	9936208	10064201	14097100	14187605	11
50	7050469	7091607	9941991	10058347	14101177	14183454	10
51	7052532	7089556	9947777	10052497	14105256	14179305	9
52	7054594	7087504	9953566	10046651	14109340	14175161	8
53	7056655	7085451	9959358	10040807	14113427	14171020	7
54	7058716	7083398	9965154	10034968	14117517	14166883	6
55	7060776	7081345	9970953	10029131	14121611	14162749	5
56	7062835	7079291	9976756	10023298	14125709	14158619	4
57	7064894	7077236	9982562	10017469	14129810	14154493	3
58	7066953	7075180	9988371	10011642	14133915	14150370	2
59	7069011	7073124	9994184	10005819	14138024	14146251	1
60	7071068	7071068	10000000	10000000	14142136	14142136	0
	N.Co.Sine.	N. Sine.	L.Co Tang.	N.Tangent.	N. Co-Secant	N.Secant.	M

45 DEGREES.

The END of the TABLE of

44 DEGREES.

M	L. Sine.	L Co.-Sine	L. Tangent	L. Co.Tang.	L. Secant.	L Co-Secant	
0	9.8417713	9.8569341	9.9848327	10.0151628	10.1430659	10.1582287	60
1	9.8419021	9.8568121	9.9850900	10.0149100	10.1431879	10.1580979	59
2	9.8420328	9.8566900	9.9853428	10.0146572	10.1433100	10.1579672	58
3	9.8421634	9.8565670	9.9855956	10.0144044	10.1434322	10.1578366	57
4	9.8422939	8.8564455	9.9858484	10.0141516	10.1435545	10.1577061	56
5	9.8424244	9.8563232	9.9861012	10.0138988	10 1436768	10.1575756	55
6	9.8425548	9.8562006	9.9863540	10 0136460	10.1437992	10.1574452	54
7	9.8426851	9.8560784	9.9866068	10.0133932	10.1439216	10.1573149	53
8	9.8428154	9.8559558	9.9868596	10.0131404	10.1440442	10.1571846	52
9	9.8429456	9.8558332	9.9871123	10.0128877	10.1441668	10.1570544	51
10	9.8430757	9.8557106	9.9873651	10.0126349	10.1442894	10.1569243	50
11	9.8432057	9 8555878	9.9876179	10.0123821	10.1444122	10.1567943	49
12	9.8433356	9.8554650	9.9878706	10.0121294	10.1445350	10.1566644	48
13	9.8434655	9.8553421	9.9881234	10.0118766	10.1446579	10.1565345	47
14	9.8435953	9.8552191	9.9883761	10 0116239	10.1447808	10.1564047	46
15	9.8437250	9.8550961	9.9886289	10.0113711	10.1449039	10.1562750	45
16	9.8438547	9.8549730	9.9888816	10.0111184	10.1450270	10.1561453	44
17	9.8439842	9.8548499	9.9891344	10 0108656	10.1451501	10.1560158	43
18	9.8441137	9.8547266	9.9893871	10.0106129	10.1452734	10.1558863	42
19	9.8442432	9.8546033	9.9896399	10.0103601	10.1453967	10.1557568	41
20	9.8443725	9.8544799	9.9898926	10.0100014	10.1455201	10.1556275	40
21	9.8445018	9.8543564	9.9901453	10.0098547	10.1456436	10.1554982	39
22	9.8446310	9.8542329	9.9903981	10.0096019	10.1457671	10 1553690	38
23	9.8447601	9.8541093	9.9906508	10.0093492	10 1458907	10.1552399	37
24	9.8448891	9.8539856	9.9909035	10.0090965	10.1460144	10.1551109	36
25	9.8450181	9.8538619	9.9911562	10.0088438	10.1461381	10.1549819	35
26	9.8451470	9.8537381	9.9914089	10.0085911	10.1462619	10.1548530	34
27	9.8452758	9.8536142	9.9916616	10.0083384	10.1463858	10.1547242	33
28	9.8454045	9.8534902	9.9919143	10.0080857	10.1465098	10 1545955	32
29	9.8455332	9.8533662	9.9921670	10.0078330	10.1466338	10.1544668	31
30	9.8456618	9.8532421	9.9924197	10.0075803	10.1467579	10.1543382	30
31	9.8457903	9 8531179	9.9926724	10.0073276	10.1468821	10.1542097	29
32	9 8459188	9.8529936	9.9929251	10.0070749	10.1470064	10.1540812	28
33	9.8460471	9.8528693	9.9931778	10.0008222	10.1471307	10.1539519	27
34	9.8461754	9.8527449	9.9934305	10.0065695	10.1472551	10.1538246	26
35	9.8463036	9.8526204	9.9936832	10.0063168	10.1473796	10.1536964	25
36	9.8464318	9.8524959	9.9939359	10.0060641	10.1475041	10.1535682	24
37	9.8465597	9.8523713	9.9941886	10.0058114	10.1476287	10.1534401	23
38	9.8466879	9.8522460	9.9944413	10.0055587	10.1477534	10.1533121	22
39	9.8468158	9.8521218	9.9946940	10.0053050	10.1478782	10.1531842	21
40	9.8469436	9.8519970	9.9949466	10.0050534	10.1480030	10.1530564	20
41	9.8470714	9.8518721	9.9951993	10.0048007	10.1481279	10.1529286	19
42	9.8471991	9.8517471	9.9954520	10 0045480	10.1482529	10.1528009	18
43	9.8473267	9.8516220	9 9957047	10.0042953	10.1483780	10.1526733	17
44	9.8474543	9.8514969	9.9959573	10.0040427	10.1485031	10.1525457	16
45	9.8475817	9.8513717	9.9962100	10.003790	10.1486283	10.1524183	15
46	9.8477091	9.8512465	9.9964627	10.0035373	10.1487535	10.1522909	14
47	9 8478365	9.8511211	9.9967154	10.0032846	10.1488789	10.1521635	13
48	9.8479637	9.8509957	9.9969680	10.0030320	10.1490043	10.1520363	12
49	9.8480909	9.8508702	9.9972207	10.0027793	10.1491298	10.1519091	11
50	9.8482180	9 8507446	9.9974734	10.0025266	10.1492554	10.1517820	10
51	9.8483450	9.8506190	9.9977260	10.0022740	10.1493810	10.1516550	9
52	9.8484720	9.8504933	9.9979787	10.0020213	10.1495067	10.1515280	8
53	9.8485989	9.8503675	9.9982314	10.0017686	10.1496325	10.1514011	7
54	9.8487257	9.8502417	9.9984840	10.001516	10.1497583	10.1512743	6
55	9.8488524	9.8501157	9 9987367	10.0012633	10.1498843	10.1511476	5
56	9.8489791	9 8499897	9.9989893	10.0010107	10.1500103	10.1510209	4
57	9.8491057	9.8498637	9.9992420	10.0007580	10.1501363	10.1508943	3
58	9.8492322	9.8497375	9.9994947	10.0005053	10.1502725	10.1507678	2
59	9.8493586	9.8496113	9.9997473	10.0002527	10 1503887	10.1506414	1
60	9.8494850	9.8494850	10 0000000	10.0000000	10.1505150	10.1505150	0
	L Co Sine	L. Sine	L. Co-Tang.	L Tangent	L. Co-Secant	L. Secant.	M

45 DEGREES.

THE
Description and Use
OF THE
TABLES
OF
Natural and *Artificial Sines, Tangents,* and *Secants.*

THESE are continued to every Degree and 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 Right-hand 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 Case 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 Tables, 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 *Logarithmical Tangent* 9.6324015, &c.

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 you will find (reckoning the 23 upwards in the Right-hand Column of Minutes over M) that the *Natural Sine* will be 8781222, and the *Natural Tangent* will be 18353999; the *Logarithmick Sine* will be 9.9435549, and the *Logarithmick Tangent* will be 10.2637307; and so for the *Secants*, &c.

3. If you want the Natural or Artificial Sine, Tangent or Secant of any Ark greater than 90°. as suppose of 123°, 11′ you must first substract it from 180 if it be less than it, or from 360 when 'tis greater than 180; and then seek 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° 39′ For tho' it be not to be found there exactly, 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.

Thus the Arch to the Log. Sine 8.8647376, will be found to be 4°. 12′, &c.

How these Tables are useful in all kinds of Trigonometrical Calculations; as in Navigation, Dialling, Astronomy, &c. all Treatises on those Subjects 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 been committed; but whenever the *Calculator* finds Reason to suspect the Tables, it will be very easie for him, by considering the Course and Proportion of the Encrease or Decrease of the Numbers in the Tables, as they stand near that which he judges faulty, either above or below it, to find out nearly what Figure is wrong, and how much or how little; as Experience will soon teach him.

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Deg. 0, 1, 2, 3. A Table of Natural Versed

M	N. 0	N. 1	N. 2	N. 3	L. 0	L. 1	L. 2	L. 3	M
0	0000.000	0001.523	0006.092	0013.705	0.0000000	6.1827137	6.7847406	7.1368680	0
1	0000.001	0001.574	0006.194	0013.857	2.6264222	6.1970707	6.7919482	7.1416791	1
2	.002	1.62[illegible]	6.296	14.011	3.2284822	6.2111938	6.7990963	7.1464636	2
3	.004	1.679	6.400	14.165	3.5806647	6.2250913	6.8061860	7.1512219	3
4	007	1.733	6.505	14.320	3.8305422	6.2387696	6.8132185	7.1559542	4
5	.011	1.788	6.610	14.476	4.0243620	6.2522361	6.8201944	7.1606609	5
6	.016	1.843	6.716	14.633	4.1827246	6.2654968	6.8271147	7.1653422	6
7	0000.022	0001.89[illegible]	0006.823	0014.791	4.3166182	6.2785581	6.8339812	7.1699984	7
8	.028	1.956	6.931	14.950	4.4326020	6.2914259	6.8407920	7.1746297	8
9	.035	2.014	7.[illegible]40	15.109	4.5349070	6.3041058	6.8475506	7.1792365	9
10	.043	2.073	7.150	15.269	4.6264219	6.3166033	6.8542572	7.1838189	10
11	.052	2.133	7.260	15.430	4.7092072	6.3289234	6.8609122	7.1883773	11
12	.062	2.194	7.371	15.592	4.7847843	6.3410714	6,8675167	7.1929118	12
13	0000.073	0002.255	0007.483	0015.755	4.8543084	6.3530516	6.8740712	7.1974228	13
14	.084	2.317	7.596	15.919	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	2.444	7.825	16.248	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	5.1369663	6.4105928	6.9061221	7.2196326	18
19	0000.154	0002.641	0008.173	0016.749	5.1839282	6.4216574	6.9123926	7.2240071	19
20	.170	2.708	8.291	16.918	5.2284810	6.4325826	6.9186183	7.2283597	20
21	.187	2.776	8.410	17.088	5.2708594	6.4433603	6.9248004	7.2326906	21
22	.205	2.845	8.530	17.258	5.3112661	6.4540294	6.9309372	7.2370000	22
23	.224	2.915	8.651	17.429	5.3498762	6.4645573	6.9370316	7.2412881	23
24	.244	2.986	8.772	17.601	5.3868430	6.4749592	6.9430837	7.2455551	24
25	0000.265	0003.057	0008.894	0017.774	5.4223002	6.4852380	6.9490938	7.2498013	25
26	.287	3.129	9.017	17.948	5.4563669	6.4953965	6.9550627	7.2540267	26
27	.309	3.202	9.141	18.123	5.4891474	6.5054376	6.9609886	7.2582317	27
28	.332	3.276	9.266	18.299	5.5207359	6.5153639	6.9668786	7.2624164	28
29	.356	3.351	9.392	18.475	5.5512156	6.5251780	6.9727272	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	6.5444797	6.9843062	7.2748508	31
32	.434	3.581	9.773	19.009	5.6367191	6.5539720	6.9900387	7.2789563	32
33	.461	3.659	9.920	19.189	5.6634468	6.5633617	6.9957334	7.2830425	33
34	.489	3.738	10.032	19.36[illegible]	5.6893765	6.5726509	7.0013911	7.2871095	34
35	.518	3.818	10.163	19.550	5.7145546	6.5818418	7.0069920	7.2911576	35
36	.548	3.899	10.294	19.732	5.7390233	6.5909365	7.0125969	7.2951869	36
37	0000.579	0003.981	0010.426	0019.925	5.7628214	6.5999368	7.0182460	7.2991975	37
38	.611	4.063	10.559	20.099	5.7859850	6.6088450	7.0236600	7.3031897	38
39	.644	4.14[illegible]	10.693	20.284	5.8085468	6.6176626	7.0291390	7.3071636	39
40	.677	4.230	10.828	20.470	5.8305373	6.6263916	7.0345838	7.3111194	40
41	.711	4.315	10.964	20.657	5.8519848	6.6350337	7.0399946	7.3150572	41
42	.746	4.401	10.101	20.844	5.8729154	6.6435907	7.0453719	7.3189773	42
43	0000.782	0004.488	0011.239	0021.032	5.8933534	6.6520642	7.0507160	7.3228797	43
44	.819	4.576	11.377	21.221	5.9133217	6.6604558	7.0560276	7.3267646	44
45	.857	4.664	11.516	21.411	5.9328412	6.6687671	7.0613068	7.3306322	45
46	.896	4.753	11.656	21.602	5.9519314	6.6769996	7.0665540	7.3344827	46
47	.935	4.843	11.797	21.793	5.9706112	6.6851548	7.0717698	7.3383161	47
48	.975	4.934	11.939	21.985	5.9888977	6.6932340	7.0769544	7.3421327	48
49	0001.016	0005.026	0012.082	0022.178	6.0068070	6.7012388	7.0821082	7.3459326	49
50	1.058	5.119	12.225	22.372	6.0243546	6.7091706	7.0872316	7.3497159	50
51	1.101	5.213	12.369	22.567	6.0415546	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	6.0912008	6.7401921	7.1074280	7.3646863	54
55	0001.280	0005.595	0012.955	0023.355	6.1071384	6.7477774	7.1124044	7.3683888	55
56	1.327	5.693	13.103	23.554	6.1227887	6.7552970	7.1173527	7.3720757	56
57	1.375	5.792	13.252	23.754	6.1381620	6.7627520	7.1222728	7.3757469	57
58	1.424	5.891	13.402	23.955	6.1532679	6.7701436	7.1271652	7.3794027	58
59	1.473	5.991	13.553	24.157	6.1681156	6.7774728	7.1320302	7.3830431	59
60	1.523	6.092	13.705	24.360	6.1827137	6.7847406	7.1368680	7.3866683	60

Sines and their Logarithms. Deg. 89, 88, 87, 86.

M	L. 89	L. 88	L. 87	L. 86	N. 89.	N. 88.	N. 87	N. 86	M
60	10000000	9.9923536	9.9845725	9.9766544	10000000	9825.476	9651.005	9476.640	60
59	9.9998736	9.9922250	9.9844417	9.9765212	9997.091	9822.567	9648.098	9473.735	59
58	9.9997473	9.9920964	9.9843108	9.9763881	9994.182	9819.659	9645.191	9470.830	58
57	9.9996208	9.9919677	9.9841799	9.9762548	9991.273	9816.750	9642.284	9467.925	57
56	9.9994944	9.9918391	9.9840490	9.9761216	9988.364	9813.842	9639.337	9465.020	56
55	9.9993679	9.9917103	9.9839179	9.9759883	9985.456	9810.934	9636.470	9462.116	55
54	9.9992414	9.9915816	9.9837869	9.9758550	9982.547	9808.025	9633.563	9459.211	54
53	9.9991148	9.9914528	9.9836559	9.9757216	9979.638	9805.117	9630.656	9456.306	53
52	9.9989882	9.9913240	9.9835248	9.9755882	9976.729	9802.208	9627.749	9453.402	52
51	9.9988615	9.9911951	9.9833936	9.9754547	9973.820	9799.300	9624.842	9450.497	51
50	9.9987348	9.9910662	9.9832624	9.9753212	9970.912	9796.392	9621.936	9447.593	50
49	9.9986081	9.9909372	9.9831312	9.9751877	9968.003	9793.483	9619.029	9444.688	49
48	9.9984814	9.9908082	9.9830000	.9750541	9965.094	9790.575	9616.122	9441.784	48
47	9.9983546	9.9906792	9.9828686	9.9749205	9962.185	9787.667	9513.215	9438.880	47
46	9.9982278	9.9905501	9.9827373	9.9747868	9959.276	9784.759	9610.308	9435.976	46
45	9.9981009	9.9904210	9.9826059	9.9746531	9956.368	9781.851	9607.402	9433.072	45
44	9.9979740	9.9902919	9.9824745	9.9745194	9953.459	9778.943	9604.495	9430.168	44
43	9.9978470	9.9901627	9.9823431	9.9743856	9950.550	9776.035	9601.588	9427.264	43
42	9.9977201	9.9900335	9.9822116	9.9742519	9947.641	9773.127	9598.682	9424.360	42
41	9.9975930	9.9899043	9.9820801	9.9741180	9944.732	9770.219	9595.775	9421.456	41
40	9.9974660	9.9897750	9.9819485	9.9739841	9941.823	9767.311	9592.869	9418.552	40
39	9.9973389	9.9896456	9.9818169	9.9738502	9938.914	9764.403	9589.962	9415.648	39
38	9.9972118	9.9895163	9.9816853	9.9737162	9936.005	9761.495	9587.056	9412.744	38
37	9.9970846	9.9893869	9.9815536	9.9735822	9933.096	9758.587	9584.149	9409.840	37
36	9.9969574	9.9892575	9.9814219	9.9734482	9930.187	9755.679	9581.243	9406.936	36
35	9.9968302	9.9891280	9.9812901	9.9733141	9927.279	9752.771	9578.337	9404.033	35
34	9.9967029	9.9889985	9.9811583	9.9731800	9924.370	9749.863	9575.430	9401.129	34
33	9.9965756	9.9888689	9.9810265	9.9730458	9921.461	9746.955	9572.524	9398.225	33
32	9.9964483	9.9887393	9.9808946	9.9729117	9918.552	9744.047	9569.618	9395.322	32
31	9.9963209	9.9886097	9.9807627	9.9727774	9915.643	9741.139	9566.712	9392.418	31
30	9.9961935	9.9884801	9.9806308	9.9726431	9912.735	9738.231	9563.806	9389.515	30
29	9.9960660	9.9883503	9.9804988	9.9725088	9909.826	9735.323	9560.900	9385.511	29
28	9.9959385	9.9882206	9.9803668	9.9723745	9906.917	9732.415	9557.994	9383.708	28
27	9.9958110	9.9880908	9.9802347	9.9722401	9904.008	9729.507	9555.088	9380.804	27
26	9.9956834	9.9879610	9.9801026	9.9721056	9901.099	9726.599	9552.182	9377.901	26
25	9.9955558	9.9878311	9.9799704	9.9719712	9898.191	9723.692	9549.276	9374.998	25
24	9.9954282	9.9877013	9.9798383	9.9718367	9895.282	9720.784	9546.370	9372.095	24
23	9.9953005	9.9875713	9.9797060	9.9717021	9892.373	9717.876	9543.464	9369.192	23
22	9.9951728	9.9874414	9.9795738	9.9715675	9889.464	9714.968	9540.558	9366.289	22
21	9.9950450	9.9873114	9.9794415	9.9714329	9886.555	9712.060	9537.652	9363.386	21
20	9.9949172	9.9871813	9.9793092	9.9712982	9883.647	9709.153	9534.747	9360.483	20
19	9.9947894	9.9870512	9.9791768	9.9711635	9880.738	9706.245	9531.841	9357.580	19
18	9.9946615	9.9869211	9.9790444	9.9710288	9877.829	9703.337	9528.935	9354.677	18
17	9.9945336	9.9867910	9.9789119	9.9708940	9874.921	9700.430	9526.030	9351.774	17
16	9.9944057	9.9866608	9.9787795	9.9707592	9872.012	9697.522	9523.124	9348.871	16
15	9.9942777	9.9865305	9.9786469	9.9706243	9869.104	9694.615	9520.219	9345.969	15
14	9.9941497	9.9864003	9.9785144	9.9704894	9866.195	9691.707	9517.313	9343.066	14
13	9.9940216	9.9862700	9.9783817	9.9703545	9863.286	9688.800	9514.408	9340.163	13
12	9.9938936	9.9861396	9.9782491	9.9702195	9860.378	9685.892	9511.502	9337.261	12
11	9.9937654	9.9860092	9.9781164	9.9700845	9857.469	9682.985	9508.595	9334.358	11
10	9.9936373	9.9858788	9.9779837	9.9699494	9854.561	9680.079	9505.692	9331.456	10
9	9.9935091	9.9857484	9.9778509	9.9698143	9855.652	9677.170	9502.786	9328.553	9
8	9.9933808	9.9856179	9.9777182	9.9696792	9848.743	9674.263	9499.881	9325.651	8
7	9.9932526	9.9854873	9.9775853	9.9695440	9845.835	9671.355	9496.976	9322.749	7
6	9.9931243	9.9853568	9.9774525	9.9694088	9842.926	9668.448	9494.071	9319.847	6
5	9.9929959	9.9852261	9.9773195	9.9692735	9840.018	9665.541	9491.166	9316.945	5
4	9.9928675	9.9850955	9.9771866	9.9691382	9837.109	9662.633	9488.260	9314.043	4
3	9.9927391	9.9849648	9.9770536	9.9690029	9834.201	9659.726	9485.355	9311.141	3
2	9.9926106	9.9848341	9.9769206	9.9688675	9831.292	9656.819	9482.450	9308.239	2
1	9.9924821	9.9847033	9.9767875	9.9687321	9828.384	9653.912	9479.545	9305.337	1
0	9.9923536	9.9845725	9.9766544	9.9685967	9825.476	9651.005	9476.640	9302.435	0

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Deg. 4, 5, 6, 7. A Table of Natural Versed

M	N. 4	N. 5	N. 6	N. 7	L. 4	L. 5	L. 6	L. 7	M
0	0024.360	0038.053	0054.781	0074.539	7.3866683	7.5803891	7.7386303	7.8723800	0
1	0024.563	0038.307	0055.086	0074.894	7.3902785	7.5832777	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	75.607	7.3974540	7.5890263	7.7458319	7.8785550	3
4	25.178	39.074	56.004	75.964	7.4010196	7.5918864	7.7482192	7.8806033	4
5	25.385	39.331	56.212	76.322	7.4045706	7.5947322	7.7505999	7.8826469	5
6	25.592	39.589	56.621	76.681	7.4081071	7.5975783	7.7529742	7.8846856	6
7	0025.800	0039.848	0056.931	0077.041	7.4116293	7.6004103	7.7553419	7.8867196	7
8	26.009	40.108	57.241	77.681	7.4151372	7.6032331	7.7577031	7.8887487	8
9	26.219	40.369	57.552	77.764	7.4186311	7.6060468	7.7600580	7.8907784	9
10	26.430	40.630	57.864	78.126	7.4221109	7.6088513	7.7624064	7.8927928	10
11	26.642	40.893	58.177	78.484	7.4255767	7.6116468	7.7647485	7.8948078	11
12	26.855	41.156	58.491	78.853	7.4290288	7.6144333	7.7670843	7.8968181	12
13	0027.069	0041.420	0058.806	0079.218	7.4324672	7.6172109	7.7694138	7.8988238	13
14	27.283	41.685	59.121	79.584	7.4358921	7.6199796	7.7717371	7.9008248	14
15	27.498	41.951	59.437	79.951	7.4393034	7.6227395	7.7740541	7.9028212	15
16	27.714	42.217	59.754	80.318	7.4417015	7.6254906	7.7763649	7.9048130	16
17	27.931	42.485	60.072	80.686	7.4460862	7.6282330	7.7786696	7.9068002	17
18	28.149	42.753	60.391	81.055	7.4494578	7.6309668	7.7809682	7.9087829	18
19	0028.367	0043.022	0060.710	0081.425	7.4528163	7.6336920	7.7832607	7.9107610	19
20	28.586	43.292	61.030	81.796	7.4561619	7.6364086	7.7855472	7.9127346	20
21	28.806	43.563	61.351	82.168	7.4594946	7.6391167	7.7878276	7.9147038	21
22	29.027	43.835	61.673	82.541	7.4628146	7.6418164	7.7901020	7.9166684	22
23	29.249	44.107	61.996	82.914	7.4661219	7.6445078	7.7923705	7.9186268	23
24	29.472	44.380	62.320	83.288	7.4694166	7.6471908	7.7946331	7.9205844	24
25	0029.696	0044.655	0062.645	0083.663	7.4726989	7.6498655	7.7968897	7.9225358	25
26	29.921	44.930	62.971	84.039	7.4759688	7.6525320	7.7991405	7.9244827	26
27	30.146	45.205	63.297	84.416	7.4792265	7.6551903	7.8013855	7.9264253	27
28	30.372	45.482	63.624	84.794	7.4824719	7.6578404	7.8036246	7.9283636	28
29	30.599	45.760	63.952	85.172	7.4857052	7.6604825	7.8058580	7.9302975	29
30	30.827	46.038	64.281	85.551	7.4889265	7.6631166	7.8080856	7.9322271	30
31	0031.056	0046.317	0064.611	0085.931	7.4921359	7.6657427	7.8103076	7.9341523	31
32	31.285	46.597	64.942	86.312	7.4953353	7.6683608	7.8123237	7.9360734	32
33	31.515	46.878	65.273	86.694	7.4985193	7.6709711	7.8147343	7.9379901	33
34	31.746	47.160	65.605	87.077	7.5016934	7.6735735	7.8169392	7.9399027	34
35	31.978	47.443	65.938	87.460	7.5048560	7.6761682	7.8191386	7.9418110	35
36	32.211	47.726	66.272	87.844	7.5080071	7.6787550	7.8213323	7.9437151	36
37	0032.445	0048.010	0066.608	0088.229	7.5111468	7.6813342	7.8235205	7.9456150	37
38	32.680	48.295	66.943	88.615	7.5142751	7.6839058	7.8257032	7.9475107	38
39	32.915	48.581	67.279	89.002	7.5173922	7.6864697	7.8278804	7.9494023	39
40	33.151	48.868	67.616	89.391	7.5204982	7.6890260	7.8300522	7.9512898	40
41	33.388	49.156	67.954	89.779	7.5235930	7.6915749	7.8322185	7.9531732	41
42	33.626	49.444	68.293	90.168	7.5266769	7.6941162	7.8343794	7.9550525	42
43	0033.865	0049.734	0068.633	0090.558	7.5297498	7.6966502	7.8365349	7.9569276	43
44	33.405	50.024	68.974	90.949	7.5328119	7.6991767	7.8386851	7.9587988	44
45	34.345	50.315	69.315	91.341	7.5358632	7.7016959	7.8408299	7.9606663	45
46	34.586	50.607	69.657	91.734	7.5389038	7.7042078	7.8429695	7.9625290	46
47	34.828	50.900	70.000	92.124	7.5419338	7.7067124	7.8451037	7.9643880	47
48	35.071	51.193	70.344	92.521	7.5449532	7.7092098	7.8472327	7.9662431	48
49	0035.315	0051.487	0070.689	0092.916	7.5479321	7.7117001	7.8493565	7.9680942	49
50	35.560	51.783	71.035	93.312	7.5509607	7.7141832	7.8514751	7.9699414	50
51	35.806	52.079	71.382	93.709	7.5539489	7.7166592	7.8535885	7.9717846	51
52	36.052	52.375	71.729	94.107	7.5569268	7.7191281	7.8556968	7.9736239	52
53	36.299	52.673	72.077	94.506	7.5598946	7.7215900	7.8577999	7.9754593	53
54	36.547	52.972	72.426	94.905	7.5628522	7.7240450	7.8598980	7.9772908	54
55	0036.796	0053.271	0072.776	0095.395	7.5657997	7.7264930	7.8619910	7.9791184	55
56	37.046	53.572	73.127	95.796	7.5687373	7.7289341	7.8640789	7.9809422	56
57	37.297	53.873	73.479	96.108	7.5716650	7.7313683	7.8661618	7.9827621	57
58	37.548	54.175	73.831	96.511	7.5745828	7.7337658	7.8682397	7.9845782	58
59	37.800	54.477	74.184	96.915	7.5774908	7.7362164	7.8703126	7.9863905	59
60	38.053	54.781	74.539	97.319	7.5803891	7.7386303	7.8723806	7.9881990	60

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Sines, and their Logarithms — Deg. 85, 84, 83, 82

M	L. 85	L. 84	L. 83	L. 82	N. 85	N. 84	N. 83	N. 82	M
60	9.9685967	9.9603967	9.9520518	9.9435591	9302.435	9128.543	8954.715	8781,307	60
59	9.9684611	9.9602588	9.9519114	9.9434163	9299.533	9125.54[illegible]	8951.827	8778.420	59
58	9.9683256	9.9601205	9.9517711	9.9432735	9296.631	9122.647	8948.929	8775.533	58
57	9.9681900	9.9599825	9.95 6307	9.9431306	9293.730	9119.750	8946.036	8772.646	57
56	9.9680544	9.9598445	9.9514902	9.9429876	9290.828	9116.852	8943.143	8769.759	56
55	9.9679188	9.9597068	9.9513497	9.9428446	9287.927	9113.955	8940.251	8766.872	55
54	9.9677831	9.9595688	9.9512092	9.9427016	9285.025	9111.057	8937.358	8763.985	54
53	9.9676474	9.9594306	9.9510686	9.9425586	9282.124	9108.160	8934.466	8761.099	53
52	9.9675116	9.9592925	9.9509280	9.9424155	9279.223	9105.263	8931.574	8758.212	52
51	9.9673758	9.959154[illegible]	9.9507874	9.9422723	9276.222	9102.366	8928.682	8755.326	51
50	9.9672399	9.9590160	9.9506467	9.9421291	9273.421	9099.469	8925.790	8752.440	50
49	9.9671040	9.9588777	9.9505059	9.9419859	9270.520	9096.572	8922.898	8749.554	49
48	9.9669681	9.958739	9.950365[illegible]	9.9418426	9267.619	9093.675	8920.006	8746.668	48
47	9.9668321	9.9586010	9.9502243	9.9416993	9264.718	9090.778	8917.114	8743.782	47
46	9.9666961	9.9584626	9.9500835	9.941556[illegible]	9261.817	9087.881	8914.222	8740.856	46
45	9.9665601	9.9583241	9.9499426	9.9414125	9258.916	9084.984	8911.331	8738.010	45
44	9.9664240	9.9581857	9.9498016	9.9412691	9256.015	9082.087	8908.439	8735.124	44
43	9.9662879	9.9580471	9.9496606	9.9411256	9253.114	9079.191	8905.548	8732.239	43
42	9.9661517	9.9579086	9.9495196	9.9409822	9250.213	9076.294	8902.656	8729.353	42
41	9.9660155	9.9577699	9.9493785	9.9408385	924.7312	9073.398	8899.765	8726.468	41
40	9.9658793	9.9576313	9.9492375	9.9406949	9244.412	9070.502	8896.874	8723.583	40
39	9.9657430	9.9574926	9.9490963	9.9405513	9241.511	9067.605	8893.983	8720.698	39
38	9.9656067	9.9573539	9.9489553	9.9404076	9238.611	9064.709	8891.092	8717.813	38
37	9.9654703	9.9572151	9.9488139	9.9402638	9235.710	9061.813	8888.201	8714.928	37
36	9.9653339	9.9570763	9.9486716	9.9401201	9232.810	9058.917	8885.310	8712.043	36
35	9.9651974	9.9569374	9.9485313	9.9399762	9229.910	9056.021	8882.420	8709.159	35
34	9.9650610	9.9567985	9.9483899	9.9398324	9227.009	9053.125	8879.529	8706.274	34
33	9.9649244	9.9566596	9.9482485	9.9396885	9224.109	9050.229	8876.639	8703.390	33
32	9.9647879	9.9565206	9.9481071	9.9395445	9221.209	9047.333	8873.746	8700.505	32
31	9.9646512	9.9563816	9.9479656	9.9394005	9218.309	9044.437	8870.858	8697.622	31
30	9.9645146	9.9562425	9.9478241	9.9392565	9215.409	9041.542	8867.968	8694.738	30
29	9.9643779	9.9561034	9.9476825	9.9391224	9212.509	9038.646	8865.078	8691.854	29
28	9.9642412	9.9559643	9.9475409	9.9389083	9209.609	9035.751	8862.188	8688.970	28
27	9.9641044	9.9558251	9.9473993	9.938[illegible]241	9206.709	9032.856	8859.298	8686.086	27
26	9.9639676	9.9556859	9.9472576	9.9386800	9203.809	9029.061	8856.408	8683.202	26
25	9.9638308	9.9555466	9.9471159	9.9385357	9200.910	9027.066	8353.518	8680.319	25
24	9.9636939	9.9554073	9.9469741	9.9383914	9198.010	9024.171	8850.628	8677.436	24
23	9.9635570	9.9552680	9.9468323	9.9382411	9195.111	9021.276	8847.739	8674.553	23
22	9.9634200	9.9551286	9.9466904	9.9381027	9192.211	9018.381	8844.849	8671.670	22
21	9.9632830	9.9549891	9.9465485	9.9379583	9189.312	9015.486	8841.960	8668.787	21
20	9.9631460	9.9548497	9.9464066	9.9378139	9186.413	9012.592	8839.071	8665.904	20
19	9.9630089	9.9547102	9.9462646	9.9376693	9183.514	9009.697	8836.182	8663.921	19
18	9.9628718	9.9545706	9.9461126	9.9375248	9180.615	9006.802	8823.293	8660.138	18
17	9.9627346	9.9544310	9.9459805	9.9373802	9177.716	9003.908	8830.404	8657.256	17
16	9.9625974	9.9542914	9.9458385	9.9372356	9174.817	9001.013	8827.515	8654.373	16
15	9.9624601	9.9541517	9.9456963	9.9370909	9171.918	8998,119	8824.626	8651.491	15
14	9.9623229	9.9540120	9.9455541	9.9369462	9169.019	8995.225	8821.737	8648.608	14
13	9.9621855	9.9538723	9.9454119	9.9368015	9166.120	8992.331	8818.849	8645.726	13
12	9.9620482	9.9537325	9.9452696	9.9366567	9163.222	8989.437	8815.960	8642.844	12
11	9.9619108	9.9535926	9.9451273	9.9365118	9160.323	8985.543	8813.072	8639.962	11
10	9.9617733	9.9534528	9.9449850	9.9363670	9157.424	8983.649	8810.184	8637.080	10
9	9.9616358	9.9533128	6.9448425	9.9362220	9154.526	8980.755	8807.296	8634.198	9
8	9.9614983	9.9531729	9.9447001	9.9360771	9151.628	8977.861	8804.408	8631.317	8
7	9.9613607	9.9530329	9.9445576	9.9359321	9148.729	8974.968	8801.520	8628.436	7
6	9.9612232	9.9528929	9.9444151	9.9357870	9145.831	8972.074	8798.632	8625.554	6
5	9.9610855	9.9527528	9.9442726	9.9356419	9142.933	8969.181	8796.745	8622.673	5
4	9.9609478	9.9526127	9.9441300	9.9354968	9140.035	8966.287	8792.857	8619.792	4
3	9.9608101	9.9524725	9.9439873	9.9353156	9137.137	8963.394	8789.969	8616.911	3
2	9.9606723	9.9523323	9.9438446	9.9352064	9134.239	8960.501	8787.082	8614.030	2
1	9.9605345	9.9521920	9.9437019	9.9350611	9131.341	8957.508	8784.194	8611.194	1
0	9.9603967	9.9520518	9.9435591	9.9349158	9128.443	8954.715	8781.307	8608.269	0

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Deg. 8, 9, 10, 11. A Table o Natural Versed

M	N. 8	N. 9	N. 10	N. 11	L. 8	L. 9	L. 10	L. 11	M
0	0097.319	0123.117	0151.922	0183.728	7.9881990	8.0903166	8.1816220	8.2641757	0
1	097.724	0123.573	0152.428	0184.284	7.9900038	8.0919203	8.1830648	8.2654867	1
2	98.130	124.029	152.934	184.840	7.9918047	8.0935210	8.1845051	8.2667957	2
3	98.537	124.486	153.441	185.397	7.9936020	8.0951188	8.1859431	8.2681028	3
4	98.935	124.944	153.949	185.955	7.9953955	8.0967136	8.1873786	8.2694078	4
5	99.354	125.403	154.450	186.514	7.9971853	8.0983055	8.1888118	8.2707169	5
6	99.763	125.863	154.968	187.074	7.9989713	8.0998944	8.1902426	8.2720119	6
7	0100.173	0126.323	0155.479	0187.634	8.0007537	8.1014804	8.1916710	8.2733111	7
8	100.584	126.784	155.990	188.195	8.0025325	8.1030635	8.1930971	8.2746082	8
9	100.996	127.246	156.502	188.757	8.0043076	8.1046437	8.1945208	8.2759035	9
10	101.409	127.709	157.015	189.320	8.0060790	8.1062211	8.1959421	8.2771967	10
11	101.823	128.173	157.529	189.884	8.0078468	8.1077955	8.1973611	8.2784880	11
12	102.238	128.638	158.044	190.449	8.0096110	8.1093671	8.1987778	8.2797774	12
13	0102.653	0129.103	0158.560	0191.014	8.0113716	8.1109358	8.2001921	8.2810649	13
14	103.069	129.569	159.076	191.580	8.0131287	8.1125017	8.2056042	8.2823504	14
15	103.486	130.036	159.593	192.147	8.0148822	8.1140647	8.2030139	8.2836341	15
16	103.904	130.544	160.111	192.715	8.0166321	8.1156249	8.2044213	8.2849158	16
17	104.323	130.973	160.630	193.284	8.0183785	8.1171823	8.2058264	8.2861956	17
18	104.743	131.443	161.150	193.853	8.0201213	8.1187369	8.2072293	8.2874735	18
19	0105.163	0131.915	0161.671	0194.423	8.0218607	8.1202887	8.2086298	8.2887495	19
20	105.584	132.384	162.192	194.994	8.0235965	8.1218377	8.2100281	8.2900236	20
21	106.006	132.856	162.714	195.566	8.0253289	8.1233840	8.2114241	8.2912958	21
22	106.429	133.329	163.237	196.139	8.0270578	8.1249274	8.2128179	8.2925661	22
23	106.853	133.803	163.761	196.713	8.0287833	8.1264681	8.2142094	8.2938346	23
24	107.277	134.278	164.286	197.288	8.0305053	8.1280061	8.2155987	8.2951012	24
25	0107.702	0134.754	0164.811	0197.863	8.0322239	8.1295413	8.2169857	8.2963660	25
26	108.128	135.230	165.337	198.439	8.0339391	8.1310738	8.2183705	8.2976289	26
27	108.555	135.707	165.864	199.016	8.0356508	8.1326036	8.2197531	8.2988899	27
28	108.983	136.185	166.392	199.594	8.0373592	8.1341307	8.2211334	8.3001491	28
29	109.182	136.664	166.921	200.174	8.0390643	8.1356551	8.2225116	8.3014064	29
30	109.841	137.144	167.451	200.753	8.0407659	8.1371768	8.2238875	8.3026619	30
31	0110.271	0137.624	0167.981	0201.333	8.0424642	8.1386958	8.2252613	8.3039156	31
32	110.702	138.105	168.512	201.914	8.0441592	8.1402121	8.2266329	8.3051675	32
33	111.134	138.587	169.044	202.496	8.0458509	8.1417258	8.2280023	8.3064175	33
34	111.567	139.070	169.577	203.079	8.0475393	8.1432368	8.2293695	8.3076657	34
35	112.001	139.554	170.111	203.663	8.0492243	8.1447452	8.2307345	8.3089122	35
36	112.436	140.039	170.646	204.247	8.0509061	8.1462510	8.2320974	8.3101568	36
37	0112.872	0140.525	0171.182	0204.832	8.0525847	8.1477541	8.2334581	8.3113996	37
38	113.308	141.011	171.718	205.418	8.0542599	8.1492546	8.2348167	8.3126406	38
39	113.745	141.498	172.255	206.005	8.0559319	8.1507525	8.2361732	8.3138798	39
40	114.183	141.986	172.793	206.592	8.0576007	8.1522478	8.2375275	8.3151172	40
41	114.622	142.475	173.332	207.182	8.0592663	8.1537405	8.2388797	8.3163529	41
42	115.062	142.965	173.872	207.772	8.0609286	8.1552307	8.2452297	8.3175868	42
43	0115.502	0143.456	0174.413	0208.362	8.0625878	8.1567182	8.2415737	8.3188189	43
44	115.943	143.947	174.954	208.953	8.0641438	8.1582032	8.2429235	8.3200493	44
45	116.385	144.439	175.496	209.545	8.0658966	8.1596857	8.2442673	8.3212779	45
46	116.828	144.932	176.039	210.138	8.0675463	8.1611656	8.2456089	8.3225047	46
47	117.272	145.426	176.583	210.732	8.0691928	8.1626430	8.2469485	8.3237298	47
48	117.717	145.921	177.128	211.326	8.0708362	8.1641178	8.2482860	8.3249532	48
49	0118.162	0146.417	0177.673	0211.921	8.0724764	8.1655902	8.2496214	8.3261748	49
50	118.608	146.913	178.219	212.517	8.0741136	8.1670600	8.2509547	8.3273947	50
51	119.055	147.410	178.766	213.114	8.0757476	8.1685273	8.2522860	8.3286128	51
52	119.503	147.908	179.314	213.712	8.0773786	8.1699921	8.2536152	8.3298292	52
53	119.952	148.407	179.863	214.311	8.0790065	8.1714545	8.2549424	8.3310439	53
54	120.402	148.907	180.413	214.910	8.0806313	8.1729144	8.2562675	8.3322569	54
55	0120.852	0149.407	0180.963	0215.510	8.0822531	8.1743717	8.2575906	8.3334682	55
56	121.303	149.908	181.514	216.111	8.0838718	8.1758267	8.2589117	8.3346778	56
57	121.755	150.410	182.066	216.713	8.0854976	8.1772792	8.2602307	8.3358857	57
58	122.208	150.913	182.619	217.316	8.0871002	8.1787292	8.2615477	8.3370918	58
59	122.662	151.417	183.173	217.920	8.0887099	8.1801768	8.2628626	8.3382963	59
60	123.117	151.922	183.728	218.524	8.0903166	8.1816220	8.2641757	8.3394991	60

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Sines and their Logarithms. Deg. 81, 80, 79, 78.

M	L. 81	L. 80	L. 79	L. 78	N. 81	N. 80	N. 79	N. 78	M
60	9.9349155	9.9261188	9.9171650	9.9080510	[illegible]	[illegible]	8263.518	8091.910	60
59	9.9347705	9.9259709	9.9170144	9.9078977	8605.3[illegible]	8432.7[illegible]	8260.653	8089.055	59
58	9.9346251	9.9258229	9.9168638	9.9077445	8602.508	8429.909	8257.789	8086.200	58
57	9.6344756	9.9256749	9.9167131	9.9075911	8599.627	8427.036	8254.925	8083.345	57
56	9.9343342	9.9255268	9.9165624	9.9074377	8596.747	8424.163	8252.061	8080.490	56
55	9.9341886	9.9253787	9.9164116	9.9072842	8593.867	8411.291	8249.197	8077.635	55
54	9.9340431	9.9252306	9.9162609	9.9071307	8590.987	8418.419	8246.333	8074.780	54
53	9.9338975	9.9250823	9.9161100	9.9069771	8588.107	8415.547	8243.469	8071.926	53
52	9.9337526	9.9249341	9.9159591	9.9068236	8585.226	8412.675	8240.606	8069.072	52
51	9.9336061	9.9247858	9.9158082	9.9066699	8582.348	8409.803	8237.742	8066.218	51
50	9.9334604	9.9246375	9.9156572	9.9065163	8579.469	8406.931	8234.879	8063.364	50
49	9.9333146	9.9244891	9.9155062	9.9063625	8576.590	8404.059	8232.016	8060.510	49
48	9.9331688	9.9243407	9.9153551	9.9062087	8573.711	8401.188	8229.153	8057.656	48
47	9.9330229	9.9241922	9.9152040	9.9060549	8570.832	8398.316	8226.290	8054.803	47
46	9.9328771	9.9240437	9.9150528	9.9059011	8567.953	8395.445	8223.427	8051.950	46
45	9.9327311	9.9238956	9.9149016	9.9057471	8565.074	8392.574	8220.565	8049.097	45
44	9.9325851	9.9237466	9.9147504	9.9055932	8562.195	8389.703	8217.702	8046.244	44
43	9.9324391	9.9235979	9.9145991	9.9054392	8559.310	8386.832	8214.840	8043.391	43
42	9.9322930	9.9234493	9.9144478	9.9058251	8556.438	8383.962	8211.978	8040.53[illegible]	42
41	9.9321469	9.9233005	9.9142964	9.9051310	8553.559	8381.091	8209.116	8037.686	41
40	9.9320007	9.9231518	9.9141450	9.9049769	8550.581	8378.221	8206.254	8034.834	40
39	9.9318545	9.9230030	9.9139935	9.9048227	8547.803	8375.351	8203.392	8031.982	39
38	9.9317083	9.9228541	9.9138420	9.9046685	8544.925	8372.481	8200.531	8029.130	38
37	9.9315620	9.9227052	9.9136904	9.9045142	8542.047	8369.611	8197.669	8026.278	37
36	9.9314156	9.9225563	9.9135388	9.9043599	8539.169	8366.741	8194.808	8023.426	36
35	9.9312692	9.9224073	9.9133871	9.9042055	8536.292	8363.871	8191.946	8020.575	35
34	9.9311228	9.9222583	9.9132355	9.9040511	8533.414	8361.001	8189.086	8017.724	34
33	9.9309764	9.9221092	9.9130837	9.9048966	8530.537	8358.132	8186.226	8014.873	33
32	9.9308299	9.9219601	9.9129319	9.9037421	8527.660	8355.262	8183.366	8012.022	32
31	9.9306833	9.9218109	9.9127801	9.9035876	8524.783	8352.393	8180.505	8009.171	31
30	9.9305367	9.9216617	9.9126282	9.9034330	8521.906	8349.524	8177.645	8006.321	30
29	9.9303901	9.9215124	9.9124763	9.9032783	8519.029	8346.655	8174.785	8003.470	29
28	9.9302434	9.9213632	9.9123244	9.9031236	8516.152	8343.786	8171.925	8000.620	28
27	9.9300967	9.9212138	9.9121723	9.9029689	8513.276	8340.918	8169.065	7997.770	27
26	9.9299499	9.9210644	9.9120203	9.9028141	8510.399	8338.049	8166.205	7994.920	26
25	9.9298031	9.9209150	9.9118682	9.9026593	8507.52[illegible]	8335.181	8163.346	7992.070	25
24	9.9296563	9.9207656	9.9117161	9.9025044	8504.647	8332.313	8160.487	7989.220	24
23	9.9295094	9.9206160	9.9115638	9.9023495	8501.77[illegible]	8329.445	8157.628	7986.371	23
22	9.9293624	9.9204665	9.9114116	9.9021945	8498.89[illegible]	8326.577	8154.769	7983.522	22
21	9.9292154	9.9203169	9.911259[illegible]	9.9020395	8496.019	8323.709	8151.910	7980.673	21
20	9.9290684	9.9201672	9.911107[illegible]	9.9018845	8493.143	8320.841	8149.051	7977.824	20
19	9.9289213	9.9200175	9.9109546	9.9017293	8490.267	8317.97[illegible]	8146.192	7974.975	19
18	9.9287743	9.9198678	9.9108022	9.9015742	8487.392	8315.106	8143.334	7972.126	18
17	9.9286271	9.9197180	9.9106498	9.9014190	8484.516	8312.239	8140.476	7969.278	17
16	9.9284799	9.9195682	9.9104973	9.9012638	8481.641	8309.372	8137.618	7965.430	16
15	9.9283326	9.9194183	9.9103447	9.9011085	8478.766	8306.505	8134.760	7963.582	15
14	9.9281854	9.9192684	9.9101921	9.9009531	8475.891	8303.638	8131.902	7960.734	14
13	9.9280380	9.9191184	9.9100395	9.9007977	8473.016	8300.771	8125.044	7957.886	13
12	9.9278907	9.9189685	9.9098868	9.9006423	8470.141	8297.905	8126.187	7955.038	12
11	9.9277432	9.9188184	9.9097341	9.9004868	8467.266	8295.038	8123.330	7952.191	11
10	9.9275958	9.9186683	9.9095813	9.9003313	8464.392	8292.172	8120.473	7949.344	10
9	9.9274483	9.9185182	9.9094285	9.9001758	8461.518	8289.306	8117.616	7945.497	9
8	9.9273008	9.9183680	9.9092756	9 9000202	8458.644	8286.440	8114.759	7943.650	8
7	9.9271531	9.9182278	9.9091227	9.8998645	8455.770	8283 574	8111.902	7940.803	7
6	9.9270055	9.9180675	9.9089697	9.8997088	8452.896	8280.708	8109.046	7937.957	6
5	9.9268578	9.9179172	9.9088167	9.8995530	8450.022	8277.843	8106.190	7935.111	5
4	9.9267101	9.9177669	9.9086637	9.8993973	8447.148	8274.978	8103.334	7932.265	4
3	9.9265624	9.9176164	9.9085106	9.8992414	8444.275	8272.113	8100.478	7929.419	3
2	9.9264146	9.9174660	9.9083575	9.8990855	8441.401	8269.248	8097.622	7926.573	2
1	9.9262667	9.9173155	9.9082043	9.8989296	8438.528	8266.383	8094.766	7923.728	1
0	9.9261188	.99171650	9.9080510	9.8987736	8435.65[illegible]	[illegible]	[illegible]	7920.883	0

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A Table of Natural Versed.

Deg. 12, 13, 14, 15.

M	N. 12	N. 13	N 14	N. 15	L. 12	L. 13	L. 14	L. 15	M
0	0218.524	0256.300	0297.043	0340.742	8.3394991	8.4087475	8.4728189	8.5324253	0
1	0219.129	0256.955	0297.747	0341.495	8.3407002	8.4098556	8.4738472	8.533384[illegible]	1
2	219.735	257.611	298.452	342.249	8.3418997	8.4109622	8.4748742	8.5343423	2
3	220.342	258.267	299.158	343.004	8.3430975	8.4120675	8.4759001	8.5352992	3
4	220.950	258.924	299.865	343.760	8.3442936	8.4131713	8.4769246	8.5362551	4
5	221.558	259.582	300.572	344.516	8.3454880	8.4142736	8.4779480	8.5372098	5
6	222.167	260.241	301.280	345.273	8.3466808	8.4153746	8.4789701	8.5381635	6
7	0222.777	0260.901	0301.989	0346.031	8.3478719	8.4164741	8.4799910	8.5391161	7
8	223.388	261.561	302.699	346.790	8.3490614	8.4175723	8.4810107	8.5400677	8
9	224.000	262.222	303.410	347.550	8.3502492	8.4186590	8.4820291	8.5410182	9
10	224.613	262.884	304.121	348.311	8.3514354	8.4197644	8.4830464	8.5419676	10
11	225.227	263.547	304.833	349.073	8.3526200	8.4208583	8.4840625	8.5429160	11
12	225.841	264.211	305.546	349.835	8.3538029	8.4219508	8.4850773	8.5438633	12
13	0226.456	0264.876	0306.260	0350.598	8.3549842	8.4230420	8.4860910	8.5448096	13
14	227.072	265.541	306.975	351.362	8.3561639	8.4241318	8.4871034	8.5457548	14
15	227.689	266.207	307.691	352.127	8.3573419	8.4252280	8.4881146	8.5466983	15
16	228.307	266.874	308.407	352.892	8.3585184	8.4263072	8.4891247	8.5476422	16
17	229.925	267.542	309.124	353.658	8.3596932	8.4273928	8.4901336	8.5485843	17
18	229.544	268.211	309.842	354.425	8.3608664	8.4284770	8.4911412	8.5495253	18
19	0230.164	0268.880	0310.561	0355.193	8.3620380	8.4295600	8.4921477	8.5504654	19
20	230.785	269.550	311.281	355.962	8.3632081	8.4306414	8.4931530	8.5514044	20
21	231.407	270.221	312.002	356.732	8.3643765	8.4317216	8.4941572	8.5523423	21
22	232.030	270.893	312.723	357.502	8.3655434	8.4328004	8.4951601	8.5532793	22
23	232.653	271.566	313.445	358.273	8.3667086	8.4338778	8.4961619	8.5542152	23
24	233.277	272.240	314.168	359.045	8.3678723	8.4349539	8.4971625	8.5551500	24
25	0233.902	0272.915	0314.892	0359.818	8.3690344	8.4360286	8.4981619	8.5560839	25
26	234.528	273.591	315.617	360.592	8.3701950	8.4371020	8.4991602	8.5570167	26
27	235.155	274.267	316.343	361.367	8.3713540	8.4381740	8.5001573	8.5579485	27
28	235.783	274.944	317.069	362.142	8.3725114	8.4392447	8.5011532	8.5588793	28
29	236.411	275.622	317.796	362.918	8.3736672	8.4403141	8.5021480	8.5598091	29
30	237.040	276.301	318.524	363.695	8.3748215	8.4413821	8.5031416	8.5607379	30
31	0237.670	0276.980	0319.253	0364.473	8.3759743	8.4424488	8.5041341	8.5616656	31
32	238.301	277.660	319.983	365.252	8.3771255	8.4435142	8.5051254	8.5625924	32
33	238.933	278.341	320.713	366.031	8.3782751	8.4445743	8.5061136	8.5635181	33
34	239.565	279.023	321.444	366.311	8.3794232	8.4456410	8.5071046	8.5644429	34
35	240.198	279.706	322.176	367.592	8.3805698	8.4467024	8.5080925	8.5653666	35
36	240.832	280.390	322.909	368.374	8.3817149	8.4477625	8.5090792	8.5662894	36
37	241.467	0281.074	0323.643	0369.157	8.3828584	8.4488213	8.5100648	8.5672111	37
38	242.103	281.759	324.377	369.941	8.3840004	8.4498788	8.5110493	8.5681318	38
39	242.740	282.445	325.112	370.725	8.3851409	8.4509350	8.5120326	8.5690516	39
40	243.377	283.132	325.848	371.510	8.3862799	8.4519898	8.5130148	8.5699704	40
41	244.015	283.820	326.585	372.296	8.3874174	8.4530434	8.5139959	8.5708881	41
42	244.654	284.509	327.323	373.083	8.3885533	8.4540957	8.5149758	8.5718049	42
43	245.294	0285.198	0328.002	0373.871	8.3896878	8.4551467	8.5159546	8.5727207	43
44	245.935	285.888	328.8[illegible]	374.659	8.3908207	8.4561964	8.5169324	8.5736355	44
45	246.577	286.579	329.541	375.448	8.3919522	8.4572448	8.5179089	8.5745494	45
46	247.219	287.271	330.282	375.238	8.3930822	8.458292	8.5188844	8.5754622	46
47	247.862	287.964	331.024	377.029	8.3942107	8.4593378	8.5198588	8.5763741	47
48	248.506	288.657	331.767	377.821	8.3953377	8.4603824	8.5208320	8.5772850	48
49	0249.151	0289.351	0332.510	0378.613	8.3964638	8.4614257	8.5218042	8.5781949	49
50	249.797	290.046	333.254	379.406	8.3975873	8.4624677	8.5227752	8.5791039	50
51	250.443	290.742	333.999	380.200	8.3987098	8.4635085	8.5237451	8.5800119	51
52	251.090	291.439	334.745	380.995	8.3998310	8.4645480	8.5247140	8.5809189	52
53	251.738	292.137	335.492	381.791	8.4009506	8.4655863	8.5256817	8.5818250	53
54	252.387	292.835	336.239	382.587	8.4020688	8.4666233	8.5266484	8.5827301	54
55	0253.037	0293.534	0336.987	0383.384	8.4031855	8.4676461	8.5276139	8.5836342	55
56	254.688	294.234	337.736	384.182	8.4043008	8.4686935	8.5285784	8.5845374	56
57	254.34[illegible]	294.935	338.486	384.981	8.4054147	8.4697269	8.5295417	8.5855396	57
58	255.992	295.637	338.237	385.781	8.4065270	8.4707587	8.5305040	8.5863409	58
59	255.645	296.340	339.989	386.582	8.4076380	8.4717894	8.5314652	8.5872412	59
60	256.300	297.043	340.742	387.38[illegible]	8.4087475	8.4728189	8.5324253	8.5881406	60

Sines and their Logarithms. Deg. 77, 76, 75, 74.

M	L. 77	L. 76	L. 75	L. 74	N. 77	N. 76	N. 75	N. 74	M
60	9.8987736	9.8893291	9.8797140	9.8699243	7920.883	7750.489	7580.781	7411.810	60
59	9.8986176	9.8891703	9.8795522	9.8697596	7918.038	7747.655	7577.959	7409.000	59
58	9.8984615	9.8890114	9.8793905	9.8695949	7915.193	7744.821	7575.137	7406.191	58
57	9.8983054	9.8888524	9.8792286	9.8694301	7912.348	7741.987	7572.315	7403.382	57
56	9.8981492	9.8886935	9.8790668	9.8692653	7909.503	7739.153	7569.493	7400.573	56
55	9.8979930	9.8885344	9.8789048	9.8691004	7906.658	7736.320	7566.671	7397.764	55
54	9.8978367	9.8883754	9.8787429	9.8689355	7903.814	7733.487	7563.850	7394.755	54
53	9.8976804	9.8882162	9.8785809	9.8687705	7900.970	7730.654	7561.029	7392.147	53
52	9.8975241	9.8880571	9.8784188	9.8686056	7898.126	7727.821	7558.208	7389.339	52
51	9.8973676	9.8878978	9.8782567	9.8684405	7895.282	7724.988	7555.387	7386.531	51
50	9.8972112	9.8877386	9.8780946	9.8682754	7892.438	7722.156	7552.566	7383.723	50
49	9.8970547	9.8875792	9.8779323	9.8681102	7889.595	7719.324	7549.746	7380.916	49
48	9.8968982	9.8874199	9.8777701	9.8679450	7886.752	7716.492	7546.926	7378.109	48
47	9.8967416	9.8872604	9.8776078	9.8677797	7883.909	7713.660	7544.106	7375.302	47
46	9.8965850	9.8871010	9.8774454	9.8676145	7881.066	7710.828	7541.286	7372.495	46
45	9.8964283	9.8869415	9.8772850	9.8674491	7878.223	7707.996	7538.467	7369.688	45
44	9.8962716	9.8867819	9.8771206	9.8672837	7875.380	7705.165	7535.648	7366.882	44
43	9.8961148	9.8866223	9.8769581	9.8671182	7872.538	7702.334	7532.829	7364.076	43
42	9.8959580	9.8864627	9.8767955	9.8669527	7869.696	7699.503	7530.010	7361.270	42
41	9.8958011	9.8863029	9.8766329	9.8667871	7866.854	7696.672	7527.191	7358.464	41
40	9.8956442	9.8861432	9.8764703	9.8666216	7864.012	7693.841	7524.372	7355.658	40
39	9.8954872	9.8859834	9.8763076	9.8664559	7861.170	7691.011	7521.554	7352.853	39
38	9.8953302	9.8858236	9.8761449	9.8662902	7858.329	7688.181	7518.736	7350.048	38
37	9.8951731	9.8856637	9.8759821	9.8661244	7855.488	7685.351	7515.918	7347.243	37
36	9.8950161	9.8855038	9.8758192	9.8659586	7852.647	7682.521	7513.100	7344.438	36
35	9.8948589	9.8853437	9.8756563	9.8657927	7849.806	7679.691	7510.283	7341.634	35
34	9.8947017	9.8851837	9.8754934	9.8656269	7846.965	7676.862	7507.466	7338.830	34
33	9.8945445	9.8850236	9.8753304	9.8654609	7844.124	7674.033	7504.649	7336.026	33
32	9.8943872	9.8848635	9.8751674	9.8652949	7841.284	7671.204	7501.832	7333.223	32
31	9.8942298	9.8847033	9.8750043	9.8651288	7838.444	7668.375	7499.016	7330.420	31
30	9.8940725	9.8845431	9.8748412	9.8649627	7835.604	7665.545	7496.200	7327.617	30
29	9.8939150	9.8843828	9.8746780	9.8647965	7832.764	7662.718	7493.384	7324.814	29
28	9.8937576	9.8842225	9.8745147	9.8646303	7829.924	7659.890	7490.568	7322.011	28
27	9.8936000	9.8840621	9.8743514	9.8644641	7827.084	7657.062	7487.752	7319.208	27
26	9.8934425	9.8839017	9.8741881	9.8642978	7824.245	7654.234	7484.936	7316.405	26
25	9.8932848	9.8837412	9.8740247	9.8641314	7821.406	7651.406	7482.121	7313.603	25
24	9.8931272	9.8835807	9.8738613	9.8639650	7818.567	7648.579	7479.306	7310.801	24
23	9.8929695	9.8834202	9.8736978	9.8637985	7815.728	7645.752	7476.491	7307.999	23
22	9.8928117	9.8832596	9.8735343	9.8636320	7812.889	7642.925	7473.676	7305.198	22
21	9.8926539	9.8830989	9.8733707	9.8634655	7810.051	7640.098	7470.862	7302.397	21
20	9.8924961	9.8829382	9.8732071	9.8632989	7807.213	7637.271	7468.048	7299.596	20
19	9.8923381	9.8827774	9.8730434	9.8631322	7804.375	7634.445	7465.234	7296.795	19
18	9.8921802	9.8826167	9.8728797	9.8629655	7801.537	7631.619	7462.420	7293.995	18
17	9.8920222	9.8824558	9.8727159	9.8627987	7798.700	7628.793	7459.607	7291.195	17
16	9.8918642	9.8822949	9.8725521	9.8626319	7795.863	7625.967	7456.794	7288.395	16
15	9.8917061	9.8821339	9.8723882	9.8624650	7793.026	7623.141	7453.981	7285.595	15
14	9.8915480	9.8819730	9.8722243	9.8622981	7790.189	7620.316	7451.168	7282.796	14
13	9.8913898	9.8818119	9.8720603	9.8621314	7787.352	7617.491	7448.355	7279.997	13
12	9.8912316	9.8816508	9.8718963	9.8619642	7784.515	7614.666	7445.542	7277.198	12
11	9.8910733	9.8814897	9.8717322	9.8617971	7781.678	7611.841	7442.730	7274.399	11
10	9.8909150	9.8813285	9.8715682	9.8616300	7778.842	7609.017	7439.918	7271.600	10
9	9.8907566	9.8811672	9.8714040	9.8614628	7776.006	7606.192	7437.106	7268.802	9
8	9.8905982	9.8810060	9.8712398	9.8612956	7773.170	7603.368	7434.294	7266.004	8
7	9.8904397	9.8808446	9.8710755	9.8611283	7770.334	7600.544	7431.483	7263.206	7
6	9.8902812	9.8806833	9.8709112	9.8609610	7767.498	7597.720	7428.672	7260.408	6
5	9.8901226	9.8805218	9.8707468	9.8607936	7764.963	7594.896	7425.861	7257.611	5
4	9.8899640	9.8803604	9.8705824	9.8606262	7761.828	7592.073	7423.050	7254.814	4
3	9.8898054	9.8801988	9.8704179	9.8604587	7758.993	7589.250	7420.240	7252.017	3
2	9.8896467	9.8800372	9.8702534	9.8602912	7756.158	7586.427	7417.430	7249.220	2
1	9.8894879	9.8798956	9.8700888	9.8601236	7753.323	7583.604	7414.620	7246.423	1
0	9.8893291	9.8797140	9.8699243	9.8599560	7750.489	7580.781	7411.810	7243.627	0

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Deg. 16, 17, 18, 19. A Table o Natural Versed

M	N. 16	N. 17	N. 18	N. 19	L. 16	L. 17	L. 18	L. 19	M
0	0387.383	0436 952	0489.435	0544.814	8.5881406	8.6404342	8.6896949	8.7362485	0
1	0388.185	0437.803	0490.334	0545.762	8.5890390	8.641279	8.6904921	8.7370030	1
2	388.988	438.655	491.234	546.710	8.5899365	8.6421231	8.6912886	8.7377570	2
3	389.792	439.508	492.135	547.659	8.5908330	8.6429663	8.6920844	8.7385102	3
4	290.597	440.361	493.037	548.609	8.5917286	8.6438037	8.6928794	8.7392628	4
5	391.402	441.215	493.939	549.559	8.5926232	8.6446502	8.6936736	8.7400147	5
6	392.208	442.070	494.843	550.511	8.5935170	8.6454909	8.6944672	8.7407659	6
7	0393.015	0442.926	0495.747	0551.463	8.5944097	8.6463308	8.6952599	8.7415165	7
8	393.823	443.782	496.652	552.416	8.5953016	8.6471698	8.6960520	8.7422664	8
9	394.632	444.639	497.557	553.370	8.5961925	8.6479880	8.6968432	8.7430156	9
10	395.441	445.498	498.464	554.325	8.5970824	8.6488454	8.6976338	8.7437642	10
11	396.251	446.357	499.371	555.280	8.5979715	8.6496820	8.6984236	8.7445121	11
12	397.062	447.216	500.279	556.236	8.5988596	8.6505177	8.6992127	8.7452593	12
13	0397.874	0448.077	0501.188	0557.193	8.5997468	8.6513526	8.7000010	8.7460059	13
14	398.687	448.938	502.098	558.151	8.6006330	8.6521867	8.7007886	8.7467518	14
15	399.501	449.801	503.009	559.110	8.6015184	8.6530200	8.7015755	8.7474971	15
16	400.315	450.664	503.920	560.069	8.6024028	8.6538524	8.7023617	8.7482417	16
17	401.130	451.527	504.832	561.029	8.6032763	8.6546841	8.7031471	8.7489857	17
18	401.946	452.392	505.745	561.990	8.6041683	8.6655149	8.7039318	8.7497290	18
19	0402.763	0453.257	0506.659	0562.952	8.6050505	8.6563449	8.7047158	8.7504716	19
20	403.581	454.124	507.574	563.915	8.6059313	8.6571741	8.7054990	8.7512136	20
21	404.400	454.991	508.489	564.878	8.6068112	8.6580025	8.7062815	8.7519549	21
22	405.219	455.859	509.405	565.843	8.6076901	8.6588301	8.7070633	8.7526956	22
23	406.039	456.727	510.322	566.808	8.6085681	8.6596569	8.7078444	8.7534357	23
24	406.860	457.597	511.240	567.773	8.6094453	8.6604829	8.7086247	8.7541751	24
25	0407.682	0458.467	0512.158	0568.740	8.6103215	8.6613081	8.7094044	8.7549138	25
26	408.505	459.338	513.078	569.707	8.6111968	8.6621324	8.7101833	8.7556519	26
27	409.328	460.210	513.998	570.676	8.6120712	8.6629560	8.7109615	8.7563894	27
28	410.152	461.083	514.919	571.645	8.6129448	8.6637788	8.7117390	8.7571262	28
29	410.977	461.956	515.841	572.614	8.6138174	8.6646008	8.7125157	8.7578623	29
30	411.803	462.830	516.763	573.585	8.6146891	8.6654220	8.7132918	8.7585979	30
31	0412.629	0463.706	0517.687	0574.556	8.6155600	8.6662424	8.7140671	8.7593327	31
32	413.456	464.582	518.611	575.529	8.6164299	8.6670620	8.7148418	8.7600670	32
33	414.284	465.458	519.536	576.502	8.6172990	8.6678808	8.7156157	8.7608006	33
34	415.113	466.336	520.462	577.475	8.6181672	8.6686988	8.7163889	8.7615336	34
35	415.947	467.214	521.388	578.450	8.6190345	8.6695160	8.7171614	8.7622659	35
36	416.774	468.093	522.316	579.425	8.6199009	8.6703324	8.7179332	8.7629976	36
37	0417.605	0468.973	0523.244	0580.402	8.6207664	8.6711481	8.7187044	8.7637286	37
38	418.437	469.854	524.173	581.379	8.6216331	8.6719630	8.7194748	8.7644591	38
39	419.270	470.736	525.103	582.356	8.6224948	8.6727771	8.7202445	8.7651889	39
40	420.104	471.618	526.034	583.335	8.6233577	8.6735904	8.7210135	8.7659180	40
41	420.939	472.501	526.965	584.314	8.6242197	8.6744029	8.7217818	8.7666466	41
42	421.775	473.385	527.897	585 295	8.6250809	8.6752147	8.7225494	8.7673745	42
43	0422.611	0474.270	0528.830	0586.276	8.6259412	8.6760256	8.7233163	8.7681018	43
44	423.448	475.156	529.764	587.257	8.6268006	8.6768358	8.7240825	8.7688284	44
45	424.286	476.042	530.699	588.240	8.6271951	8.6776453	8.7248480	8.7695544	45
46	425.125	476.929	531.634	589.223	8.6285168	8.6784539	8.7256129	8.7702798	46
47	425.964	477.817	532.570	590.207	8.6293736	8.6792618	8.7263770	8.7710046	47
48	426.804	478.706	533.507	591.192	8.6302295	8.6800689	8.7271404	8.7717288	48
49	0427.645	0479.596	0534.445	0592.178	8.6310846	8.6808753	8.7279032	8.7724523	49
50	428.487	480.486	535.384	593.164	8.6319388	8.6816809	8.7286653	8.7731752	50
51	429.330	481.377	536.323	594.152	8.6327922	8.6824857	8.7294267	8.7738975	51
52	430.174	482.269	537.264	595.140	8.6336447	8.6832897	8.7301874	8.7746192	52
53	431.018	483.162	538.205	596.129	8.6344964	8.6840930	8.7309474	8.7753402	53
54	431.863	484.056	539.146	597.119	8.6353472	8.6848956	8.9317067	8.7760607	54
55	0432.709	0484.950	0540.089	0598.109	8.6361971	8.6856973	8.7324654	8.7767805	55
56	433.556	485.846	541.032	599.101	8.6370462	8.6864984	8.7332233	8.7774997	56
57	434.404	486.742	541.977	600.093	8.6378945	8.6872986	8.7339806	8.7782183	57
58	435.253	487.639	542.922	601.086	8.6387419	8.6880981	8.7347373	8.7789363	58
59	436.102	488.536	543.868	602.079	8.6395884	8.6888969	8.7354932	8.7796537	59
60	436.952	489.435	544.814	603.074	8.6404342	8.6896949	8.7362485	8.7803705	60

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Sines, and their Logarithms Deg. 73, 72, 71, 70

M	L. 73	L. 72	L. 71	L. 70	N. 73	N. 72	N. 71	N. 70	M
60	9.8599560	9.8498052	9.8394674	9.8289381	7243.627	7676.283	6909.830	6744.318	60
59	9.8597883	9.8496344	9.8392934	9.8287609	7240.831	7073.501	6907.064	6741.568	59
58	9.8596206	9.8494636	9.8391195	9.8285837	7238.035	7070.720	6904.298	6738.818	58
57	9.8594529	9.8492928	9.8389455	9.8284065	7235.239	7067.939	6901.532	6736.069	57
56	9.8592851	9.8491219	9.8387714	9.8282292	7232.444	7065.158	6898.766	6733.319	56
55	9.8591171	9.8489509	9.8385973	9.8280518	7229.649	7062.377	6896.001	6730.570	55
54	9.8589492	9.8487799	9.8384233	9.8278744	7226.854	7059.597	6893.236	6727.821	54
53	9.8587812	9.8486088	9.8382489	9.8276969	7224.059	7056.817	6890.471	6725.073	53
52	9.8586132	9.8484377	9.8380746	9.8275194	7221.265	7054.037	6887.706	6722.325	52
51	9.8584451	9.8482665	9.8379003	9.8273418	7218.471	7051.257	6884.942	6719.577	51
50	9.8582770	9.8480953	9.8377259	9.8271642	7215.677	7048.477	6882.178	6716.829	50
49	9.8581088	9.8479240	9.8375514	9.8269865	7212.883	7045.698	6879.414	6714.082	49
48	9.8579406	9.8477527	9.8373770	9.8268088	7210.089	7042.919	6876.651	6711.335	48
47	9.8577723	9.8475813	9.8372024	9.8266310	7207.296	7040.140	6873.888	6708.588	47
46	9.8576040	9.8474099	9.8370278	9.8264532	7204.503	7037.362	6871.125	6705.841	46
45	9.8574356	9.8472384	9.8368531	9.8262753	7201.710	7034.584	6868.362	6703.094	45
44	9.8572672	9.8470669	9.8366785	9.8260973	7198.918	7031.806	6865.600	6700.348	44
43	9.8570987	9.8468953	9.8365037	9.8259193	7196.126	7029.028	6862.838	6697.602	43
42	9.8569302	9.8467237	9.8363289	9.8257412	7193.334	7026.250	6860.076	6694.856	42
41	9.8567615	9.8465520	9.8361540	9.8255631	7190.542	7023.473	6857.314	6692.111	41
40	9.8565929	9.8463802	9.8359[illegible]91	9.8253849	7187.750	7020.695	6854.552	6689.366	40
39	9.8564242	9.8462084	9.8358041	9.8252067	7184.959	7017.919	6851.791	6686.621	39
38	9.8562555	9.8460366	9.8356791	9.8250284	7182.168	7015.143	6849.030	6683.877	38
37	9.8560867	9.8458647	9.8354540	9.8248501	7179.377	7012.367	6846.269	6681.133	37
36	9.8559179	9.8456927	9.8352789	9.8246717	7176.586	7009.591	6843.509	6678.389	36
35	9.8557489	9.8455207	9.8351037	9.8244932	7173.796	7006.815	6840.749	6675.645	35
34	9.8555800	9.8453487	9.8349285	9.8243147	7171.006	7004.040	6837.989	6672.902	34
33	9.8554110	9.8451765	9.8347531	9.8241361	7168.216	7001.265	6835.230	6670.159	33
32	9.8552420	9.8450044	9.8345778	9.8239576	7165.426	6998.490	6832.471	6667.415	32
31	9.8550728	9.8448322	9.8344024	9.8237785	7162.636	6995.716	6829.712	6664.673	31
30	9.8549037	9.8446599	9.8342269	9.8236002	7159.847	6992.942	6826.953	6661.931	30
29	9.8547345	9.8444876	9.8340514	9.8234213	7157.058	6990.168	6824.195	6659.189	29
28	9.8545653	9.8443152	9.8338759	9.8232425	7154.269	6987.394	6821.437	6656.447	28
27	9.8543959	9.8441428	9.8337002	9.8230636	7151.480	6984.620	6818.679	6653.706	27
26	9.8542266	9.8439703	9.8335246	9.8228847	7148.692	6981.847	6815.921	6650.965	26
25	9.8540572	9.8437978	9.8333488	9.8227057	7145.904	6979.074	6813.103	6648.224	25
24	9.8538877	9.8436252	9.8331731	9.8225266	7143.116	6976.301	6810.406	6645.484	24
23	9.8537182	9.8434526	9.8329972	9.8223475	7140.328	6973.528	6807.649	6642.744	23
22	9.8535486	9.8432799	9.8328213	9.8221684	7137.541	6970.756	6804.892	6640.004	22
21	9.8533790	9.8431071	9.8326454	9.8219891	7134.754	6967.984	6802.136	6637.264	21
20	9.8532094	9.8429344	9.8324694	9.8218099	7131.967	6965.212	6799.380	6634.525	20
19	9.8530396	9.8427615	9.8322933	9.8216305	7129.181	6962.441	6796.625	6631.786	19
18	9.8528699	9.8425886	9.8321172	9.8214511	7126.395	6959.670	6793.870	6629.047	18
17	9.8527000	9.8424156	9.8319411	9.8212717	7123.609	6956.899	6791.115	6626.309	17
16	9.8525302	9.8422427	9.8317649	9.8210922	7120.823	6954.128	6788.360	6623.571	16
15	9.8523602	9.8420696	9.8315886	9.8209126	7118.037	6951.357	6785.605	6620.833	15
14	9.8521903	9.8418965	9.8314123	9.8207330	7115.252	6948.587	6782.850	6618.095	14
13	9.8520202	9.8417233	9.8312359	9.8205533	7112.467	6945.817	6780.096	6615.358	13
12	9.8518502	9.8415501	9.8310595	9.8203736	7109.682	6943.047	6777.342	6612.621	12
11	9.8516800	9.8413768	9.8308830	9.8201938	7106.897	6940.277	6774.588	6609.884	11
10	9.8515099	9.8412035	9.8307064	9.8200140	7104.112	6937.508	6771.835	6607.148	10
9	9.8513396	9.8410301	9.8305298	9.8198341	7101.328	6934.739	6769.082	6604.412	9
8	9.8511693	9.8408567	9.830253[illegible]	9.8196542	7098.544	6931.970	6766.329	6601.676	8
7	9.8509990	9.8406832	9.8301765	9.8194741	7095.760	6929.202	6763.577	6598.940	7
6	9.8508286	9.8405097	9.8299997	9.8192941	7092.977	6926.434	6760.825	6596.205	6
5	9.8506581	9.8403361	9.8298229	9.8191140	7090.194	6923.666	6758.073	6593.470	5
4	9.8504877	9.8401625	9.8296401	9.8189338	7087.411	6920.898	6755.221	6590.735	4
3	9.8503171	9.8399887	9.8294691	9.8187536	7084.629	6918.131	6752.570	6588.001	3
2	9.8501465	9.8398150	9.8292922	9.8185733	7081.847	6915.364	6749.819	6585.267	2
1	9.8499759	9.8396412	9.8291151	9.8183930	7079.065	6912.597	6747.068	6582.533	1
0	9.8498052	9.8394674	9.8289381	9.8182126	7076.283	6909.830	6744.318	6579.799	0

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Deg. 8, 9, 10, 11. A Table of Natural Verſed

M	N. 20	N. 21	N. 22	N. 23	L. 20	L. 21	L. 22	L. 23	M
0	0603.074	0664.196	0728.161	0794.951	8.7803705	8.8222961	8.8622277	8.9003406	0
1	0604.069	0665.239	0729.251	0796.008	8.7810863	8.8229772	8.8628771	8.9009611	1
2	605.065	666.282	730,342	797.226	8.7818022	8.8236582	8.8633265	8.9015816	2
3	606.062	667.327	731.434	798.365	8.7825168	8.8243382	8.8641749	8.9022011	3
4	607.060	668.372	732.526	799.504	8.7832314	8.8250182	8.8648233	8.9020207	4
5	608.058	669.418	733.619	800.644	8.7839499	8.8256970	8.8654707	8.9034393	5
6	609.057	670.465	734.713	801.785	8.7846583	8.8263759	8.8661181	8.9040579	6
7	0610.058	0671.512	0735.808	0802.927	8.7853705	8.8270537	8.8667645	8.9046757	7
8	611.059	672.561	736 904	804.069	8.7860827	8.8277314	8.8674109	8.9052934	8
9	612.060	673.610	738.000	805.212	8.7867937	8.8284081	8.8680563	8.9059102	9
10	613.062	674.660	739.097	806.356	8.7875047	8.8290848	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
13	0616.075	0677.814	0742.394	0809.793	8.7896330	8.8311105	8.8706340	8.9083738	13
14	617.080	678.867	743.494	810.945	8.7903416	8.8317850	8.8712774	8.9089887	14
15	618.087	679.921	744.595	812.088	8.7910491	8.8324584	8.8719198	8.9096028	15
16	619.094	680.976	745.697	813.237	8.7917565	8.8331318	8.8725623	8.9102169	16
17	620.102	682.031	746.800	814.386	8.7924627	8.8338041	8.8732037	8.9108301	17
18	621.111	683.088	747.903	815.520	8.7931690	8.8344765	8.8738452	8.9114432	18
19	0622.120	0684.145	0749.007	0816.687	8.7938740	8.8351477	8 8744856	8.9120555	19
20	623.131	685.203	750.112	817.839	8.7945791	8.8358190	8.8751261	8.9126678	20
21	624.142	686.261	751.218	818.991	8.7952830	8.8364892	8.8757656	8.9132792	21
22	625.154	687.321	752 324	820.145	8.7959869	8.8371594	8.8764051	8.9138905	22
23	626.167	688.381	753.431	821.299	8.7966896	8.8378285	8.8770436	8.9145010	23
24	627.180	689.442	754.539	822.454	8.7973923	8.8384976	8.8776821	8.9151115	24
25	0628.194	0690.504	0755.648	0823.609	8.7980938	8.8391657	8.8783196	8.9157211	25
26	629.210	691.566	756.758	824 765	8.7987953	8.8398337	8.8789571	8.9163306	26
27	630.226	692.630	757.869	825.923	8.7994957	8.8405007	8.8795937	8.9169393	27
28	631.242	693.694	758.980	827.081	8.8001961	8.8411677	8.8808303	8.9175480	28
29	632.260	694.759	760.092	828.240	8.8008953	8.8418337	8.8808659	8.9181558	29
30	633.278	695.824	761.205	829.399	8.8015945	8.8424996	8.8815014	8.9187636	30
31	0634.297	0696.891	0762.318	0830.560	8.8022925	8.8431645	8.8821361	8.9193706	31
32	635.317	697.958	763.432	831.721	8.8029906	8.8438294	8.8827707	8.9199775	32
33	636.338	699.026	764.547	832.882	8.8036874	8.8444932	8.8834044	8.9205835	33
34	637.359	700.095	765.663	834.045	8.8043843	8.8451570	8.8840380	8.9211895	34
35	638.382	701.165	766.780	835.209	8.8050801	8.8458198	8.8846707	8.9217947	35
36	639.405	702.235	767.897	836.373	8.8057758	8.8464826	8.8853034	8.9223999	36
37	0640.429	0703.306	0769.015	0837.538	8.8064704	8.8471443	8.8859352	8.9230041	37
38	641.453	704.378	770.134	838.703	8.8071649	8.8478060	8.8865669	8.9236 84	38
39	642.479	705.451	771.254	839.870	8.8078584	8.8484667	8.8871977	8.9242118	39
40	643.505	706.525	772.375	841.037	8.8085518	8.8491274	8.8878285	8.9248152	40
41	644.532	707.599	773.496	842.205	8.8092441	8.8497870	8.8884584	8.9254177	41
42	645.560	708.674	774.618	843.374	8.8099364	8.8504467	8.8890882	8.9260202	42
43	0646.588	0709.750	0775.741	0844.544	8.8106276	8.8511053	8.8897171	8.9266219	43
44	647.618	710.827	776.865	845.714	8.8113187	8.8517639	8.8903460	8.9272235	44
45	648.648	711.904	777.990	846.885	8.8120087	8.8524215	8.8909739	8.9278243	45
46	649.679	712.983	779.116	848.057	8.8126988	8.8530790	8.8916019	8.9284251	46
47	650.711	714.062	780.242	849.230	8.8133876	8.8537356	8.8922289	8.9290250	47
48	651.743	715.142	781.369	850.403	8.8140765	8.8543921	8.8928559	8.9296249	48
49	0652.777	0716.222	0782.496	0851.578	8.8147643	8.8550476	8.8934820	8.9302240	49
50	653.811	717.304	783.624	852.753	8.8154521	8.8557032	8.8941080	8.9308231	50
51	654.846	718.386	784.753	853.928	8.8161387	8.8563576	8.8947331	8.9314212	51
52	655.881	719.469	785.883	855.105	8.8168253	8.8570121	8.8953583	8.9320194	52
53	656.918	720.553	787.014	856.282	8.8175108	8.8576656	8.8959825	8.9326168	53
54	657955	721.637	788.145	857.460	8.8181964	8.8583191	8.8966066	8.9332141	54
55	0658.993	0722.723	0789.277	0858.639	8.8188808	8.8589715	8.8972299	8.9338106	55
56	660.032	723.809	790.410	859.819	8.8195652	8.8596240	8.8978532	8.9344070	56
57	661.072	724.896	791.544	860.999	8.8202484	8.8602754	8.8984755	8.9350027	57
58	662.112	725.984	792.679	862.181	8.8209317	8.8609268	8.8990978	8.9355983	58
59	663.154	727.072	793.815	863.363	8.8216139	8.8615773	8.8997192	8.9361930	59
60	664.196	728.161	794.951	864.545	8.8222961	8.8622277	8.9003406	8.9367878	60

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Sines and their Logarithms. Deg. 69, 68, 67, 66.

M	L. 69	L. 68	L. 67	L. 66	N. 69	N. 68	N. 67	N. 66	M
60	9.8182126	9.8072860	9.7961533	9.7848090	6579.799	6416.321	6253,934	6092.689	60
59	9.8180321	9.8071022	9.7959659	9.7846181	6577.066	6413.605	6251.237	6090.011	59
58	9.8178516	9.8069183	9.7957786	9.7844271	6574.333	6410.890	6248.540	6087.334	58
57	9.8176711	9.8067343	9.7955911	9.7842361	6571.600	6408.175	6245.844	6084.657	57
56	9.8174905	9.8065503	9.7954037	9.7840450	6568.867	6405.460	6243.148	6081.980	56
55	9.8173098	9.8063652	9.7952161	9.7838539	6566.135	6402.746	6240,452	6079.304	55
54	9.8171291	9.8061821	9.7950285	9.7836627	6563 403	6400.032	6237.757	6076.628	54
53	9.8169483	9.8059979	9.7948408	9.7834714	6560.671	6397.318	6235.062	6073.952	53
52	9.8167675	9.8058137	9.7946531	9.7832801	6557.940	6394.605	6232.367	6071.277	52
51	9.8165865	9.8056294	9.7944652	9.7830887	6555.209	6391.892	6229.673	6068.602	51
50	9.8164056	9.8054451	9.7942774	9.7828973	6552.478	6389.179	6226.979	6065.928	50
49	9.8162246	9.8052606	9.7940895	9.7827058	6549.747	6386.467	6224.285	6063.254	49
48	9.8160435	9.8050762	9.7939015	9.7825143	6547.017	6383.755	6221.592	6060.580	48
47	9.8158624	9.8048916	9.7937135	9.7823226	6544.287	6381.043	6218.899	6057.907	47
46	9.8156812	9.8047070	9.7935254	9.7821309	6541.558	6378.331	6216 206	6055.234	46
45	9.8155000	9.8045224	9.7933372	9.7819392	6538.825	6375.620	6213.514	6052.561	45
44	9.8153187	9.8043377	9.7931491	9.7817474	6536.100	6372.909	6210.822	6049.888	44
43	9.8151373	9.8041529	9.7929608	9.7815555	6533.371	6370.198	6208.130	6047.216	43
42	9.8149560	9.8039681	9.7927725	9.7813636	6530.643	6367.488	6205.438	6044.544	42
41	9.8147745	9.8037832	9.7925841	9.7811716	6527.915	6364.778	6202.747	6041.872	41
40	9.8145930	9.8035983	9.7923956	9.7809796	6525.178	6362.068	6200.056	6039.201	40
39	9.8144114	9.8034133	9.7922071	9.7807874	6522.460	6359 358	6197.365	6036.530	39
38	9.8142298	9.8032283	9.7920187	9.7805953	6519 733	6356.649	6194.675	6033.860	38
37	9.8140481	9.8030431	9.7918299	9.7804030	6517.006	6353.940	6191.985	6031.190	37
36	9.8138664	9.8028580	9.7916413	9.7802108	6514.279	6351.232	6189.296	6028.520	36
35	9.8136846	9.8026727	9.7914525	9.7800184	6511.553	6348.524	6186.607	6025.851	35
34	9.8135027	9.8024875	9.7912637	9.7798260	6509.027	6345.816	6183.918	6023.182	34
33	9.8133208	9.8023021	9.7910748	9.7796335	6506.101	6343.108	6181.229	6020.513	33
32	9.8131389	9.8021167	9.7908859	9.7794410	6503.376	6340.401	6178.541	6017.845	32
31	9.8129568	9.8019313	9.7906969	9.7792484	6500.651	6337.698	6175.853	6015.177	31
30	9.8127748	9.8017458	9.7905079	9.7790558	6497.925	6334.988	6173.166	6012.509	30
29	9.8125926	9.8015602	9.7903188	9.7788630	6495.201	6332.282	6170.479	6009.841	29
28	9.8124104	9.8013746	9.7901297	9.7786703	6492.477	6329.576	6167.792	6007.174	28
27	9.8122282	9.8011889	9.7899404	9.7784774	6489.753	6426.870	6165.105	6004.507	27
26	9.8120459	9.8010031	9.7897512	9.7782845	6487.029	6324.165	6166.419	6001.841	26
25	9.8118635	9.8008173	9.7895618	9.7780915	6484.306	6321.459	6159.733	5999.175	25
24	9.8116811	9.8006315	9.7893725	9.7778985	6481.583	6318.754	6157.047	5996.509	24
23	9.8114986	9.8004455	9.7891830	9.7777054	6478.860	6316.049	6154.362	5993.844	23
22	9.8113161	9.8002596	9.7889935	9.7775123	6476.138	6313.345	6151.677	5991.179	22
21	9.8111335	9.8000735	9.7888039	9.7773191	6473.416	6310.641	6148.992	5988.514	21
20	9.8109509	9.7998875	9.7886143	9.7771258	6470.694	6307.938	6146.308	5985.850	20
19	9.8107682	9.7997013	9.7884245	9.7769325	6467.973	6305.235	6143.624	5983.186	19
18	9.8105854	9.7995151	9.7882348	9.7767391	6465.252	6302.532	6140.940	5980.522	18
17	9.8104026	9.7993288	9.7880450	9.7765456	6462.531	6299.830	6138.257	5977.859	17
16	9.8102197	9.7991425	9.7878551	9.7763521	6559.810	6297.128	6135.574	5975.196	16
15	9.8100368	9.7989561	9.7876652	9.7761585	6457.090	6294.426	6132.891	5972.533	15
14	9.8098539	9.7987697	9.7874752	9.7759649	6454.370	6291.724	6130.209	5969.870	14
13	9.8096708	9.7985831	9.7872851	9.7757712	6451.650	6289.023	6127.527	5967.208	13
12	9.8094877	9.7983966	9.7870950	9.7755775	6448.930	6286.322	6124.845	5964.546	12
11	9.8093045	9.7982099	9.7869048	9.7753836	6446.211	6283.621	6122.163	5961.885	10
10	9.8091213	9.7980233	9.7867146	9.7751898	6443.492	6280.920	6119.482	5959.224	11
9	9.8089380	9.7978365	9.7865243	9.7749958	6410.773	6278.220	6116.801	5956.563	9
8	9.8087547	9.7976498	9.7863340	9.7748018	6438.055	6275.520	6114.120	5953.903	8
7	9.8085713	9.7974629	9.7861435	9.7746077	6435.337	6272.820	6111.440	5951.243	7
6	9.8083879	9.7972760	9.7859531	9.7744136	6432.620	6270.122	6108.760	5948.584	6
5	9.8082044	9.7970890	9.7857625	9.7742194	6429.903	6267.423	6106.081	5945.925	5
4	9.8080208	9.7969020	9.7855720	9.7740252	6427.186	6264.725	6103,402	5943.266	4
3	9.8078372	9.7967149	9.7853813	9.7738308	6424.469	6262.027	6100.723	5940.608	3
2	9.8076536	9.7965278	9.7851909	9.7736365	6421.753	6259.329	6098.045	5937.950	2
1	9.8074698	9.7963405	9.7849998	9.7734420	6419 037	6256.631	6095.367	5935.292	1
0	9.8072860	9.7961534	9.7848090	9.7732475	6416.321	6253.934	6092.689	5932.634	0

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Sines, and their Logarithms — Deg. 53, 52, 51, 50.

M	N. 24	N. 25	N. 26	N. 27	L. 24	L. 25	L. 26	L. 27	M
0	0864.545	09[illegible]	1012.060	1089.935	8.9367878	8.9717035	9.0052061	9.0374005	0
1	865.729	0938.152	1013.335	1091.256	8.9373817	8.9722729	9.0057529	9.0374264	1
2	866.913	939.382	1014.613	1092.577	8.9379756	8.9728424	9.0062997	9.0384522	2
3	868.098	940,614	1015.888	1093.900	8.9385687	8.9734111	9.0068458	9.0389774	3
4	869.284	941.846	1017.166	1095.223	8.9391618	8.9739797	9.0073920	9.0395026	4
5	870.471	943.078	1018.445	1096.547	8.9397540	8.9745476	9.0079344	9.0400272	5
6	871.658	944.312	1019,724	1097.872	8.9403462	8.9751155	9.0084827	9.0405517	6
7	0872.846	0945.546	1021.004	1099.197	8.9409376	8.9756826	9.0090274	9.0410755	7
8	874.035	946.781	1022.285	1100.524	8.9415290	8.9762497	9.0095721	9.0415944	8
9	875.225	948.017	1023.567	1101.851	8.9421195	8.9768161	9.0101160	9.0421226	9
10	876.416	949.254	1024.849	1103.178	8.9427101	8.9773824	9.0106600	9.0426458	10
11	877.607	950.491	1026.132	1104.507	8.9432998	8.9779480	9.0112032	9.0431683	11
12	878.799	951.729	1027.416	1105.836	8.9438895	8.9785135	9.0117465	9.0436908	12
13	0879.992	0952.968	1028.701	1107.166	8.9444783	8.9790783	9.0122890	9.0442127	13
14	881.185	954.208	1029.986	1108.497	8.9450672	8.9796431	9.0128315	9.0447345	14
15	882.380	955.449	1031.273	1109.829	8.9456552	8.9802071	9.0133733	9.0452557	15
16	883.575	956.690	1032.560	1111.161	8.9462433	8.9807711	9.0139154	9.0457769	16
17	884.771	957.932	1033.847	1112.494	8.9468305	8.9813344	9.0144562	9.0462975	17
18	885.967	959.175	1035.136	1113.828	8.9474177	8.9818976	9.0149973	9.0468180	18
19	0887.165	0960.418	1036.425	1115.162	8.9480040	8.9824601	9.0155377	9.0473379	19
20	888.363	961,662	1037.715	1116.497	8.9485904	8.9830226	9.0160781	9.0478578	20
21	889.562	962.907	1039.006	1117.834	8.9491759	8.9835843	9.0166177	9.0483770	21
22	890.762	964.153	1040.297	1119.170	8.9497615	8.9841460	9.0171574	9.0488962	22
23	891.962	965.400	1041.588	1120.508	8.9503462	8.9847070	9.0176,64	9.0494147	23
24	893.163	966.647	1042.882	1121.846	8.9509309	8.9852679	9.0182353	9.0499333	24
25	0894.365	0967.895	1044.176	1123.185	8.9515148	8.9858281	9.0187736	9.0504512	25
26	895.568	969.144	1045.471	1124.525	8.9520982	8.9863883	9.0193119	9.0509691	26
27	896.771	970.394	1046.766	1125.866	8.9526818	8.9869478	9.0198494	9.0514864	27
28	897.976	971.644	1048.062	1127.207	8.9532648	8.9875072	9.0203870	9.0520036	28
29	899.181	972.895	1049.359	1128.549	8.9538471	8.9880659	9.0209238	9.0525202	29
30	900.387	974.147	1050.656	1129.892	8.9544294	8.9886246	9.0214607	9.0530368	30
31	0901.594	0975.400	1051.955	1131.235	8.9550108	8.9891825	9.0219969	9.0535528	31
32	902.801	976.653	1053.254	1132.580	8.9555922	8.9897404	9.0225330	9.0540687	32
33	904.010	977.908	1054.554	1133.925	8.9561729	8.9902976	9.0230685	9.0545840	33
34	905.219	979.162	1055.854	1135.270	8.9567535	8.9908548	9.0236039	9.0550993	34
35	906.428	980.418	1057.156	1135.617	8.9573333	8.9914112	9.0241387	9.0555140	35
36	907.639	981.675	1058.458	1137.964	8.9579131	8.9919675	9.0246735	9.0561286	36
37	0908.850	0982.932	1059.760	1139.312	8.9584921	8.9925233	9.0258076	6.0566426	37
38	910.062	984.190	1061.064	1140.661	8.9590711	8.9930790	9.0257416	6.0571566	38
39	911.275	985.449	1062.368	1142.011	8.9596493	8.9935339	9.0262750	6.0576700	39
40	912.489	986.708	1063.674	1143.361	8.9602275	8.9941888	9.0268084	6.0581833	40
41	913.703	987.969	1064.979	1144.712	8.9608049	8.9947430	9.0273411	6.0586961	41
42	914.918	989.230	1066.286	1146.064	8.9613823	8.9952972	9.0278738	6.0592088	42
43	0916.134	0990.492	1067.594	1147.416	8.9619589	8.9958506	9.0284058	6.0597209	43
44	917.351	991.754	1068.902	1148.770	8.9625355	8.9964041	9.0289378	6.0602329	44
45	918.568	993.018	1070.211	1150.124	8.9631112	8.9969568	9.0294691	6.0607444	45
46	919.786	994.282	1071.520	1151.478	8.9636870	8.9975095	9.0300004	6.0612558	46
47	921.005	995.547	1072.831	1152.834	8.9642620	8.9980614	9.0305310	6.0617666	47
48	922.225	996.812	1074.142	1154.191	8.9648370	8.9986134	9.0310616	6.0622774	48
49	0923.446	0998.079	1075.454	1155.547	8.9654122	8.9991646	9.0315916	9.0627876	49
50	924.657	999.346	1076.766	1156.905	8.9659854	8.9997158	9.0321215	9.0632977	50
51	925.889	1000.614	1078.080	1158.264	8.9665588	9.0002663	9.0326508	9.0638073	51
52	927.112	1001.883	1079.394	1159.623	8.9671322	9.0008168	9.0331800	9.0643168	52
53	928.335	1003.152	1080.709	1160.983	8.9677048	9.0013666	9.0337086	9.0648257	53
54	929.560	1004.422	1082.025	1162.344	8.9682774	9.0019163	9.0342372	9.0653346	54
55	0930.785	1005.694	1083.341	1163.705	8.9688492	9.0024653	9.0347651	9.0658428	55
56	932.011	1006.965	1084.658	1165.068	8.9694210	9.0030144	9.0352930	9.0663511	56
57	933.238	1008.237	1085.976	1166.431	8.9699900	9.0035626	9.0358202	9.0668587	57
58	934.465	1009.511	1087.295	1167.794	8.9705630	9.0041109	9.0363474	9.0673663	58
59	935.693	1010.785	1088.615	1169.159	8.9711333	9.0046585	9.0368740	9.0678733	59
60	936.922	1012.060	1089.935	1170.524	8.9717035	9.0052061	9.0374005	9.0683808	60

A Table of Natural Versed — Deg. 65, 64, 63, 62.

M	L. 65	L. 64	L. 63	L. 62	N. 65	N. 64	N. 63	N. 62	M
60	9.7732475	9.7614630	9.7494494	9.7372002	5932.034	5773.817	5616.268	5460.095	60
59	9.7730529	9.7612647	9.7492472	9.7309940	5929.977	5771.181	5613.674	5455.703	59
58	9.7728583	9.7610663	9.7490445	9.7367878	5927.320	5768.545	5611.060	5454.912	58
57	9.7726636	9.7608678	9.7488426	9.7365814	5924.663	5765.910	5608.446	5452.321	57
56	9.7724689	9.7606693	9.7486402	9.7363750	5922.007	5763.275	5605.833	5449.730	56
55	9.7722741	9.7604707	9.7484377	9.7361686	5919.351	5760.640	5603.220	5447.140	55
54	9.7720792	9.7602721	9.7482352	9.7359621	5916.695	5758.006	5600.608	5444.550	54
53	9.7718842	9.7600733	9.7480326	9.7357554	5914.040	5755.372	5597.996	5441.961	53
52	9.7716893	9.7598746	9.7478299	9.7355488	5911.385	5752.738	5595.364	5439.372	52
51	9.771494	9.7596757	9.747627	9.7353421	5908.731	5750.105	5592.773	5436.784	51
50	9.7712991	9.7594769	9.7474244	9.7351353	5906.077	5747.472	5590.162	5434.196	50
49	9.7711039	9.7592779	9.7472215	9.7349284	5903.42	5744.839	5587.551	5431.608	49
48	9.7709087	9.7590789	9.7470186	9.7347215	5900.709	5742.207	5584.941	5429.021	48
47	9.7707133	9.7588797	9.7468150	9.7345145	5898.110	5739.575	5582.331	5426.434	47
46	9.7705180	9.7586806	9.7466126	9.7343074	5895.46	5736.944	5579.722	5423.847	46
45	9.7703225	9.7584813	9.7464094	9.7341003	5892.811	5734.313	5577.113	5421.261	45
44	9.7701271	9.7582821	9.7462063	9.7338931	5890.159	5731.682	5574.504	5418.675	44
43	9.7699315	9.7580827	9.7460030	9.7336858	5887.507	5729.051	5571.896	5416.089	43
42	9.7697359	9.7578833	9.74579,7	9.7334785	5884.856	5720.421	5569.288	5413.504	42
41	9.7695402	9.7576838	9.7455963	9.7332711	5882.205	5723.794	5566.680	5410.919	41
40	9.7693444	9.7574843	9.7453928	9.7330636	5879.554	5721.162	5564.073	5408.335	40
39	9.7691486	9.7572846	9.7451893	9.7328560	5876.904	5718.533	5561.466	5405.751	39
38	9.7689528	9.7570850	9.7449857	9.7326485	5874.254	5715.904	5558.860	5403.167	38
37	9.7687568	9.7568852	9.7447821	9.7324408	5871.605	5713.276	5556.254	5400.584	37
36	9.7685608	9.7566854	9.7445784	9.7322331	5868.956	5710.648	5553.648	5398.001	36
35	9.7683647	9.7564855	9.7443745	9.7320252	5866.307	5708.021	5551.043	5395.419	35
34	9.7681687	9.7562856	9.7441707	9.7318174	5863.656	5705.394	5548.438	5392.837	34
33	9.7679724	9.7560856	9.7439668	9.7316094	5861.011	5702.767	5545.833	5390.256	33
32	9.7077762	9.7558856	9.7437626	9.7314014	5858.363	5700.141	5543.229	5387.675	32
31	9.7675799	9.7556854	9.7435587	9.7311933	5855.715	5097.515	5540.625	5385.094	31
30	9.7673835	9.7554853	9.7433547	9.7309852	5853.068	5694.889	5538.022	5382.514	30
29	9.7671871	9.7552850	9.7431505	9.7307769	5850.421	5692.264	5535.419	5379.933	29
28	9.7669906	9.7550847	9.7429462	9.7305686	5847.774	5689.639	5532.816	5377.354	28
27	9.7667940	9.7548843	9.7427419	9.7303603	5845.128	5687.014	5530.214	5374.775	27
26	9.7665974	9.7546839	9.7425174	9.7301519	5842.482	5684.390	5527.612	5372.196	26
25	9.7664007	9.7544838	9.7423331	9.7299433	5839.837	5681.766	5525.010	5369.618	25
24	9.7662040	9.7542828	9.7421280	9.7297348	5837.192	5679.142	5522.409	5367.040	24
23	9.7660071	9.7540821	9.741924	9.7295261	5834.547	5676.519	5519.808	5364.462	23
22	9.7658103	9.7538814	9.741719	9.7293175	5831.903	5673.896	5517.205	5361.885	22
21	9.7656133	9.7536806	9.7415140	9.7291087	5829.259	5671.274	5514.608	5359.308	21
20	9.7654164	9.7534798	9.7413099	9.7288999	5826.615	5668.652	5512.008	5356.732	20
19	9.7652193	9.7532789	9.7411050	9.7286909	5823.972	5666.030	5509.409	5354.156	19
18	9.7650222	9.7530779	9.7409001	9.7284820	5821.329	5663.409	5506.810	5351.580	18
17	9.7648249	9.7528769	9.7406951	9.7282729	5818.687	5660.783	5504.212	5349.005	17
16	9.7646277	9.7526758	9.740490	9.7280638	5816.045	5658.167	5501.614	5346.410	16
15	9.7644304	9.7524740	9.7402848	9.7278546	5813.403	5655.547	5499.016	5343.855	15
14	9.7642330	9.7522734	9.7400795	9.7276454	5810.761	5652.927	5496.418	5341.281	14
13	9.7640355	9.7520721	9.7398745	9.7274360	5808.120	5650.307	5493.821	5338.707	13
12	9.7638381	9.7518708	9.7396692	9.7272267	5805.479	5647.688	5491.224	5336.134	12
11	9.7636405	9.7516693	9.7394638	9.7270172	5802.838	5645.029	5488.628	5333.561	11
10	9.7634429	9.7514679	9.7392584	9.7268077	5800.198	5642.451	5486.032	5330.988	10
9	9.7632451	9.7512662	9.7390528	9.7265981	5797.558	5639.833	5483.437	5328.416	9
8	9.7630474	9.7510647	9.7388473	9.7262885	5794.919	5637.215	5480.842	5325.844	8
7	9.7628496	9.7508630	9.7386416	9.7261787	5792.280	5634.598	5478.242	5323.273	7
6	9.7626517	9.7506613	9.7384359	9.7259689	5789.64	5631.981	5475.653	5320.702	6
5	9.7624537	9.7504594	9.7382301	9.7257590	5787.003	5629.365	5473.059	5318.131	5
4	9.7622557	9.7502576	9.7380243	9.7255491	5784.365	5626.749	5470.465	5315.561	4
3	9.7620576	9.7500556	9.7378183	9.7253391	5781.727	5624.133	5467.872	5312.991	3
2	9.7618595	9.7498536	9.7376124	9.7251290	5779.090	5621.518	5465.279	5310.422	2
1	9.7616613	9.7496515	9.7374063	9.7249188	5776.453	5618.903	5462.687	5307.853	1
0	9.7614620	9.7494494	9.7372002	9.7247087	5773.817	5616.288	5460.095	5305.284	0

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Sines, and their Logarithms — Deg. 28, 29. 30, 31

M	N. 28	N. 29	N 30	N. 31	L. 28	L. 29	L. 30	31 L.	M
0	1170.521	1253.803	1339 746	1428 327	9.0683803	9.0982293	9.1270225	9.1548276	0
1	1171.890	1255.214	1341.201	1429.820	9.0688867	9.0987175	9.1274937	9.1552829	1
2	1173.257	1256.625	1342.656	1431.325	9.0693931	9.0992057	9.1279649	9.1557382	2
3	1174.624	1258.037	1344.113	1432.825	9.0698988	9.0996933	9.1284355	9.1561930	3
4	1175.993	1259.450	1345.570	1434.326	9.0704046	9.1001809	9.1289062	9.1566477	4
5	1177.362	1260,863	1347.027	1435.827	9.0709097	9.1006679	9.1293763	9.157 1020	5
6	1178.721	1262.278	1348.486	1437.329	9.0714148	9.1011549	9.1298464	9.1575562	6
7	1180.102	1263.693	1349,945	1438.832	9.0719193	9.1016414	9.1303 159	9.1580100	7
8	1181.473	1265.109	1351.405	1440.336	9.0724238	9.1021278	9.1307855	9.1584637	8
9	1182.845	1266.525	1352.866	1441 840	9.0729227	9.1026130	9.1312545	9.1589169	9
10	1184.218	1267.942	1354.327	1443.345	9.0734316	9.1030995	9.1317235	9.1593702	10
11	1185.591	1269.360	1355.789	1444.851	9.0739348	9.1035848	9.1321920	9.1598229	11
12	1186.965	1270.779	1357.252	1446.357	9.0744381	9.1040701	9.1326605	9.1602756	12
13	1188.340	1272.199	1358.716	1447.865	6,0749407	9.1045548	9.1331284	9.1607278	13
14	1189.716	1273.619	1360.180	1449.373	6.0754434	9.1050395	9.1335964	9.1611800	14
15	1191.093	1275.040	1361.645	1450.881	6.0759454	9.1055236	9.1340637	9.1616318	15
16	1192.470	1276.462	1363.111	1452.391	6.0764474	9.1060078	9.1345311	9.1620835	16
17	1193.848	1277.884	1364.577	1453.901	6.0769488	9.1064913	9.1349980	9.1625347	17
18	1195.220	1279.307	1366.044	1455.412	6.0774502	9.1069749	9.1354648	9.1629859	18
19	1196.606	1280.731	1367.512	1456.923	9.0779510	9.1074578	9 1359312	9.1634366	19
20	1197.986	1282.156	1368.981	1458.436	9.0784518	9.1079408	9.1363975	9.1638873	20
21	1199.367	1283.581	1370.451	1459.949	9.0789519	9.1084232	9.1368633	9.1643374	21
22	1200.749	1285.007	1371.921	1461.462	9.0794521	9.1089056	9.1373290	9.1647876	22
23	1202.131	1286.434	1373.392	1462.977	9.0799517	9.1093875	9.1377943	9.1652373	23
24	1203.514	1287.862	1374.863	1464.492	9.0804512	9.1098693	9.1382595	9.1656870	24
25	1204.898	1289.290	1376.336	1466.008	9.0809502	9.1103506	9.1387242	9.1661362	25
26	1206.283	1290.719	1377.809	1467.525	9.0814491	9.1108318	9.1391889	9.1665854	26
27	1207.668	1292.149	1379.283	1469.042	9.0819475	9.1113125	9.1396531	9.1670341	27
28	1209.054	1293.580	1380.757	1470.560	9.0824458	9.1117932	9.1401173	9.1674828	28
29	1210.441	1295.011	1382.232	1472.079	9.0829436	9.1122733	9.1405809	9.1679309	29
30	1211.829	1296.443	1383.708	1473.598	9.0834413	9.1127534	9.1410446	9.1683791	30
31	1213.217	1297.876	1385.185	1475.119	9.0839384	9.1132330	9.1415077	9.1688268	31
32	1214,606	1299.309	1386.663	1476.640	9.0844356	9.1137126	9.1419708	9.1692745	32
33	1215.996	1300.744	1388.141	1478.161	9.0849321	9.1141915	9.1424334	9.1697217	33
34	1217.387	1302.179	1389.620	1479.684	9 0854286	9.1146705	9.1428960	9.1701689	34
35	1218.778	1303.614	1391.099	1481.207	9.0859245	9.115149	9.1433580	9.1706156	35
36	1220.170	1305.051	1392.580	1482.731	9.0864204	9.1156274	9.1438201	9.1710623	36
37	1221.563	1306.488	1394.061	1484.255	9.0869157	9.1161052	9.1442816	6.1715085	37
38	1222.957	1307.926	1395.543	1485.781	9.0874111	9.1165831	9.1447431	6.1719547	38
39	1224.351	1309.364	1397.025	1487.307	9.0879058	9.1170604	9.1452041	6.1724004	39
40	1225.746	1310.804	1398.509	1488.833	9.0884005	9.1175377	9.1456651	6.1728461	40
41	1227.142	1312.244	1399.993	1490.361	9.0888946	9.1180145	9.1461256	6.1732913	41
42	1228.538	1313.685	1401.477	1491.889	9.0893887	9.1184912	9.1465861	6.1737365	42
43	1229.936	1315,126	1402.963	1493.418	6.0898822	9.1189674	9.1470465	6.1741812	43
44	1231.334	1316.569	1404.449	1494.947	6.0903758	9.1194436	9.1475060	6.1746259	44
45	1232.732	1318.012	1405.936	1496.478	6.0908687	9.1199192	9.1479654	6.1750701	45
46	1234.132	1319.456	1407.424	1498.009	6.0913616	9.1203948	9.1484248	6.1755144	46
47	1235.532	1320.900	1408.912	1499.541	6.0918539	9.1208699	9.1488837	6.1759581	47
48	1236.933	1322.345	1410.401	1501.073	6.0923462	9.1213449	9.1493426	6.1764018	48
49	1238.335	1323.791	1411.891	1502.506	6.0928380	9.1218194	9.1498010	9.1768451	49
50	1239.737	1325.238	1413.381	1504.140	6.0933297	9.1222939	9.1502594	9.1772883	50
51	1241.141	1326.686	1414.373	1505.675	6.0938208	9.1227679	9.1507172	9.1777311	51
52	1242.545	1328.134	1416.365	1507.210	6.0943120	9.1232419	9.1511751	9.1781738	52
53	1243.949	1329.583	1417.857	1508.746	6.0948025	9.1237153	9.1516324	9.1786161	53
54	1345.355	1331.033	1419.351	1510.283	6.0952931	9.1241887	9.1520898	9.1790584	54
55	1246.761	1332.483	1420.845	1511.821	6.0957830	9.1246615	9.1525466	9.1795002	55
56	1248.168	1333.934	1422.340	1513.358	6.0962730	9.1251344	9.1530034	9.1799419	56
57	1249.575	1335.386	1423.836	1514.898	6.0967625	9.1256057	9.1534597	9.1803832	57
58	1250.984	1336.839	1425.332	1516.438	6.0972517	9.1260790	9.1539161	9.1808245	58
59	1252.393	1338.292	1426.829	1517.978	6 0977405	9.1265507	9.1543719	9.1812653	59
60	1253 803	1339.746	1428.327	1519.519	6.0982293	9.1270225	9.1548276	9.1817061	60

Deg. 61, 60, 59, 58. A Table of Natural Versed

M	L. 61	L. 60	L. 59	L. 58	N. 61	N. 60	N. 59	N. 58	M
60	9.7247087	9.7119677	9.6989700	9.6857076	5305.28	5151.904	5000,000	4849.619	60
59	9.7244983	9.7117537	9.6987511	9.6854843	5302.716	5159.300	4997.481	4847.126	59
58	9.7242880	9.7115387	9.6985322	9.6852609	5300.148	5146.816	4994.962	4844.633	58
57	9.7240776	9.7113240	9.6983132	9.6850374	5297.581	5144.273	4992.444	4842.141	57
56	9.7238671	9.7111093	9.6980942	9.6848139	5295.014	5141.730	4989.926	4839.649	56
55	9.7236565	9.710894	9.6978750	9.6845902	5292.447	5139.188	4987.409	4837.157	55
54	9.7234459	9.7106797	9.6976558	9.6843665	5289.881	5136.646	4984.892	4834.666	54
53	9.7232352	9.7104647	9.6974365	9.6841427	5287.315	5134.105	4982.376	4832.175	53
52	9.7230244	9.7102497	9.6972172	9.6839189	5284.750	5131.564	4979.860	4829.685	52
51	9.7228136	9.7100346	9.6969977	9.6836949	5282.185	5129.023	4977.344	4827.195	51
50	9.7226037	9.7098195	9.6967782	9.6834710	5279.620	5126.483	4974.829	4824.706	50
49	9.7223917	9.7096042	9.6965586	9.6832468	5277.056	5123.943	4972.314	4822.217	49
48	9.7221807	9.7093890	9.6963390	9.6830227	5274.49	5121.404	4969.800	4819.729	48
47	9.7219695	9.7091736	9.6961192	9.6827984	5271.929	5118.865	4967.286	4817.241	47
46	9.7217584	9.7089582	9.6958994	9.6825741	5269.360	5116.326	4964.773	4814.754	46
45	9.7215471	9.7087426	9.6956795	9.6823497	5266.803	5113.788	4962.260	4812.267	45
44	9.7213358	9.7085271	9.6954596	9.6821253	5264.241	5111.250	4959.747	4809.780	44
43	9.7211243	9.7083114	9.6952395	9.6819007	5261.679	5108.713	4957.235	4807.294	43
42	9.7209129	9.7080957	9.6950194	9.6816761	5259.118	5106.176	4954.723	4804.808	42
41	9.7207013	9.7078799	9.6947992	9.6814514	5256.557	5103.639	4952.212	4802.323	41
40	9.7204898	9.7076641	9.6945790	9.6812266	5253.996	5101.103	4949.701	4799.838	40
39	9.7202781	9.7074481	9.6943587	9.6810018	5251.436	5098.567	4947.191	4797.354	39
38	9.7200663	9.7072321	9.6941383	9.6307769	5248.876	5096.032	4944.681	4794.870	38
37	9.7198545	9.707016	9.6939178	9.6805518	5246.317	5093.497	4942.171	4792.386	37
36	9.7196426	9.7067999	9.6936973	9.6803268	5243.758	5090.963	4939.662	4789.903	36
35	9.7194306	9.7065836	9.6934766	9.6801015	5241.199	5088.429	4937.153	4787.420	35
34	9.7192186	9.7063674	9.6932557	9.6798764	5238.641	5085.895	4934.645	4784.938	34
33	9.7190065	9.7061510	9.6930351	9.6796510	5236.083	5083.362	4932.137	4782.456	33
32	9.7187944	9.7059346	9.6928143	9.6794257	5233.526	5080.829	4929.630	4779.975	32
31	9.7185821	9.7057180	9.6925934	9.6792002	5230.969	5078.297	4927.123	4777.494	31
30	9.7183698	9.7055015	9.6923724	9.6789747	5228.412	5075.765	4924.616	4775.014	30
29	9.7181574	9.7052848	9.6921513	9.6787490	5225.856	5073.233	4922.110	4772.534	29
28	9.7179450	9.7050681	9.6919302	9.6785234	5223.300	5070.702	4919.604	4770.054	28
27	9.7177325	9.7048512	9.6917089	9.6782976	5220.745	5068.171	4917.099	4767.575	27
26	9.7175199	9.7046344	9.6914877	9.6780717	5218.190	5065.641	4914.594	4765.096	26
25	9.7173072	9.7044174	9.6912663	9.6778458	5215.635	5063.111	4912.089	4762.618	25
24	9.7170945	9.7042004	9.6910449	9.6776198	5213.081	5060.582	4909.585	4760.140	24
23	9.7168817	9.7039833	9.6908233	9.6773937	5210.527	5058.053	4907.081	4757.663	23
22	9.7166688	9.7037661	9.6906017	9.6771676	5207.974	5055.524	4904.578	4755.186	22
21	9.7164559	9.7035489	9.6903800	9.0769413	5205.421	5052.996	4902.075	4752.710	21
20	9.7162429	9.7033316	9.6901583	9.6767150	5202.868	5050.468	4899.573	4750.234	20
19	9.7160298	9.7031742	9.6899365	9.6764886	5200.316	5047.941	4897.071	4747.759	19
18	9.7158186	9.7028967	9.6897146	9.6762622	5197.764	5045.414	4894.570	4745.284	18
17	9.7156034	9.7026792	9.6894926	9.6760356	5195.213	5042.887	4892.069	4742.809	17
16	9.7153901	9.7024616	9.6892706	9.6758090	5192.662	5040.361	4889.569	4740.335	16
15	9.7151767	9.7022439	9.6890484	9.6755823	5190.112	5037.835	4887.069	4737.861	15
14	9.7149633	9.7020262	9.6888263	9.6753555	5187.56	5035.310	4884.569	4735.388	14
13	9.7147498	9.7018083	9.6886040	9.6751286	5185.012	5032.785	4882.070	4732.915	13
12	9.7145362	9.7015905	9.6883817	9.6749017	5182.46	5030.260	4879.571	4730.443	12
11	9.7143225	9.7013725	9.6881592	9.6746747	5179.914	5027.736	4877.073	4727.971	11
10	9.7141089	9.7011545	9.6879368	9.6744476	5177.365	5025.212	4874.575	4725.499	10
9	9.7138950	9.7009363	9.6877141	9.6742204	5174.817	5022.689	4872.078	4723.028	9
8	9.7136812	9.7007182	9.6874915	9.6739932	5172.269	5020.166	4869.581	4720.557	8
7	9.7134672	9.7004999	9.6872688	9.6737659	5169.722	5017.644	4867.084	4718.087	7
6	9.7132533	9.7002816	9.6870460	9.6735385	5167.175	5015.122	4864.588	4715.617	6
5	9.7130392	9.7000631	9.6868231	9.6733110	5164.629	5012.601	4862.092	4713.148	5
4	9.7128250	9.6998447	9.6866002	9.6730835	5162.083	5010.080	4859.597	4710.679	4
3	9.7126108	9.6996271	9.6863771	9.6728558	5159.538	5907.559	4857.102	4708.211	3
2	9.7123965	9.6994075	9.6861541	9.6726281	5156.993	5005.039	4854.607	4705.742	2
1	9.7121821	9.6991887	9.6859309	9.6724003	5154.448	5002.519	4852.113	4703.275	1
0	9.7119677	9.6989700	9.6857076	9.6721725	5151.904	5000.000	4849.619	4700.808	0

Deg. 32, 33, 34, 35. Sines and their Logarithms.

M	N. 32	N. 33	N. 34	N. 35	L. 32	L. 33	L. 34	L. 35	M
0	1519.519	1613.294	1709.624	1808.487	9.1817001	9.2077136	9.2329007	9.2573136	0
1	1521.061	1614.879	1711.251	1810.148	9.1821465	9.2081299	9.2333137	9.2577141	1
2	1522.603	1616.464	1712.879	1811.818	9.1825868	9.2085661	9.2337267	9.2581145	2
3	1524.147	1618.050	1714.507	1813.488	9.1830265	9.2089919	9.2341392	9.2585146	3
4	1525.691	1619.637	1716.136	1815.159	9.1834665	9.2094177	9.2345518	9.2589147	4
5	1527.235	1621.225	1717.766	1816.831	9.1839059	9.2098431	9.2349639	9.2593143	5
6	1528.781	1622.813	1719.397	1818.502	9.1843452	9.2102684	9.2353761	9.2597140	6
7	1530.327	1624.402	1721.028	1820.178	9.1847841	9.2106933	9.2357878	9.2601132	7
8	1531.874	1625.991	1722.660	1821.849	9.1852230	9.2111182	9.2361995	9.2605125	8
9	1533.421	1627.582	1724.292	1823.524	9.1856614	9.2115427	9.2366108	9.2609113	9
10	1534.970	1629.173	1725.926	1825.199	9.1860998	9.2119671	9.2370221	9.2613102	10
11	1536.519	1630.764	1727.560	1826.875	9.1865377	9.2123911	9.2374329	9.2617086	11
12	1538.068	1632.357	1729.194	1828.551	9.1869756	9.2128151	9.2378438	9.2621071	12
13	1539.619	1633.950	1730.830	1830.228	9.1874131	9.2132387	9.2382542	9.2625051	13
14	1541.170	1635.544	1732.460	1831.906	9.1878505	9.2136622	9.2386647	9.2629032	14
15	1542.722	1637.138	1734.103	1833.584	9.1882875	9.2140853	9.2390747	9.2633008	15
16	1544.274	1638.734	1735.740	1835.264	9.1887245	9.2545084	9.2394847	9.2636985	16
17	1545.828	1640.330	1737.378	1836.944	9.1891610	9.2149310	9.2398943	9.2640957	17
18	1547.382	1641.926	1739.017	1838.624	9.1895974	9.2153537	9.2403038	9.2644929	18
19	1548.936	1643.524	1740.657	1840.305	9.1900335	9.2157759	9.2407130	9.2648898	19
20	1550.492	1645.122	1742.297	1841.987	9.1904695	9.2161981	9.2411222	9.2658266	20
21	1552.048	1646.721	1743.938	1843.670	9.1909050	9.2166198	9.2415309	9.2656831	21
22	1553.605	1648.320	1745.580	1845.353	9.1913406	9.2170416	9.2419396	9.2660795	22
23	1555.162	1649.920	1747.222	1847.037	9.1917756	9.2174629	9.2423480	9.2664756	23
24	1556.721	1651.521	1748.865	1848.722	9.1922107	9.2178842	9.2427563	9.2668716	24
25	1558.280	1653.123	1750.509	1850.407	9.1926453	9.2183051	9.2431642	9.2672673	25
26	1559.839	1654.725	1752.153	1852.094	9.1930799	9.2187259	9.2435721	9.2676729	26
27	1561.400	1656.328	1753.793	1853.780	9.1935140	9.2191463	9.2439796	9.2680582	27
28	1562.961	1657.932	1755.444	1855.468	9.1939482	9.2195668	9.2443871	9.2684534	28
29	1564.523	1659.537	1757.091	1857.156	9.1943818	9.2199867	9.2441941	9.2688483	29
30	1566.086	1661.142	1758.738	1858.845	9.1948155	9.2204067	9.2452012	9.2692431	30
31	1567.649	1662.748	1760.386	1860.534	9.1952487	9.2208262	9.2456078	9.2696376	31
32	1569.213	1664.354	1762.035	1862.225	9.1956819	9.2212458	9.2460145	9.2700321	32
33	1570.778	1665.962	1763.684	1863.916	9.1961146	9.2216649	9.2464207	9.2704251	33
34	1572.343	1667.570	1765.334	1865.607	9.1965473	9.2220839	9.2468269	9.2708202	34
35	1573.909	1669.178	1766.985	1867.299	9.1969795	9.2225026	9.2472327	9.2712139	35
36	1575.476	1670.788	1768.636	1868.992	9.1974118	9.2229212	9.2476385	9.2716075	36
37	1577.044	1672.398	1770.288	1870.686	9.1978436	9.2233395	9.2480439	9.2720008	37
38	1578.612	1674.009	1771.941	1872.380	9.1982754	9.2237577	9.2484493	9.2723941	38
39	1580.181	1675.620	1773.595	1874.075	9.1987067	9.2241754	9.2488543	9.2727870	39
40	1581.751	1677.232	1775.249	1875.771	9.1991380	9.2245932	9.2492593	9.2731799	40
41	1583.321	1678.845	1776.904	1877.468	9.1995689	9.2250105	9.2496619	9.2735724	41
42	1584.892	1680.459	1778.560	1879.165	9.1999997	9.2254279	9.2500584	9.2739649	42
43	1586.464	1682.973	1780.216	1880.863	9.2004301	9.2258448	9.2504725	9.2743570	43
44	1588.037	1683.688	1781.873	1882.561	9.2008605	9.2262617	9.2508767	9.2747491	44
45	1589.610	1685.304	1783.531	1884.260	9.2012904	9.2266781	9.2512805	9.2751408	45
46	1591.184	1686.920	1785.189	1885.960	9.2017204	9.2270946	9.2516842	9.2755325	46
47	1592.759	1688.537	1786.848	1887.661	9.2021498	9.2275106	9.2520875	9.2759238	47
48	1534.334	1690.155	1788.508	1889.362	9.2025793	9.2279266	9.2524909	9.2763151	48
49	1595.910	1691.774	1790.168	1891.054	9.2030083	9.2283422	9.2528938	9.2767061	49
50	1597.487	1693.393	1791.830	1892.765	9.2034373	9.2287578	9.2532967	9.2770970	50
51	1599.064	1695.013	1793.491	1894.470	9.2038659	9.2291729	9.2536992	9.2774875	51
52	1600.643	1696.634	1795.154	1896.174	9.2042944	9.2295881	9.2541017	9.2778787	52
53	1602.222	1698.255	1796.817	1897.878	9.2047225	9.2300028	9.2545038	9.2782683	53
54	1603.801	1699.877	1798.481	1899.584	9.2051506	9.2304175	9.2549059	9.2786584	54
55	1605.382	1701.500	1800.146	1901.290	9.2055782	9.2308318	9.2553076	9.2790482	55
56	1606.963	1703.123	1801.811	1902.996	9.2060058	9.2312461	9.2557093	9.2794380	56
57	1608.545	1704.748	1803.477	1904.704	9.2064330	9.2316600	9.2561106	9.2798273	57
58	1610.127	1706.372	1805.144	1906.412	9.2068602	9.2320738	9.2565119	9.2802157	58
59	1611.710	1707.998	1806.811	1908.121	9.2072869	9.2324872	9.2569127	9.2806657	59
60	1613.294	1709.624	1808.480	1909.830	9.2077136	9.2329007	9,2573136	9.2809947	60

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Deg. 57, 56, 55, 54. A Table of Natural Versed.

M	L. 57	L. 56	L. 55	L. 54	N. 57	N. 56	N. 55	N. 54	M
60	9.6721725	9.6583558	9.6442486	9.6298412	4700.808	4553.610	4408.071	4264.236	60
59	9.6719445	9.6581230	9.6440109	9.6295984	4698.341	4551.171	4405.600	4261.853	59
58	9.6717165	9.6578903	9.6437732	9.6293557	4695.875	4548.732	4403.249	4259.471	58
57	9.6714883	9.6576574	9.6435354	9.6291127	4693.409	4546.293	4400.839	4257.089	57
56	9.6712602	9.6574245	9.6432975	9.6288698	4690.944	4543.855	4398.429	4254.708	56
55	9.0710319	9.6571914	9.6430595	9.6286267	4688.479	4541.417	4396.019	4252.328	55
54	9.6708036	9.6569583	9.6428215	9.6283836	4686.015	4538.980	4393.610	4249.948	54
53	9.6705751	9.6567251	9.6425833	9.6281403	4683.551	4536.543	4391.202	4247.563	53
52	9.6703467	9.6564918	9.6423452	9.6278970	4681.087	4534.108	4388.794	4245.189	52
51	9.6701181	9.6562584	9.6421068	9.6276535	4678.624	4531.672	4386.386	4242.810	51
50	9.6698895	9.6560250	9.6418685	9.6274101	4676.161	4529.237	4383.979	4240.432	50
49	9.6696607	9.6557915	9.6416299	9.6271664	4673.699	4526.802	4381.573	4238.054	49
48	9.6694319	9.6555579	9.6413914	9.6269228	4671.237	4524.368	4379.167	4235.677	48
47	9.6692030	9.6553242	9.6411527	9.6266790	4668.776	4521.934	4376.761	4233.300	47
46	9.6689741	9.6550904	9.6409141	9.6264352	4666.315	4519.501	4374.356	4230.924	46
45	9.6687450	9.6548566	9.6406752	9.6261912	4663.855	4517.068	4371.951	4228.548	45
44	9.6685159	9.6546227	9.6404364	9.6259473	4661.395	4514.636	4359.547	4226.173	44
43	9.6682867	9.6543886	9.6401973	9.6257031	4658.935	4512.204	4367.143	4223.798	43
42	9.6680574	9.6541546	9.6399583	9.6254589	4656.476	4509.772	4364.740	4221.424	42
41	9.6678280	9.6539204	9.6397191	9.6252146	4654.017	4507.341	4362.337	4219.050	41
40	9.6675986	9.6536861	9.6394800	9.6249703	4651.559	4504.910	4359.934	4216.676	40
39	9.6673691	9.6534518	9.6392406	9.6247258	4649.102	4502.480	4357.532	4214.303	39
38	9.6671395	9.6532174	9.6390012	9.6244813	4646.645	4500.050	4355.131	4211.931	38
37	9.6669098	9.6529828	9.6387617	9.6242366	4644.188	4497.621	4352.730	4209.559	37
36	9.6666801	9.6527483	9.6385222	9.6239919	4641.732	4495.192	4350.330	4207.108	36
35	9.6664502	9.6525136	9.6382825	9.6237471	4639.276	4492.764	4347.930	4204.817	35
34	9.6662203	9.6522789	9.6380428	9.6235022	4636.821	4490.336	4345.531	4202.447	34
33	9.6659903	9.6520440	9.6378030	9.6232572	4634.366	4487.909	4343.132	4200.077	33
32	9.6657603	9.6518092	9.6375633	9.6230122	4631.912	4485.482	4340.734	4197.708	32
31	9.6655301	9.6515741	9.6373231	9.6227670	4626.458	4483.056	4338.336	4195.339	31
30	9.6652989	9.6513391	9.6370830	9.6225218	4627.004	4480.630	4335.938	4192.970	30
29	9.6650695	9.6511039	9.6368428	9.6222764	4624.551	4478.205	4333.541	4190.602	29
28	9.6648392	9.6508687	9.6366016	9.6220311	4622.098	4475.780	4331.144	4188.234	28
27	9.6646087	9.6506333	9.6363623	9.6217855	4619.646	4473.355	4328.748	4185.867	27
26	9.6643781	9.6503980	9.6361219	9.6215400	4617.194	4470.931	4326.352	4183.501	26
25	9.6641475	9.6501625	9.6358813	9.6212942	4614.742	4468.507	4323.957	4181.135	25
24	9.6639168	9.6499269	9.6356408	9.6210485	4612.291	4465.084	4341.562	4178.770	24
23	9.6636860	9.6496912	9.6354001	9.9208026	4609.841	4463.662	4319.168	4176.405	23
22	9.6634552	9.6494556	9.6351594	9.6205567	4607.391	4461.240	4316.774	4174.041	22
21	9.6632242	9.6492197	9.6349185	9.6203106	4604.942	4458.818	4314.381	4171.677	21
20	9.6629932	9.6489839	9.6346776	9.6200645	4602.493	4456.397	4311.988	4169.313	20
19	9.6627620	9.6487478	9.6344366	9.6198183	4600.045	4453.976	4309.596	4166.950	19
18	9.6625309	9.6485118	9.6341955	9.6195720	4597.597	4451.556	4307.204	4164.388	18
17	9.6622996	9.6482756	9.6339543	9.6193256	4595.146	4449.136	4304.813	4162.226	17
16	9.6620683	9.6480394	9.6337131	9.6190792	4592.702	4446.717	4302.422	4159.864	16
15	9.6618368	9.6478031	9.6334717	9.6188326	4590.255	4444.298	4300.032	4157.503	15
14	9.6616053	9.6475667	9.6332303	9.6185860	4587.809	4441.880	4297.642	4155.141	14
13	9.6613737	9.6473302	9.6329887	9.6183392	4585.363	4439.462	4295.253	4152.782	13
12	9.6611421	9.6470937	9.6327472	9.6180924	4582.918	4437.044	4292.854	4150.422	12
11	9.6609103	9.6468570	9.6325054	9.6178454	4580.473	4434.627	4290.476	4148.063	11
10	9.6606785	9.6466204	9.6322637	9.6175985	4578.028	4432.210	4288.088	4145.705	10
9	9.6604466	9.6463835	9.6320218	9.6173513	4575.584	4429.794	4285.701	4143.347	9
8	9.6602146	9.6461467	9.6317799	9.6171042	4573.141	4427.378	4283.314	4141.990	8
7	9.6599825	9.6459097	9.6315378	9.6168569	4570.698	4424.96	4280.928	4138.633	7
6	9.6597504	9.6456726	9.6312957	9.6166096	4568.255	4422.548	4278.542	4136.276	6
5	9.6595181	9.6454355	9.6310535	9.6163621	4565.813	4420.134	4276.156	4133.920	5
4	9.6592858	9.6451983	9.6308112	9.6161146	4563.371	4417.72	4273.771	4131.564	4
3	9.6590534	9.6449609	9.6305688	9.6158669	4560.930	4415.307	4271.387	4129.200	3
2	9.6588210	9.6447236	9.6303264	9.6156192	4558.490	4412.894	4269.003	4126.855	2
1	9.6585884	9.6444861	9.6300838	9.6153714	4556.050	4410.482	4266.619	4124.501	1
0	9.6583558	9.6442486	9.6298412	9.6151235	4553.610	4408.071	4264.235	4122.148	0

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eg. 36, 37, 38, 39. Sines and their Logarithms.

M	N. 36	N. 37	N. 38	N. 39	L. 36	L. 37	L. 38	L. 39	M
0	1909.830	2013 645	2119.08	2228.54	9.2809947	9.3039820	9.3263138	9.348 205	0
1	1911.540	2015.396	2121.884	2230.371	9.2813833	9.3042603	9.3265805	9.3483771	1
2	1913.251	2017.147	2123.476	2232.203	9.2817720	9.3047376	9.3270473	9.3487337	2
3	1914.963	2018.900	2125.268	2234.035	9.2821602	9.3051147	9.3274136	9.3490899	3
4	1916.675	2020.653	2127.061	2235.868	9 2825484	9.3054917	9.327780	9.3494462	4
5	1918.388	2022.406	2128.855	2237.702	9.2829363	9.3058683	9.3281450	9.3498021	5
6	1920.101	2024.161	2130.650	2239.536	9.2833241	9.3062450	9.3285121	9.3501580	6
7	1921.815	2025.916	2132.445	2241.37	9.2837116	9.3066213	9.3288776	9.3505136	7
8	1923.530	2027.671	2134.241	2243.200	9.2840990	9.3069972	9.3292434	9.3508692	8
9	1925.246	2029.428	2136 037	2245.043	9.2844861	9.3073735	9.3296088	9.3512245	9
10	1926 962	2031.185	2137.835	2246.875	9.2848732	9.3077494	9.3299741	9.3515798	10
11	1928.679	2032.942	2139.633	2248.717	9.2852599	9.3081250	9.3303391	9.3519347	11
12	1930.397	2034.701	2141.431	2250.55	9.2856466	9.3085006	9.3307042	9.3522897	12
13	1932.115	2036.460	2143.230	2252.394	9.2860329	9.3088758	9.3310688	9.3526443	13
14	1933.834	2038.220	2145.030	2254.233	9.2864192	9.3092510	9.3314334	9.3529989	14
15	1935.554	2039.980	2146.831	2256.074	9.2868052	9.3096258	9.3317977	9.3533532	15
16	1937.274	2041.741	2148.632	2257.914	9.2871911	9.3100007	9.3321620	9.3537075	16
17	1938.995	2043.503	2150.434	2259.756	9.2875767	9.3103572	9.3325260	9.3540614	17
18	1940.717	2045.265	2152 236	2261.598	9.2879622	9.3107495	9.332890	9.3544454	18
19	1942.440	2047.028	2154.039	2263.441	9.2883474	9.3111238	9.3332536	9.3547690	19
20	1944.163	2048.792	2155.843	2265.284	9 2887326	9.3114979	9.3336172	9.3551227	20
21	1945.887	2050.556	2157 048	2267.128	9.2891174	9.3118716	9.3339805	9.3554760	21
22	1947.611	2052.322	2159.453	2268.973	9.2895022	9.3122454	9.3343436	9.3558293	22
23	1949.336	2054.087	2161.259	2270.818	9 2898856	9.3126188	9 3347067	9.3561823	23
24	1951.062	2055.854	2163.065	2272.654	9.2902711	9.3129922	9.3350697	9.3565353	24
25	1952.789	2057.621	2164.873	2274.511	9.2906551	9.3133653	9.3354323	9.3568880	25
26	1954.516	2059.389	2166 680	2276.358	9.2910392	9.3137383	9.3357949	9.3572406	26
27	1956.244	2061.157	2168.489	2278.206	9.2914229	9.3141110	9.3361571	9.3575930	27
28	1957.972	2062.926	2170.298	2280.055	9.2918065	9.3144837	9.3365194	9.3579453	28
29	1959.701	2064.696	2172.108	2181.904	9.2921898	9.3148561	9.3368813	9.3582973	29
30	1961.431	2066.467	2173.918	2283.754	9.2925731	9.3152284	9.3372432	9.3586494	30
31	1963.164	2068.238	2175.370	2285.605	9.2929560	9.3156004	9.3376048	9.3590011	31
32	1964.893	2070.010	2177.451	2287.456	9.2933390	9.3159724	9.3379664	9.3593528	32
33	1966.625	2071.782	2179.534	2289.308	9.2937215	9.3163440	9.3383277	9.3597041	33
34	1968.358	2073.555	2181.167	2291.160	9.2941041	9.3167156	9.3386889	9.3600555	34
35	1970.091	2075.329	2182.981	2293.014	9.2944862	9.3170869	9.3390498	9.3604066	35
36	1971.825	2077.104	2184.795	2294.868	9.2948684	9.3174582	9.3394107	9.3607576	36
37	1973.560	2078.879	2186.610	2296.722	9.2952502	9.3178291	9.3397713	9.3611084	37
38	1975.295	2080.655	2188.426	2298.577	9.2956320	9.3182000	9.3401319	9.3614591	38
39	1977.031	2082 431	2190.243	2300.433	9.2960135	9.3185706	9.3404921	9.3618095	39
40	1978.768	2084.208	2192.060	2302 290	9.2963949	9.3189413	9.3408524	9.3621599	40
41	1980.505	2085.986	2193.877	2304 147	9.2967760	9.3193113	9.3412123	9.3625100	41
42	1982.244	2087.765	2195.695	2306.004	9.2971570	9.3196815	9.3415722	9.3628601	42
43	1983.982	2089.544	2197.515	2307.863	9.2975377	9.3200514	9.3419318	9.3632099	43
44	1985.722	2091.324	2199.335	2309.722	9.2979184	9.3204213	9.3422913	9 3635597	44
45	1987.462	2093.101	2201.155	2311.582	9.2982987	9.3207908	9.3426506	9.3639092	45
46	1989.203	2094.885	2202.976	2313.442	9.2986790	9.3211603	9.3430098	9.3642586	46
47	1990.944	2096.667	2204.798	2315.303	9.2990590	9.3215294	9.3433687	9.3646078	47
48	1992.686	2098.450	2206.620	2317.165	9.2994389	9.3218986	9.3437276	9.3649569	48
49	1994.429	2100.233	2208.443	2319.027	9.2998185	9.3222674	9.3440862	9.3653057	49
50	1996.173	2102.017	2210.267	2320.89	9.3001981	9.3226362	9.3444448	9.3656546	50
51	1997.917	2103.802	2212.090	2322.754	9.3005773	9.3230047	9.3448030	9.3660031	51
52	1999.662	2105.587	2213.916	2324.618	9.3009565	9.3233771	9.3451612	9.3663516	52
53	2001.407	2107.373	2215.742	2326.483	9.3013354	9.3237412	9.3455191	9.3666998	53
54	2003.154	2109.159	2217.569	2328.348	9.3017142	9.3241094	9.3458770	9.3670480	54
55	2004.900	2110 946	2219.396	2330.215	9.3020927	9.3244771	9.3462346	9.3673959	55
56	2006.648	2112.734	2221.223	2332.082	9.3024712	9.3248449	9.3465921	9.3677437	56
57	2008.396	2114.523	2223.051	2333.949	9 3028493	9.3252123	9.3469494	9.3680913	57
58	2010.145	2116.312	2224.880	2335.817	9.3032274	9.3255797	9.3473067	9.3684389	58
59	2011.895	2118.102	2226.710	2337.686	9.3036051	9.3259468	9.3476636	9.3687861	59
60	2013.645	2119.892	2228.540	2339.556	9.3039829	9.3263138	9,3480205	9.3691334	60

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Deg. 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	9.6000849	9.5847129	9.5689987	4122.148	3981.850	3843.385	3706.796	60
59	9.6148755	9.5998314	9.5844548	9.5687337	4119.795	3979.527	3841.093	3704.536	59
58	9.6146275	9.5995779	9.5841957	9.5684688	4117.442	3977.204	3838.802	3702.276	58
57	9.6143793	9.5993243	9.5839364	9.5682036	4115.090	3974.882	3836.511	3700.017	57
56	9.6141311	9.5990706	9.5836771	9.5679385	4112.738	3972.561	3834.220	3697.758	56
55	9.6138827	9.5988168	9.5834176	9.5676731	4110.387	3970.240	3831.930	3695.499	55
54	9.6136343	9.5985625	9.5831581	9.5674078	4108.036	3967.920	3829.641	3693.241	54
53	9.6133857	9.5983089	9.5828984	9.5671422	4105.686	3965.600	3827.352	3690.984	53
52	9.6131372	9.5980545	9.5826387	9.5668766	4103.336	3963.281	3825.064	3688.727	52
51	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	4098.639	3958.643	3820.488	3684.216	50
49	9.6123907	9.5972920	9.5818589	9.5660792	4096.291	3956.325	3818.201	3681.961	49
48	9.6121418	9.5970376	9.5815988	9.5658132	4093.944	3954.008	3815.915	3679.707	48
47	9.6118927	9.5967831	9.5813385	9.5655471	4091.597	3951.691	3813.629	3677.453	47
46	9.6116436	9.5965285	9.5810783	9.5652804	4089.250	3949.375	3811.344	3675.200	46
45	9.6113943	9.5962737	9.5808178	9.5659564	4086.904	3947.060	3809.060	3672.947	45
44	9.6111451	9.5960189	9.5805574	9.5647482	4084.558	3944.745	3806.776	3670.695	44
43	9.6108956	9.5957640	9.5802967	9.5644817	4082.213	3942.430	3804.492	3668.443	43
42	9.6106461	9.5955090	9.5800361	9.5642151	4079.868	3940.116	3802.209	3666.192	42
41	9.6103965	9.5952539	9.5797752	9.5639484	4077.524	3937.802	3799.926	3663.941	41
40	9.6101469	9.5949987	9.5795144	9.5636816	4075.180	3935.489	3797.644	3661.690	40
39	9.6098970	9.5947434	9.5792533	9.5634147	4072.837	3933.176	3795.362	3659.440	39
38	9.6096472	9.5944881	9.5789923	9.5631477	4070.495	3930.864	3793.081	3657.191	38
37	9.6093972	9.5942325	9.5787311	9.5628805	4068.153	3928.552	3790.801	3654.942	37
36	9.6091472	9.5939770	9.5784698	9.5626134	4065.811	3926.241	3788.521	3652.694	36
35	9.6088970	9.5937213	9.5782084	9.5623460	4063.470	3923.931	3786.242	3650.447	35
34	9.6086468	9.5934656	9.5779470	9.5620787	4061.129	3921.621	3783.963	3648.200	34
33	9.6083965	9.5932097	9.5776854	9.5618111	4058.789	3919.312	3781.685	3645.95[illegible]	33
32	9.6081461	9.5929538	9.5774237	9.5615436	4056.449	3917.003	3779.407	3643.7[illegible]8	32
31	9.6078956	9.5926977	9.5771619	9.5612758	4054.110	3914.694	3777.130	3641.46[illegible]	31
30	9.6076450	9.5924417	9.5769001	9.5610080	4051.772	3912.386	3774.854	3639.228	30
29	9.6073943	9.5921854	9.5766381	9.5607401	4049.434	3910.078	3772.578	3636.974	29
28	9.6071346	9.5919291	9.5763761	9.5604721	4047.096	3907.771	3770.302	3634.730	28
27	9.6068927	9.5916727	9.5761139	9.5602040	4044.759	3905.464	3768.027	3632.487	27
26	9.6066417	9.5914162	9.5758517	9.5599358	4042.422	3903.158	3765.752	3630.244	26
25	9.6063907	9.5911599	9.5755893	9.5596674	4040.086	3900.853	3763.478	3628.001	25
24	9.6061396	9.5909029	9.5753269	9.5593991	4037.750	3898.548	3761.204	3625.759	24
23	9.6058883	9.5906461	9.5750643	9.5591305	4035.415	3896.244	3758.931	3623.518	23
22	9.6056370	9.5903893	9.5748417	9.5588619	4033.081	3893.940	3756.058	3621.278	22
21	9.6053856	9.5901322	9.5745389	9.5585932	4030.747	3891.636	3754.386	3619.038	21
20	9.6051341	9.5898752	9.5742761	9.5583244	4028.414	3889.333	3752.115	3616.799	20
19	9.6048825	9.5896180	9.5740131	9.5580554	4026.081	3887.030	3749.844	3614.560	19
18	9.6046308	9.5893608	9.5737502	9.5577864	4023.749	3884.728	8747.574	3612.322	18
17	9.6043790	9.5891034	9.5734870	9.5575173	4021.417	3882.427	3745.304	3610.084	17
16	9.6041272	9.5888460	9.5732218	9.5572481	4019.083	3880.127	3743.034	3607.847	16
15	9.6038752	9.5885884	9.5729604	9.5569787	4016.754	3877.827	3740.765	3605.610	15
14	9.6036232	9.5883308	9.5726970	9.5567093	4014.423	3875.527	3738.497	3603.374	14
13	9.6033710	9.5880730	9.5724335	9.5564397	4012.093	3873.228	3736.229	3601.138	13
12	9.6031188	9.5878153	9.5721699	9.5561701	4009.763	3870.929	3733.962	3598.903	12
11	9.6028664	9.5875573	9.5719061	9.5559004	4007.434	3868.631	3731.695	3596.668	11
10	9.6626143	9.5872993	9.5716423	9.5556306	4005.106	3866.333	3729.428	3594.434	10
9	9.6023615	9.5870412	9.5713784	9.5553606	4002.778	3864.035	3727.162	3592.201	9
8	9.6021090	9.5867830	9.5711144	9.5550906	4000.451	3861.739	3724.897	3589.968	8
7	9.6018562	9.5865247	9.5708502	9.5548204	3998.124	3859.443	3722.532	3587.736	7
6	9.6016035	9.5862663	9.5705861	9.5545502	3995.798	3857.147	3720.368	3585.504	6
5	9.6013506	9.5860078	9.5703217	9.5542798	3993.472	3854.852	3718.105	3583.272	5
4	9.6010976	9.5857492	9.5700573	9.5540094	3991.147	3852.558	3715.842	3581.041	4
3	9.6008446	9.5854905	9.5697928	9.5537388	3988.821	3850.264	3713.580	3578.811	3
2	9.6005914	9.5852318	9.5695282	9.5534681	3986.498	3847.970	3711.318	3576.581	2
1	9.6003382	9.5849728	9.5692635	9.5531973	3984.174	3845.577	3709.057	3574.352	1
0	9.6000849	9.5847139	9.5689987	9.5529265	3981.850	3843.385	3706.796	3572.124	0

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Sines and their Logarithms.

Deg. 40, 41, 42, 43.

M	N. 40	N. 41	N. 42	N. 43	L. 40	L. 41	L. 42	L. 43	M
0	2339.556	2452.904	2508.552	2686.463	9.3691334	9.380[illegible]	9.4096883	9.4291808	0
1	2341.426	2454.813	2570.498	2688.447	9.3094803	9.39 0183	9.4100173	9.4295015	1
2	2343.296	2456.722	2572.44[illegible]	2690.43[illegible]	9.3698272	9.3903561	9.4103462	9.4298220	2
3	2345.168	2458.632	2574.394	2692 417	9.3701739	9.3906935	9.4106749	9.4301424	3
4	2347.040	2460.543	2576 342	2694.403	9 3705205	9.3910309	9.4110036	9.4304646	4
5	2348.913	2462.454	2578.292	2696.390	9.3708668	9.3913681	9 4113320	9.4307827	5
6	2350.786	2464.366	2580.242	2698.377	9.3712111	9.3917052	9.4116603	9.4311026	6
7	2352.660	2466.279	2582.193	2700.36[illegible]	9.3715591	9.3920421	9.4119885	9.4314224	7
8	2354.535	2468.192	2584.143	2702.354	9.3719051	9.3923789	9.4123166	9.4317423	8
9	2356.410	2470.106	2586.095	2704.343	9.3722508	9.3927155	9.4126444	9.4320617	9
10	2358.286	2472.020	2588.047	2706.332	9.3725964	9.3930520	9.4129722	9.4323811	10
11	2360.162	2473.935	2590.000	2708.323	9.3729418	9.3933882	9.4122998	9.4327004	11
12	2362.04[illegible]	2475.851	2591 954	2710.314	9.3732872	9.3937245	9.4136273	9.4330195	12
13	2363.918	2477.767	2593.908	2712.305	9.3736323	9.3940604	9.4139546	9.4333385	13
14	2365.296	2479.684	2595.863	2714.297	9.3739773	9.3943964	9.4142818	9.4336574	14
15	2307.675	2481.602	2597.819	2716.29	9.3743221	9.3947310	9.4146088	9.4339761	15
16	2369.555	2483.520	2599.775	2718.284	9.3746668	9.3950677	9.4149357	9.4342948	16
17	2371.436	2485.439	2901.732	2720.278	9.3750113	9.3954081	9.4152625	9.4346132	17
18	2373.317	2487.359	2903.689	2722.272	9.3753557	9.3957384	9.4155891	9.43493 6	18
19	2375.198	2489.279	2605.647	2724.26	9.3756998	9.3960735	9.4159155	9.4352497	19
20	2377.081	2491.200	2607.605	2726.264	9 3760440	9.3964085	9.4162419	9.4355678	20
21	2378.964	2433.121	2609.565	2728.26	9.3763878	9.3967433	9.4165681	9.4358857	21
22	2380.848	2495.043	2611.525	2730.257	9.3767316	9.3970781	9.4168941	9.4362035	22
23	2382.732	2496.966	2613.485	2732.255	9 3770751	9.3974125	9.4172199	9.4365212	23
24	2384.617	2498.889	2615.447	2734.253	9.3774186	9.3977470	9.4175458	9.4368387	24
25	2386.503	2500.813	2617.408	2736.252	9.3777618	9.3980812	9.4178715	9.4371561	25
26	2388.389	2502.738	2619.371	2738.252	9.3781050	9.3984154	9.4181970	9.4374734	26
27	2390.276	2504.663	2621.334	2748.252	9.3784479	9.3987493	9.4185223	9.4377994	27
28	2392.163	2506.589	2623.297	2742.253	9.3787908	9.3990831	9.4188475	9.4381075	28
29	2394.051	2508.516	2625.262	2744.254	9.3791334	9.3994167	9.4191726	9.4384243	29
30	2395.940	2510.44[illegible]	2627.227	2746.256	9.3794760	9.3997503	9.4194975	9.4387410	30
31	2397.830	2512.371	2629.192	2748.259	9.3798183	9.4000836	9.4198223	9.4390576	31
32	2399.720	2514.299	2631.158	2750 262	9.3801606	9 4004169	9.4201470	9.4393741	32
33	2401.611	2516.228	2633.125	2752.266	9 3805025	9.4007499	9.4204714	9.4396904	33
34	2403.502	2518.158	2635.092	2754.271	9.3808445	9.4010829	9.4207958	9.4400066	34
35	2405.394	2520.088	2637 060	2756 276	9.3811862	9.4014157	9.4211201	9.4403226	35
36	2407.287	2522.019	2639.029	2758.281	9.3815279	9.4018484	9.4214442	9.4406385	36
37	2409.180	2523.951	2640.998	2760.288	9.3818692	9.4020808	9.4217681	9.4409543	37
38	2411.074	2525.883	2642.968	2762.295	9.3822106	9.4024132	9.4220919	9.4412700	38
39	24 2.969	2527.816	2044.939	2764 302	9.3825516	9.4027453	9.4224156	9.4415855	39
40	2414.864	2529.749	2646.910	2766.310	9.3828927	9.4030775	9 4227391	9.4419009	40
41	2416.760	2531.683	2548.882	2768.319	9.3832335	9.4034093	9.4230625	9.4422161	41
42	2418.657	2533.618	2650.854	2770.32[illegible]	9.3835742	9 4037412	9.4233858	9.4425313	42
43	2420.554	2535.554	2652.827	2772.339	9.3839147	9.4040727	9.4237089	9.4428462	43
44	2422.452	2537.49[illegible]	2654.801	2774 349	9.3842551	9.4044043	9.4240319	9 4431611	44
45	2424.350	2539.426	2556.775	2776.360	9 3845953	9.4047355	9.4243547	9.4434758	45
46	2426.249	2541.364	2658.750	2778.372	9.3849354	9.4050668	9.4246774	9.4437904	46
47	2428.149	2543.301	2560.725	2780.385	9.3852753	9.4053978	9.4250000	9.4441048	47
48	2430.049	2545.240	2662 701	2782.398	9.3856151	9.4057287	9.4253224	9.4444192	48
49	2431.950	2547.179	2564.678	2784.411	9.3859547	9.4060594	9.4256447	9.4447334	49
50	2433.852	2549.119	2666.655	2786.42[illegible]	9.3862942	9.4063901	9.4259669	9.4450474	50
51	2435.754	2551.059	2668.633	2788.441	9.3866334	9.4067205	9.4262889	9.4453614	51
52	2437.657	2553.0[illegible]0	2670.612	2790.456	9 3869727	9 4070509	9.4266108	9.4456752	52
53	2439.561	2554.942	2672.591	2792.47[illegible]	9.3873116	9.4073810	9.4269325	9.4459888	53
54	2441.465	2556.885	2674.571	2794.48[illegible]	9.3876506	9.4077111	9.4272541	9.4463024	54
55	2443.370	2558.827	2676.551	2796.505	9.3879892	9.4080409	9.4275755	9.4466157	55
56	2445.276	2560.771	2678.533	2798.524	9.3883278	9.4083708	9.4278969	9.4469290	56
57	2447.182	2562.715	2680.514	2800.543	9.3886562	9.4087003	9.4282181	9.4472422	57
58	2449.089	2564.660	2682.497	2802.562	9.3890045	9.4090298	9.4285391	9.4475552	58
59	2450.996	2564.606	2684.479	2804.582	9.3893425	9.4093591	9.4288600	9.4478680	59
60	2452.904	2568.552	2686.463	2806.602	9.3896806	9.4096883	9,4291808	9.4481808	60

Deg. 49, 48, 47, 46. A Table of Natural Versed.

M	L. 49	L. 48	L. 47	L. 46	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	3569.896	3437.215	3306.532	3177.889	59
58	9.5523845	9.5359293	9.5190889	9.5018480	3567.669	3435.021	3304.371	3175.763	58
57	9.5521132	9.5356518	9.5188048	9.5015572	3565.442	3432.827	3302.211	3173.637	57
56	9.5518420	9.5353742	9.5185207	9.5012662	3563.215	3430.633	3300.051	3171.511	56
55	9.5515706	9.5350965	9.5182364	9.5009751	3560.989	3428.440	3297.892	3169.387	55
54	9.5512992	9.5348187	9.5179521	9.5006840	3558.764	3426.247	3295.733	3167.262	54
53	9.5510275	9.5345408	9.5176676	9.5003927	3556.539	3424.055	3293.573	3165.139	53
52	9.5507559	9.5342628	9.5173830	9.5001013	3554.315	3421.864	3291.418	3163.016	52
51	9.5504840	9.5339846	9.5170984	9.4998097	3552.091	3419.674	3289.261	3160.873	51
50	9.5502122	9.5337065	9.5168136	9.4995181	3549.868	3417.484	3287.105	3158.791	50
49	9.5499401	9.5334281	9.516528	9.4992263	3547.645	3415.295	3284.949	3156.650	49
48	9.5496681	9.5331497	9.5162436	9 4989345	3545.423	3413.106	3282.794	3154.529	48
47	9.5493958	9.5328711	9.5159585	9.4986425	3543.201	3410.918	3280.639	3152.409	47
46	9,5491236	9.5325925	9.5156732	9.4983504	3540.980	3408.730	3278.485	3150.289	46
45	9.5488511	9.5323137	9.5153879	9.4980581	3538.760	3406.542	3276.332	3148.170	45
44	9.5485786	9.5320349	9.5151024	9.4977658	3536.540	3404.355	3274.179	3146.052	44
43	9.5483059	9.5317558	9.5148168	9.4974733	3534.321	3402.169	3272.027	3143.934	43
42	9.5480333	9.5314768	9.5145311	9.4971808	3532.102	3399.984	3269.875	3141.816	42
41	9.5477604	9.5311975	9.5142453	9.4968881	3529.884	3397.799	3267.724	3139.700	41
40	9.5474875	9.5309183	9.5139594	9.4965953	3527.667	3395.614	3265.573	3137.584	40
39	9.5472144	9.5306388	9.5136733	9.4963023	3525.450	3393.430	3263.423	3135.468	39
38	9 5469413	9.5303593	9.5133872	9.4960093	3523.234	3391.247	3261.274	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	36
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	3514.372	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
32	9.5453002	9.5286799	9.5116679	9.4942486	3509.945	3378.159	3248.389	3120.675	32
31	9.5450263	9.5283996	9.5113810	9.4939547	3507.732	3375.979	3246.243	3118.565	31
30	9.5447524	9.5281195	9.5110939	9.4936607	3505.520	3373.800	3244.098	3116.454	30
29	9.5444783	9.5278387	9.5108068	9.4933666	3503.308	3371.621	3241.954	3114.345	29
28	9.5442041	9.5275581	9.5105195	9.4930724	3501.097	3369.443	3239.810	3112.236	28
27	9.5439298	9.5272774	9.5102321	9.4927780	3498.886	3367.266	3237.667	3110.127	27
26	9.5536554	9.5269966	9.5099446	9.4924836	3496.676	3365.089	3235.524	3108.019	26
25	9.5433809	9.5267156	9.5096569	9.4921890	3494.467	3362.913	3233.382	3105.911	25
24	9.5431063	9.5264346	9.5093692	9.4918944	3492.258	3360.737	3231.240	3103.805	24
23	9.5428315	9.5261534	9.5090813	9.4915995	3490.050	3358.562	3229.099	3101.698	23
22	9.5425568	9.5258722	9.5087934	9.4913046	3487.842	3356.388	3226.959	3099.593	22
21	9.5422818	9.5255908	9.5085053	9.4910095	3485.635	3354.214	3224.819	3097.488	21
20	9.5420068	9.5253094	9.5082172	9.4907144	3483.428	3352.041	3222.680	3095.383	20
19	9.5417316	9.5250277	9.5079288	9.4904191	3481.222	3349.865	3220.541	3093.279	19
18	9.5414564	9.5247461	9.5076404	9.4901237	3479.016	3347.696	3218.403	3091.176	18
17	9.5411810	9.5244642	9.5073519	9.4898281	3476.811	3345.524	3216.266	3089.073	17
16	9.5409056	9.5241823	9.5070633	9.4895325	3474.606	3343.353	3214.129	3086.971	16
15	9.5406300	9.5239002	9.5067745	9.4892361	3472.402	3341.183	3211.993	3084.869	15
14	9.5403544	9.5236182	9.5064856	9.4889409	3470.199	3339.013	3209.857	3082.768	14
13	9.5400786	9.5233358	9.5061966	9.4886448	3467.996	3336.844	3207.722	3080.608	13
12	9.5398027	9.5230535	9.5059075	9.4883488	3465.794	3334.675	3205.587	3078.568	12
11	9.5395267	9.5227710	9.5056183	9.4880525	3463.592	3332.507	3203.453	3076.469	11
10	9.5392507	9.5224885	9.5053290	9.4877562	3461.391	3330.339	3201.319	3074.370	10
9	9.5389744	9.5222057	9.5050395	9.4874597	3459.191	3328.172	3199.187	3072.272	9
8	9.5386982	9.5219230	9.5047500	9.4871631	3456.991	3326.006	3197.054	3070.175	8
7	9.5384217	9.5216400	9.5044603	9.4868663	3454.792	3323.840	3194.922	3068.078	7
6	9.5381452	9.5213570	9.5041705	9.4865695	3452.593	3321.674	3192.791	3065.982	6
5	9.5378686	9.5210739	9.5038805	9.4862726	3450.391	3319.509	3190.661	3063.886	5
4	9.5375919	9.5207907	9.5035906	9.4859755	3448.196	3317.845	3188.531	3061.791	4
3	9.5373150	9.5205073	9.5033005	9.4856783	3445.999	3315.182	3186.401	3059.696	3
2	9.5370381	9.5202239	9.5030102	9.4853810	3443.802	3313.019	3184.272	3057.602	2
1	9.5367610	9.5199402	9 5027198	9.4850835	3441.606	3310.856	3182.144	3055.509	1
0	9.5364839	9.5196566	9.5024293	9.4847860	3439.410	3308.694	3180,016	3053.416	0

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Deg. 44, 45, 44, 45. Sines and their Logarithms.

M	N. 44	45 N	44 N.	L. 45	L. 45	L. 44	L. 45	N. 44	M
0	2806.602	2928.932	9.4480808	9.4667093	9.4847860	9.4067093	3053,416	2928.932	0
1	2808.623	2930.989	9.4484934	9.4670142	9.4844853	9.4064042	3051.324	2926.876	1
2	2810.645	2933.047	9.4488059	9.4673190	9.4841905	9.4660991	3049.233	2924.820	2
3	2812.667	2935.106	9.4491182	9.4676237	9.4838926	9.4557937	3047.142	2922.764	3
4	2814.690	2937.165	9.4494305	9.4679283	9.4835949	9.4654883	3045.051	2920.709	4
5	2816.713	2939.224	9.4497426	9.4682326	9.4832964	9.4651828	3042.961	2918.655	5
6	2818.737	2941.284	9.4500546	9.4685370	9.4829981	9.4648771	3040.872	2916.602	6
7	2820.762	2943.345	9.4503664	9.4688411	9.4826997	9.4645713	3038.783	2914.549	7
8	2822.787	2945.406	9.4506781	9.4691452	9.4824012	9.4642654	3036.695	2912.496	8
9	2824.813	2947.468	9.4509896	9.4694491	9.4821025	9.4639593	3034.608	2910.444	9
10	2826.839	2949.531	9.4513011	9.4697536	9.4818038	9.4636531	3032.521	2908.393	10
11	2828.866	2951.594	9.4516123	9.4700566	9.4815049	9.4633468	3030.435	2906.343	11
12	2830.894	2953.658	9.4519236	9.4703602	9.4812059	9.4630404	3028.349	2904.293	12
13	2832.922	2955.722	9.4522346	9.4706636	9.4809067	9.4627338	3026.264	2902.243	13
14	2834.951	2957.787	9.4525456	9.4709669	9.4806075	9.4624271	3024.179	2900.194	14
15	2836.981	2959.853	9.4528563	9.4712700	9.4803081	9.4621202	3022.095	2898.146	15
16	2839.011	2961.919	9.4531670	9.4715732	9.4800087	9.4618133	3020.012	2896.099	16
17	2841.041	2963.986	9.4534775	9.4718760	9.4797090	9.4615062	3017.929	2894.052	17
18	2843.073	2966.053	9.4537879	9.4721789	9.4794093	9.4611991	3015.847	2892.005	18
19	2845.105	2968.121	9.4540982	9.4724815	9.4791094	9.4608917	3013.766	2889.959	19
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	21
22	2851.204	2974.328	9.4550283	9.4733889	9.4782091	9.4599611	3007.524	2883.826	22
23	2853.238	2976.399	9.4553380	9.4736910	9.4779088	9.4593532	3005.445	2881.782	23
24	2855.272	2978.469	9.4556476	9.4739931	9.4776083	9.4593532	3003.367	2879.740	24
25	2857.309	2980.541	9.2559571	9.4742951	9.4773077	9.4590451	3001.289	2877.697	25
26	2859.345	2982.613	9.4562665	9.4745969	9.4770070	9.4587369	2999.211	2875.656	26
27	2861.382	2984.686	9.4565758	9.4748985	9.4767062	9.4584285	2997.134	2873.615	27
28	2863.419	2986.759	9.4578849	9.4752002	9.4764052	9.4581201	2995.058	2871.574	28
29	2865.457	2988.833	9.4571938	9.4755016	9.4761041	9.4578114	2992.982	2869.535	29
30	2867.496	2990.907	9.4575027	9.4758029	9.4758029	9.4575027	2890.907	2867.496	30

The End of the TABLE of Versed Sines, &c.

The

The Use of the Table of Versed SINES.

THE Uses of the Table of *Versed 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 nnd 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 Rectangle 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 sides, and from the left hand of the Sum, dash out 3 for the *Cube* of the *Radius*, so rests the *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.

Exam. 1. In the Triangle *B P L*, let there be given the side *B P* 77° 00 *l*, the side *P L* 40° 00′, and the contained Angle *BPL* 52° 30 *l*, to find the side *B, L.*

Figure 5.

The Log. Sine 40° 00′	9.8080675
The Log. Sine of 77° 00′	9.9887239
The Log. Sine of 26° 15′ doubled.	19.2914116
The Natural Sine against : : :	39.0882030
Is 1227355, *whose double is*:	2454710
The Natural Ver. Sine *of* 37° 00′ *the dif. of the two sides is*	2013645
The Versed Sine *of* 57° 53′ *the side sought.*	4468355

If you make the third Term the Square of the Sine of half the Complement of the contained Angle to 180 Degrees, you will find the half difference of the *Versed Sines* of the third side, and of the Sum of the two including sides to be doubled, and subtracted 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; having found it, take the Natural Sine that stands against it, and add it to the *Natural Versed 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 sides be 38° 30′ and 66° 30′, and the containing Angle be 30° 00′.

The log. Sine of 38° 30′		9.7941496
The log Sine of 66° 30′		9.9623978
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
66° 30′ *Is*		770091
38 30	*Which taken from the Nat. Versed Sine of* 28° 00′	1170524
28 00	*There remains*	300433
	The Nat. Versed Sine of 53° 10.	

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.* given; the Distances of Stars, by having their 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 *Azimuth* 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.

2deg. 48min. 45sec.

87deg. 11min. 15sec.

Dist.	Lat. 1 D	Dep. 89 D	Lat. 2 D	Dep. 88 D	Lat. 0 p¾	Dep. 7 p¾	Lat. 3 D	Dep. 87 D	Lat. 4 D	Dep. 86 D	Dist.
1	0.9998	0.0175	0.9994	0.0349	0.9988	0.0491	0.9986	0.0523	0.9976	0.0698	1
2	1.9997	0.0349	1.9988	0.0698	1.9976	0.0981	1.9973	0.1047	1.9951	0.1395	2
3	2.9995	0.0524	2.9982	0.1047	2.9964	0.1472	2.9959	0.1570	2.9927	0.2093	3
4	3.9994	0.0698	3.9976	0.1396	3.9952	0.1963	3.9945	0.2093	3.9903	0.2790	4
5	4.9992	0.0872	4.9970	0.1745	4.9940	0.2453	4.9931	0.2617	4.9878	0.3488	5
6	5.999	0.1047	5.9963	0.2094	5.9928	0.2944	5.9918	0.3140	5.9854	0.4185	6
7	6.9989	0.1222	6.9957	0.2443	6.9916	0.3435	6.9904	0.3664	6.9829	0.4883	7
8	7.9988	0.1396	7.9951	0.2792	7.9904	0.3925	7.9890	0.4187	7.9805	0.5580	8
9	8.9986	0.1571	8.9945	0.3141	8.9892	0.4416	8.9877	0.4710	8.9781	0.6278	9

5deg. 37min.

84deg. 22min. 36sec.

Dist.	5 D	85 D	0 p½	7 p½	6 D	84 D	7 D	83 D	8 D	82 D	Dist.
1	0.9962	0.0872	0.9952	0.0980	0.9945	0.1045	0.9925	0.1219	0.9903	0.1392	1
2	1.9924	0.1743	1.9904	0.1960	1.9890	0.2091	1.9851	0.2437	1.9806	0.2783	2
3	2.9886	0.2615	2.9856	0.2940	2.9836	0.3136	2.9776	0.3656	2.9708	0.4175	3
4	3.9848	0.3486	3.9807	0.3921	3.9781	0.4181	3.9702	0.4875	3.9611	0.5567	4
5	4.9810	0.4359	4.9759	0.4901	4.9726	0.5226	4.9627	0.6093	4.9513	0.6959	5
6	5.9772	0.5229	5.9711	0.5881	5.9671	0.6272	5.9553	0.7312	5.9416	0.8350	6
7	6.9734	0.6101	6.9663	0.6861	6.9617	0.7317	6.9478	0.8531	6.9319	0.9742	7
8	7.9696	0.6972	7.9615	0.7841	7.9562	0.8362	7.9404	0.9750	7.9221	1.1134	8
9	8.9658	0.7844	8.9567	0.8822	8.9507	0.9408	8.9329	1.0968	8.9124	[illegible]	9
Dist.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dist.

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A Table of Difference of Latitude and Departure to every Degree, &c.

Dist.		Lat	Dep		Lat.	Dep.		Lat	Dep.		Lat.	Dep.		Lat.	Dep.		Dist.
	8 deg. 26 m. 15 s.	0 p ¾	7 p ¼	81 deg. 33 m. 45 s.	9 D	81 D		10 D	80 D		11 D	79 D	11 deg. 15 min	1 p	7 p	78 deg 15 min	
1		0.9892	0.1407		0.9877	0.1504		0.9848	0.1736		0.9816	0.1908		0.9808	0.1951		1
2		1.9784	0.2935		1.9754	0.3129		1.9696	0.3473		1.9633	0.3816		1.9616	0.3902		2
3		2.9675	0.4402		2.9631	0.4603		2.9544	0.5209		2.9449	0.5724		2.9424	0.5853		3
4		3.9567	0.5869		3.9508	0,6157		3.9392	0.6946		3.9265	0.7632		3.9231	0.7804		4
5		4.9459	0.7337		4.9384	0.7822		4.9240	0.8682		4.9281	0.9540		4.9039	0.9754		5
6		5.9351	0.8804		5.9261	0.9386		5.9088	1.0419		5.8898	1.1449		5.8847	1.1705		6
7		6.9242	1.0271		6.9133	1.0950		6.8937	1.2155		6.8714	1.3357		6.8655	1.3656		7
8		7.9134	1.1738		7.9015	1.2515		7.8885	1.3892		7.8530	1.5265		7.8463	1.5607		8
9		8.9026	1.3206		8.8892	1.4079		8,8833	1.5628		8.8346	1.7173		8.8271	1.7558		9

Dist.							14 deg. 3 min. 45 s.						75 deg. 56 min 15 s.				Dist.
		12 D	78 D		13 D	77 D		14 D	76 D		1 p ¼	6 p ¾		15 D	75 D		
1		0,9781	0.2079		0.9744	0.2250		0,9703	0.2419		0.9700	0.2430		0.9659	0.2588		1
2		1.9563	0.4158		1.9487	0.4499		1.9405	0.4838		1.9401	0.4860		1.9319	0.5176		2
3		2.9344	0.6237		2.9231	0.6749		2.9108	0.7258		2.9101	0.7289		2.8978	0.7765		3
4		3.9126	0.8316		3.8975	0.8998		3.8812	0.9677		3.8801	0.9719		3.8637	1.0353		4
5		4.8907	1.0396		4.8718	1.1248		4.8515	1.2096		4.8502	1.2149		4.8296	1.2941		5
6		5.8689	1.2475		5.8462	1.3497		5.8218	1.4515		5.8202	1.4579		5.7956	1.5529		6
7		6.8470	1.4554		6.8205	1.5746		6.7921	1.6935		6.7902	1.7009		6.7615	1.8117		7
8		7.8252	1.6633		7.7950	1.7996		7.7624	1.9354		7.7602	1.9438		7.7274	2.0706		8
9		8.8033	1.8712		8.7693	2.0246		8.7327	2.1773		8.7303	2.1868		8.6933	2.3294		9

Dist.				16 deg. 52 min. 30 s.			73 deg 7 min 30 sec										Dist.
		16 D	74 D		1 p ½	6 p ½		17 D	73 D		18 D	72 D		19 D	71 D		
1		0.9613	0.2756		0.9569	0.2903		0.9563	0.2924		0.9511	0.3090		0.9455	0.3256		1
2		1.9225	0.5513		1.9139	0.5806		1.9126	0.5847		1.9021	0.6180		1.8910	0.6511		2
3		2.8838	0.8269		2.8708	0.8709		2.8689	0.8771		2.8532	0.9271		2.8366	0.9767		3
4		3.8450	1.1025		3.8278	1.1611		3.8252	1.1695		3.8042	1.2361		3.7821	1.3023		4
5		4.8063	1.3782		4.7847	1.4514		4.7815	1.4519		4.7553	1.5451		4.7276	1.6278		5
6		5.7676	1.6538		5.7416	1.7417		5.7378	1.7542		5.7063	1.8541		5.6731	1.9534		6
7		6,7288	1.9295		6.6986	2.4320		6.6941	2.0466		6.6574	2.1631		6.6186	2.2790		7
8		7.6901	2.2051		7.6555	2.3223		7.6504	2.3390		7.6084	2.4721		7.5642	2.6045		8
9		8.6513	2.4807		8.6125	2.6126		8.6067	2.6313		8.5595	2.7812		8.5097	2.9301		9

Dist.	19 deg. 41 min. 15 s.			70 deg. 18 m. 45 s.									22 deg 30 min			67 deg 30 min	Dist.
		1 p ¾	6 p ¼		20 D	70 D		21 D	69 D		22 D	68 D		2 p	6 p		
1		0.9415	0.3369		0.9397	0.3422		0,9336	0.3584		0.9272	0.3746		0.9239	0.3827		1
2		1.8831	0.6738		1.8794	0.6840		1.8672	0.7167		1.8544	0.7492		1.8478	0.7654		2
3		2.8246	1.0107		2.8191	1.0261		2.8007	1.0751		2.7816	1.1238		2.7716	1.1480		3
4		3.7662	1.3476		3.7588	1.3681		3.7343	1.4335		3.7087	1.4984		3.6955	1.5307		4
5		4.7077	1.6844		4.6985	1.7102		4.6679	1.7918		4.6359	1.8730		4.6194	1.9134		5
6		5.6493	2.0213		5.6382	2.0521		5.6015	2.1502		5.5631	2.2476		5.5433	2.2961		6
7		6.5908	2.3582		6.5779	2.3941		6.5351	2.5086		6.4903	2.6222		6.4672	2.6788		7
8		7.5324	2.6951		7.5175	2.7362		7.4686	2.8669		7.4175	2.9969		7.3910	3.0615		8
9		8.4739	3.0320		8.4572	3.0782		8.4022	3.2253		8.3447	3.3715		8.3149	3,4441		9

Dist.										25 deg. 18 min. 45 s.			64 deg. 41 min. 15 s.				Dist.
		23 D	67 D		24 D	66 D		25 D	65 D		2 p. ¼	5 p ¾		26 D	64 D		
1		0.9205	0.3907		0.9135	0.4067		0.9063	0.4226		0.9040	0.4276		0.8988	0.4384		1
2		1.8410	0.7815		1.8270	0.8135		1.8126	0.8452		1.8080	0.8551		1.7976	0.8767		2
3		2.7615	1.1722		2.7406	1.2202		2.7189	1.2679		2.7120	1.2827		2.6964	1.3151		3
4		3.6820	1.5629		3.6542	1.6269		3.6252	1.6905		3.6160	1.7102		3.5952	1.7535		4
5		4.6025	1.9537		4.5677	2.0337		4.5315	2.1131		4.5199	2.1378		4.4940	2.1919		5
6		5.5230	2.3444		5.4813	2.4404		5,4678	2.5357		5.4239	2.5653		5.3928	2,6302		6
7		6.4435	2.7351		6,3948	2.8472		6,3442	2.9583		6.3279	2.9929		6.2916	3.0686		7
8		7.3640	3.1258		7.3084	3.2539		7,2505	3.3809		7.2319	3.4204		7.1904	3.5070		8
9		8.2445	3.5166		8.2219	3.6606		8.1568	3.8036		8.1359	3.8480		8.0891	3.9453		9
		Dep.	Lat		Dep.	Lat		Dep.	Lat.		Dep.	Lat		Dep.	Lat		

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A Table of Difference Latitude and Departure to every Degree, &c.

28 deg 7 min 30 sec — 61 deg. 52 min. 30 s

Dist.	Lat 27 D	Dep 63 D	Lat. 28 D	Dep. 62 D	Lat 2 p ½	Dep. 5 p ½	Lat. 29 D	Dep. 61 D	Lat. 30 D	Dep. 60 D	Dist.
1	0.8910	0.4540	0.8829	0.4695	0.8819	0.4714	0.8746	0.4848	0.8660	0.5000	1
2	1.7820	0.9080	1.7659	0.9389	1.7638	0.9428	1.7492	0.9695	1.7320	1.0000	2
3	2.6730	1.3620	2.6488	1.4084	2.6458	1.4142	2.6239	1.4544	2.5981	1.5000	3
4	3.5640	1.8160	3.3218	1.8779	3.5277	1.8856	3.4985	1.9392	3.464	2.0000	4
5	4.4550	2.2699	4.4147	2.3474	4.4096	2.3570	4.3731	2.4240	4.3301	2.5000	5
6	5.3460	2.7239	5.2977	2.8168	5.2915	2.8184	5.2477	2.9089	5.1961	3.0000	6
7	6.2370	3.1779	6.1806	3,2863	6.1734	3.2998	6.1223	3.3937	6.0622	3.5000	7
8	7.1280	3.6319	7.0636	3.7558	7.0554	3.7712	6.9970	3.8785	6.9282	4.0000	8
9	8.0191	4.0859	7.9465	4.2252	7,9373	4.2426	7.8716	4.3633	7.7942	4.5000	9

30 deg. 56 m. 15 s — 59 deg. 03 m. 45 s — 33 deg. 45 min — 33 [illegible] min

Dist.	2 P ¾	5 P ¼	31 D	59 D	32 D	58 D	33 D	57 D	3 P	5 P	Dist.
1	0,8577	0.5141	0.8572	0.5150	0,8480	0.5299	0.8387	0.5446	0.8315	0.5556	1
2	1.7155	1.0282	1.7143	1.0301	1.6961	1.0598	1.6773	1.0893	1.6629	1.1111	2
3	2.5732	1.5423	2.5715	1.5451	2.5441	1.5896	2.5160	1.6339	2.4944	1.6667	3
4	3.4309	2.0564	3.4287	2.0602	3.3922	2.1197	3.3547	2.1786	3.3259	2.2223	4
5	4.2886	2.5705	4.2858	2.5752	4.2402	2.6496	4.1934	2,7232	4.1573	2.7778	5
6	5.1464	3.0846	5.1430	3.0902	5.0883	3.1795	5.0320	3.2678	4.9888	3.3334	6
7	6.0041	3.5987	6.0002	3.6052	5.9363	3.7094	5.8707	3.8125	5.8203	3.8890	7
8	6.8618	4.1128	6.8573	4.1203	6.7843	4.2394	6.7094	4.3571	6,6518	4.4446	8
9	7.7196	4.6269	7.7145	4.6353	7.6324	4.7693	7.5480	4.9018	7.4832	5.0001	9

36 deg. 33 min. 45 s. — 53 deg 26 min 15 s — 53 deg [illegible] min 15 s

Dist.	34 D	56 D	35 D	55 D	36 D	54 D	3 P ¼	4 P ¾	37 D	53 D	Dist.
1	0.8290	0.5592	0 8192	0.5730	0.8090	0.5878	0.8032	0.5957	0.7986	0.6018	1
2	1.6581	1.1184	1.6383	1.1472	1.6180	1.1756	1.6064	1.1914	1.5973	1 2036	2
3	2.4871	1.6776	2.4575	1.7207	2.4271	1.7634	2.4096	1.7871	2.3959	1.8054	3
4	3.3162	2.2368	3.2766	2.2943	3.2361	2.3511	3.2128	2.3828	3.1945	2.4073	4
5	4.1452	2.7960	4.0958	2.8679	4.0451	2.9389	4.0160	2.9785	3.9932	3.0091	5
6	4.9742	3 3552	4.9149	3.4415	4.8541	3.5267	4.8192	3.5742	4.7918	3.6109	6
7	5.8033	3.9144	5.7341	4.0150	5.6631	4 1145	5.6224	4.1699	5.5904	4.2127	7
8	6,6323	4.4735	6.5532	4.5886	6.4721	4.7023	6.4257	4.7656	6.3891	4.8145	8
9	7.4613	5.0327	7.3724	5.1662	7.2812	5.2901	7.2289	5.3613	7.1877	5.4163	9

39 deg 22 min 30 sec — 50 deg. 37 min. 30 s.

Dist.	38 D	52 D	39 D	51 D	3 P ½	4 P. ½	40 D	50 D	41 D	49 D	Dist.
1	0.7880	0.6157	0.7771	0.6293	0,7730	0.6344	0.7660	0.6428	0.7547	0.6561	1
2	1.5760	1.2313	1.5543	1.2586	1 5460	1.2688	1.5321	1.2856	1 5094	1.3121	2
3	2.3640	1.8470	2.3314	1.8880	2.3190	1.9032	2 2981	1.9284	2.2641	1.9682	3
4	3.1520	2.4626	3.1086	2.5173	3.0920	2.5376	3.0642	2.5712	3.0188	2.6242	4
5	3.9401	3.0783	3.8857	3.1466	3.8650	3.1720	3.8302	3.2139	3.7736	3.2803	5
6	4.7281	3.6940	4.66[illegible]	3.7759	4.6381	3.8064	4.5963	3.8567	4.5283	3.9363	6
7	5.5161	4.3096	5.4400	4.4052	5.4111	4.4408	5.3623	4.4995	5.2830	4 5924	7
8	6.3041	4 9253	6.2172	5.0346	6.1841	5.0751	6.1284	5.1423	6.0377	5.2085	8
9	7.0921	5.5409	6.9943	5.6639	6.9571	5.7095	6.8944	5.7851	6.7924	5,9045	9

42 deg. 11 m. 15 s — 47 deg 48 min 45 sec

Dist.	42 D	48 D	3 P ¾	4 ¼ P	43 D	47 D	44 D	46 D	45 D	45 D	Dist.
1	0.7431	0.6691	0.7410	0.6716	0.7314	0.6820	0.7193	0.6974	0.7071	0,7071	1
2	1.4863	1.3383	1.4819	1.3431	1.4628	1.3640	1.4387	1.3894	1.4142	1.4142	2
3	2.2294	2,0074	2.2229	2.0147	2.1941	2.0460	2.1580	2.0840	2.1213	2.1213	3
4	2.9726	2.6765	2.9638	2.6862	2,9254	2 7280	2.8774	2.7786	2.8284	2.8284	4
5	3.7157	3,3457	3.7048	3.3578	3.6568	3 4100	3.5967	3.4733	3.5355	3.5355	5
6	4.4589	4.0148	4.4457	4.0294	4.3881	4.0920	4 3160	4.1679	4.2426	4.2426	6
7	5.2020	4 6839	5.1867	4.7009	5 1195	4.7740	5.0354	4.8626	4.9497	4.9497	7
8	5.9452	5.3530	5.9276	5.3725	5,8508	5.4560	5.7547	5.0573	5.6569	5.6569	8
9	6.6883	6,0222	6,6686	6.0410	6,5822	6.1380	6.4741	6.5519	6 3640	6.3640	9
D.	Dep	Lat	Dep	Lat	Dep.	Lat.	Dep	Lat	Dep	Lat	

The

The Nature, Construction, and Use of the TABLE *of Difference of Latitude and Departure.*

THE Table of Difference of Latitude and 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 uppermost 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 proper Columns 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. *&c.* Deg. so is 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. *&c.* Miles to the Departure.

By the Tables thus formed, no more is requisite to find the Alteration of Latitude and Departure; but to seek 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. $\frac{3}{4}$ Easterly 7 Miles, and the Difference of Latitude and Departure be required.

In the Column under Latitude and Departure, I seek for 2 p. $\frac{3}{4}$ (because the distance of the Rumb N.N.E. $\frac{3}{4}$ 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 $\frac{41}{1000}$ of a Mile, and the Departure 35 987, that is 35 Miles and $\frac{987}{1000}$ 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 consist of any Number of 10's, as suppose 753, then the proper Requisites may be thus found.

From the dif. of Lat. answering to 800		686.18
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 of Latitude 600.41, answering to the Distance 700, gives 645 87, the Difference of Latitude to the Distance 753, and Course as before, N. N. E. $\frac{3}{4}$ 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 required.

But the Difference of Lat. and Departure in the former Case, may be more readily found by dividing 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. $\frac{3}{4}$ E. and Distance 753.

The dif. of Lat. answering	to	700 is	600.41
	to	50 is	42.886
	to	3 is	2.573
The Dif. of Lat. answering	to	753	645.869

After the same manner may be found.

The Departure belonging	to	700	359.87
	to	50	25.705
	to	3	1.542
			387.117

The same Difference of Latitude and Departure answering to 75 $\frac{3}{10}$, by placing the Prick one place forwarder, that is, instead of 645.869, for the Difference of Latitude take 64.5869, and for the Departure, instead of 387.117: 38.7117, also by placing it two places forwarder, they serve for the 7 $\frac{53}{100}$, by placing of it three places forwarder for $\frac{753}{1000}$.

In like manner, If the Distance had been any Number greater than 1000, as suppose 86753, by diving it as in the former Example, into its component Parts 80000. 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 2$\frac{3}{4}$, as the NNW. $\frac{3}{4}$ W the SSE. $\frac{3}{4}$ E. or the SSW. $\frac{3}{4}$ 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

E. N

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E N E N. *&c.* the proper difference of Latitude to each, or any of these will be the same with the 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 found, and the Proportional Increment investigated, as in the following Example.

Suppose a Ship sails North 38° 20′ westerly 600
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 38° the departure is 369 40
Against 6, and under 39 the Departure is 377 59

8.19

Therefore as 60′ to 30′, so is 819 to 4.095, 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 $\frac{3}{4}$ E. 108, then N 48° East, 112, then E. 5° southerly 70, then East 50° Northerly 84, then North 48; And it be required to find the Latitude the Ship is in, her direct Course and Distance, and how much she has departed from her first Meridian.

Having set down the Courses and Distances, as in the following Table, proceed to find out the difference of Latitude and Departure for each (according to the directions already given) in the Table placing each in its proper Column, *viz.* If the Course be Northerly the difference of Latitude must be placed in the North Column, if Southerly, in the South Column, if Easterly, the departure must be put in the East Column, if Westerly, in the West Column; which done, add up the Columns of difference of Latitude and departure, and substract the lesser difference of Latitude from the greater, as also the lesser 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. of Lat N	Dif. of Lat S.	Departure E	Departure W
N N W, $\frac{1}{2}$ W	79	69.67	—	—	37.24
N W $\frac{1}{2}$ W	86	54.56	—	—	66.47
N by E $\frac{3}{4}$ E	108	101.68	—	36.39	—
N 48° E	112	74.94	—	83.23	—
E 55°	70	—	6.10	69.73	—
E 50° N	84	64.35	—	53.99	—
North	48	48.00	—	—	—
		413.20	6.10	243.34	103.71
		6.10		103.71	—
	Northing	407.10		139.63	E. ing

Hence it appears, that the Ship has departed from her first Meridian, 139.63 miles Easterly, and altered her Latitude 407.1 miles, which reduced 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 18°, and less than 19, and the Distance greater than 400.00, and less than 500.00 and after working the necessary Proportion (by the reverse of the Method made use of in the former *Examples*) the Course out North 18° 56′ *E.* or *E.* by *N.* 70° 41′ *East*, and the direct Distance 430.305 Miles.

The chief Use of this Table being for the Solution of Traverses, it would be needless to give an *Example* of each particular Case in Plane-Sailing, especially since he that is but moderately apprehensive of what has been said, will find it not difficult to do it himself, by the Directions given in *Vol.* 1. under the words *Plain Sailing*.

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