

THE  
THEORY  
OF  
SCIENCES  
ILLUSTRATED;  
OR THE  
Grounds and Principles  
OF THE  
Seven Liberal Arts

Grammar } { Musick  
Logick } { Arithmetick  
Rhetorick } { Geometry  
Astronomy.

Accurately Demonstrated and Reduced to  
Practice.

With Variety of Questions, Problems and Propositions  
both Delightful and Profitable.

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By <sup>MA</sup> H<sup>ON</sup> CURSON, Gent.

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L O N D O N,  
Printed, for Richard Smith at the *Angel*  
and *Bible* without *Temple-Bar*. MDCCLII.

341

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THE  
P R E F A C E  
T O T H E  
R E A D E R.

**T**O speak in the Praise of Learning were a Theme very needless, none doubting the excellency and necessity thereof. *Solomon's* desire was not Riches, but Wisdom and understanding that he might govern so mighty a People. *Rome* saw her best days under her Learned Kings and Emperors, and the *Persians* would elect none but Philosophers for Kings

## The P R E F A C E:

and though we read that *Licinius*, and *Lewis* the Eleventh King of *France* were Enemies to Learning, yet was it *Ovid's* only Comforter in his Banishment who speaketh thus,

— Nil non mortale tenemus  
Pectoris exceptis, ingenijq; bonis.  
En ego, cum Patria, caream, vobisq;  
(domoq;  
Raptaque sint, adimi quæ potuere  
(mibi  
Ingenio tamen ipse meo comitorque,  
(fruoque,  
Cæsar, in hoc potuit Juris habere  
(nihil,  
Qui libet hanc sævo vitam mihi finiet  
(ense  
Me tamen extincto, fama perennis erit.

Which



## The P R E F A C E.

they seem to be something lesser regarded, probably by reason of their Intricacy, and being dressed up in Foreign Languages, which being not easily acquirable to some whole want of Latine and other Languages, renders 'em incapable to learn the admirable secrets of Sciences, they by meer necessity must decline the Knowledge thereof. But having designed to Publish a Book called *The Gentlemans Treasury*, containing choice Collections in all Arts and Sciences with several other Treatises and Discourses to which I shall refer you, and believing that several of the Ingenious upon perusal of that manual of Rarities would be desirous of some knowledge in the Rudiments of those Sciences that afford such delightful and profitable Experiments, so very useful and beneficial to all men, I was induced

to

## The P R E F A C E.

to Compose this Theory of the Sciences, wherein is briefly demonstrated the Solid Grounds and Principles of the Seven Liberal Arts, which are the foundation of all Sciences and Professions. This Book containeth matter distinct from what is in my other Book, and is reduced to this Compass for the more speedy Improvement of those whose other occasions will not permit them time for long Study, and will be assistant to all, as well in the understanding of most other Books as my *Gentleman's Treasury*, which had swelled too much had I incerted what is the substance of this Book therein, and rendered it inconvenient, whereas now both may be sometime or other useful for every one to read, as his reason or Genius inclines him. And this Collection may be of more esteem to some, being judicially  
and

## *The* P R E F A C E.

and carefully Epitomized for the encouragement of those who are many times disencouraged by the sight of large Volumes, from undertaking the fatigue of many years supposed laborious Study, which makes them prefer an easy Ignorance before a hard acquired Knowledge, but here the Reader will find the matter so inviting and succinct he scarce will have power to resist the attaining of Sciences at so cheap a rate, and small expence of time as bestowing two or three hours every day in reading, apprehending and retaining whatever he reads, when the method and brevity will please, the Study delight, and the Instruction of a good Master in these Sciences make him soon perfect therein. And may be advantageous to all Gentlemen who will not only find the instructive part of Science, but also

## The P R E F A C E.

also be informed without any mechanic Operation in the Mensuration of Land, Timber, Stone, Solids, &c. And of all Bricklayers, Carpenters, Plaisterers, Joiners and Masons work, to prevent their being defrauded by Architects and others who build for them. Also give them an insight in Navigation Gauging, Gunnery, Mortar-pieces Dyaling and Astrology, with many profitable Experiments in the Sciences Beneficial to all and of use for ever, with the Censures and Objections made by *Agrippa*, *Des Cartes* and others abusive to the Sciences, and diverting to the Wits.

*Vale.*

THE





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## Errata.

Page 91, line 1 for *putopina* read *putopina*. P. 337.  
 L. 1 for *rom* read *rom*.

GRAM

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[Signature]

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# GRAMMAR.

**G**rammar is an Art of speaking and writing a Language correctly, and taketh its Name from the Greek γραμματικὴ, ἡ, which comes from γραμμα, *i.e.* *Litera, quia Grammatica docet principium literaturæ, & est Scientia literaria.* It is the first of the Liberal Arts and Sciences, and the Latine Grammar (as all other Books) is composed of Words, which words are made up of Letters being either Vowels or Consonants. Its chief Division is into four parts, *viz.* *Orthography, Etymology, Syntax, and Prosody.*

B

O R =



## O R T H O G R A P H Y.

*Orthography* teacheth us to write words with proper Letters, and pronounce syllables with due time. Now a Letter is the least part of a word, and the Latine Tongue hath 25 of them, to wit, A B C D E F G H I J K L M N O P Q R S T U V X Y Z, there being no W. written nor heard in the sound thereof; nor are K Y Z used in pure Latin, but only in foreign words; and altho you find H here written, yet hath it not the power of a Letter, being only a sign of Aspiration. These letters are divided into Vowels, *viz.* a. e. i. o. u. y. so called, because they render a sound of themselves; and Consonants, *viz.* b. c. d. f. g. h. k. l. m. n. p. q. r. s. t. x. z. and great J. and great V.; and are called Consonants because they render a sound with another letter; as *Amo*, *a* is a Vowel that sounds of it self, and *m* a Consonant, because it sounds with another letter. A Diphthong is the sound of two Vowels in one Syllable. The number of these Diphthongs is different in Grammarians, for some  
account

account them eight ; *viz.* æ. ai, au, ei, eu, œ, oi, ui, or, yi; others make them but four, *viz.* œ, æ, au, eu. The Mutes are nine, *viz.* b. c. d. f. g. k. p. q. t. and are so called because they are still, and have no proper sound. The Half-vowels (so called because they are Consonants which make a sound by themselves as tho a Vowel were pre-poned ) are also reckoned nine, *viz.* l. m. n. r. s. x. z. jod. ve. of which l. m. n. r. s. are called Liquids, because the sound seems melting and soft; x. z. j. are called Double-Consonants, because they seem to have the force of two Consonants. He who has a desire to read more about the Latine Letters and the Letters of other Languages, may look in the Treatise of Letters in my Book called the *Gentleman's Treasury*.

A Syllable is the discovery of a perfect sound at one motion of the Breath; and may consist of one or more Letters, as may be seen in many words. Why *Josephus* is spell'd with an *J*. and not with a *G*. is because *G*. (like the Greek *Gamma*) sounds hard before *a. o. u.* And *ph*: is used because it sounds like *f*. as *ch*: like *k*. A Consonant set between two

Vowels belongs to the following Vowel, and begins that Syllable, but *x* belongs to the former in any word; and Consonants which cannot be joynd in the beginning of a Word, must be parted in the middle, as *Prin-ceps*. Why *Audacia* is writ with *cia*, not *sia* nor *tia*, is because derivative words are spell'd with the same Letters their Primitives are; and this may serve to satisfy the Reader of many other words, which I omit, as designing all possible Brevity, as well as information in this so compendious a Work. Quantity, or Time of pronouncing Syllables, is threefold; long marked over the Vowel (˘); short marked thus (˙); or Common (which is long or short as we please) marked thus (˘˙).

A Word of one Syllable is called a Monosyllable, and from words which are a comprehension of Letters and Syllables proceed Sentences, Speeches and Languages.

Points used in the separation of a Speech is twofold, of an Imperfect, and a perfect Sentence. Points of an Imperfect Sentence are 1. a *Comma* (,) made at the end of a few Syllables. 2. *Semicolon* (;) used about half the space between

between a Comma and a Colon, being a distinction which giveth us a time to Breath. The Points of a perfect Sentence are 1 a *Colon* (:) called also a *Member*, which divides the Sentence into two parts, or is a stop which grants more time to Breath: And 2 a *Period* (.) or *Punct*, which is a full stop.

*Parenthesis* ( ) shuts up a Sentence between two Semicircles, which if omitted in the reading, the Sence would yet remain whole.

*Interrogation* (?) is used at the end of a Question ; as, *Who are you?*

Note of *Exclamation* or *Admiration* is marked thus (!)

*Hyphen* (-) Couples together two words, and is always used when a word is parted at the end of a Line.

*Section* (§) Divides a large discourse into two parts.

*Parathesis* [ ] are used in Expositions.

*Asterism* \* in Annotations.

*Obelus* † in Versions.

*Equal Lines* in Quotations are marked thus ||.

Note of *Citation* (“) when Authors are cited word for word.

*Index* ☞ points out something of Note.

*Induction* ^ is for the bringing in something omitted.

*Apostrophe* ' is used when a Letter is purposely left out, as 'twas instead of *it was*.

*Dialysis* or *Dieresis* (¨) is used to part a Diphthong, and is made over the Vowels; as, *Aër, Poëta*, that they may not be pronounced *Ær, Pæta*.

*Paragraph* ¶ is an absolute Passage or Article.

*Grave Accent* ` is used over a Vowel, when the Voice must be Depressed.

*Acute Accent* ´ when the Voice is to be raised higher.

*Crasis* ^ is used over Circumflex Syllables long by Nature, as *Dî pro Dij*.

Small Alphabetical Letters as <sup>a</sup> <sup>b</sup> or <sup>c</sup> <sup>d</sup>, &c. refer to several Marginal Notes or Explanations.

The Figures belonging to *Orthography* are Twelve, whose use is chiefly to allow some Liberty to Poets for making their Verses run more smooth, which they call *Carminis gratia*. They are,

1. *Prothesis* which adds a Letter or Syllable to the beginning of a Word.
2. *Apharesis* which takes away a Letter or Syllable.

3. *Syncope* taketh away a Letter or Syllable from the middle of a Word ; which,

4. *Epenthesis* addeth thereunto.

5. *Apocope* takes away a Letter or Syllable from the end of a Word ; which

6. *Paragoge* addeth thereunto.

7. *Antithesis* and

8. *Antistæchon* change one Letter ; for another.

9. *Metathesis* misplaceth a Letter as for *Thymber* is writ *Thymbre*.

10. *Tmesis* divides or separates the parts of a Compound Word, by Interposing something between them.

11. *Synæresis* contracteth two Syllables into one.

12. *Diaeresis* divideth a Syllable, and of one maketh two.

See more of Orthography at large in the Grammarians Books<sup>s</sup>, and among others in *Jasz Berenys's Fax Nova*, *Hool's Easy Entrance to the Latine Tongue*, *Lily's Grammar*, *Ob. W.* his Instructions in the Art of Grammar, *Lane's* speedy Method of attaining the Latine Tongue, *Clare's Compleat System of Grammar*, *Berault's*

New, Short and Exact Latine Grammar, &c.

## ETYMOLOGY.

*Etymology* teacheth the Definitions, Divisions and Accidents of the parts of Speech or Languages ; but before I speak of the parts of Speech I shall say something of

The Figures belonging to Etymology, 1. *Antimery* is when one part of Speech is used instead of another, as *Scire tuum* for *Scientia tua*. 2. *Enallage* changeth one Person, Number, Tense with Mood and Gender for another, as *Pe-reo quod charius est mi*. 3. *Hellenism* is when Latin words are declined like to Greek words, as *fami-liâs* for *familia* ; or have a Greek construction, as *Desine clamorum, fal-lunt, ardebat Alexin, abstinet irarum, irarum* is used for *irâ*. 4. *Archaism* tolerateth old, obsolete and also new coyned words, as *mis, tis, anuis*, i. e. *mei, tui, anus*.

The parts of Speech are Eight, *viz.* *Noun, Pronoun, Verb, Participle, Ad-verb, Conjunction, Preposition* and *Interjection*. The four first whereof are only declined.

I. A *Noun* is that part of Speech which signifies a Person or a Thing; as *Terra* the Earth, and is two-fold, Substantive and Adjective. A *Substantive* is a word that signifies a thing that may be declined in good Sence in every ones Native Language; as the word *Man*, &c. which I know to be a Substantive, because I can decline it in good Sence, *Man, of Man, to Man*, &c. In *English* they may have *a, an* or *the* applyed to them, as *Homo a Man, Dominus the Lord*. Aor *an* is used when we don't determine which we mean. *Substantives* are of two sorts; *Proper* given to some one individual thing of a kind, as *Peter, London*: Or *Common*, which signifies some one kind of thing but is common to all of that kind, as *City, Kingdom*. Some *Substantives* are *Collectives* signifying many things together as *Plebs* the People. A *Noun Adjective* or *Adjunct* (in Rhetorick called *Epithets*, in Logick *Concretes*) requires to be joyned to some *Substantive* to make its signification more intelligible; as *Albus equus* a White Horse (*Albus* is Adjective, *Equus* Substantive) and in *English* they may have *thing* or *person* joyned to



to them. And Note that Adjectives are sometimes placed without Substantives expressed, and then if they be of the Masculine or Feminine Gender, [*a person*] He or She, Man or Woman is understood ; as *Doctus est*, He, or the Man is Learned. But if of the Neuter Gender *thing* is understood ; as *hoc album* this white thing.

Eight things belong to a Noun,

1. *Person.* *Liber* a Book is of the third Person, because every Noun, Participle, and whatsoever is put instead of a Substantive, are of the third Person ; as *Scire tuum*, pro *Scientia tua*, thy Knowledge.

2. *Number*, which of Nouns, Pronouns, Verbs and Participles are two, *viz.* The *Singular* which speaketh but of one, and the *Plural* which speaks of more, and in *English* is made by adding *s* to the Nominative Singular, as King, Kings, &c. but there are many Irregulars, as when the old *Saxon* termination *en* is reserved ; as, *Ox*, *Oxen* ; *Man*, *Men* for *Manen*. What Masculines are content with the Plural Number only, altho' they may seem to signify but one thing, may be seen in *Clare's* compleat System of Grammar.

3. *Case*, which is the proper termination of

of a Noun, Pronoun or Participle, by which it swerves from the Nominative. The Declining of a Noun is the variation thereof according to the various State or Case of the thing signified by it, and in Grammar every thing is considered in a six-fold State or Case; viz. The *Nominative* which cometh before the Verb in *English*; as *Sol lucet* the Sun shineth. *Ob. W.* in his Instructions in the Art of Grammar, saith that the Nominative is not properly a Case (and *Aptotes* are not so called because they have no Case, but none proceeding from the Nominative) for the Noun or Name it self is said to be the Nominative Case, and is the Foundation or Subject of Speech. The second Case is the *Genitive*, which shews that either one thing proceeds from another or belongs to it; as *Filius Regis*, the Kings Son; *Casaris Gladius*, the Sword of *Cesar*. The third Case is the *Dative* known by the sign *to*; as, *Do tibi Consilium*, I give thee Counsel. The fourth Case is the *Accusative*, which follows the Verb and is governed by it; as, *Amo Deum*, I Love God. The fifth is the *Vocative* Case known by calling, *O Petre*, *O Peter*, and is most-ly

ly the same with the Nominative, and the sixth is the *Ablative* Case which takes away from, and is commonly joyned with a Preposition serving to the Ablative Case; as, *Accipio à te*, I receive from thee. If any of these Prepositions *in, with, thro, for, from, by* or *than*, &c. come before a Noun, that Noun in Latin is put in the Ablative Case. *Note*, our *English* Language is in expressing these Relations more Accurate and Distinct than the *Latine*, but the *Latine* more Elegant than the *English* as avoiding the so frequent repetition of the same Monosyllable: And *Note* also that in Construing *Latine* into *English* you add always the sign of the Case, because it serves instead of the Termination. Of Nouns which are varied into no Case, but are applyed to every Case and called *Aptotes*, See *Clare's* Compleat System of Grammar.

4. *Declension* is the Declining of a Noun according to the Case; and they are five in Number, and known by their Genitive Cases Singular. The first Declension hath four Terminations *a, as, es, e*; as *Musa, Aeneas, Anchises, Penelope*, but the Termination in *a* is only *Latine*, and is known by its Genitive Case  
Sin-

Singular in æ Diphthong, and thus Declined ;

Sing. No. hæc *Mensæ*, G. hujus *Mensæ*,  
D. huic *Mensæ*, A. hanc *Mensam*,  
V. o *Mensæ*, Ab. ab hac *Mensæ*.

Plur. N. hæ *Mensæ*, G. harum *Mensarum*,  
D. his *Mensis*, A. has *Mensas*,  
V. o *Mensæ*, A. ab his *Mensis*.

*Filia*, *Mula*, *Equa*, *Nata*, *Dea*, *Liberta*, make *abus* in the Dative and Ablative Plural. *Filia* and *Nata* make *is* also.

The Second Declension hath five Terminations, *us*, *um*, *ir*, *er*, *ur*, as *Dominus*, *Regnum*, *Vir*, *Magister*, *Satur*, and hath its Genitive case in *i* ; as *Dominus*, *Domini*. Some Nouns in *er* do increase in their Genitive, as *Lucifer*, *Luciferi*, and some do not increase as *niger*, *nigri*. The Nouns in *us* make their Vocative in *e*, as *Dominus*, *Domine*, but *Deus* maketh *Deus*. Nouns in *ius* make their Vocative in *i*, as *Antonius*, *Antoni*, but *Meus* maketh *Mi*, *Pius* maketh

Sing. *Dominus*, *ni*, *no*,  
*num*, *ne*, *no*.  
Plur. *ni*, *norum*,  
*nis*, *nos*, *ni*, *nis*.

Sing. *Magister*, *stri*,  
*stro*, *strum*, *ster*,  
*stro*. Plural. *stri*,  
*strorum*, *stris*,  
*stros*, *stri*, *stris*.

Sing. *Regnum*, *ni* *no*,  
*num*, *nam*, *no*,  
Plural. *na*, *no*,  
*rum*, *nis*, *na*,  
*na*, *nis*.

*Pie*.

*Pie.* All Neuter Nouns have three Cases alike, *viz.* Nom. Accus. and Voc. which all end in *a* in the Plural Number, as may be seen in *Regnum*.

Sing. *Pater, tris, tri, trem, ter, tre.*

Plur. *tres, trum, tribus, tres, tres, tribus.*

Sing. *Bonitas, tatis, tati, tatem, tas, tate.* Plur. *tates, tatum, tatibus, tates, tates, tatibus.*

Sing. *Ænigma, matis, mati, ma, ma, mate.* Pluraliter, *mata, matum, matibus, mata, mata, matibus.*

The third Declension hath several Terminations, and its Genitive Case Singular in *is*, and is Declined thus:

Sing. *Manus, nūs, nuī, num, nus, nu.* Plur. *nus, nuum, nibus, nus, nus, nibus.*

Sing. *Genu, u, u, u, u, u.*  
Plur. *nua, nuum, nibus, nua, nua, nibus.*

The fourth Declension endeth in *us* and in *u*. Nouns in *us* have their Genitive Case Singular in *ūs*: Nouns in *u* are undeclined in the Singular Number; but *Lacus, Arcus, Specus, Artus, Tribus, Portus, Partus, Veru*, and *Genu* make *ubus* in the Dat. and Abl. Plural, but *Portus* and *Genu* make also *ibus*: *Jesus* maketh *Jesum* in the Accus. and *Jesu* in the other Cases.

The

The fifth Declension endeth in *es*, and hath its Genitive Case in *ei*. Of Nouns compounded see *Berault's Grammar*.

Sing. *Facies, ciei, ciei, ciem, cies, cie.* Plur. *cies, cierum, ciebus, cies, cies, ciebus.*

Adjectives having three endings in the Nominative Case, are declined by the first and second Declension of Substantives. But all other Adjectives are declined by the third Declension of Substantives.

The 5th. thing belonging to a Noun is *Gender* which the Latine (for some Languages have no Genders) makes to be three, the Masculine, the Feminine and Neuter; to which three are commonly applied the like Genders of the Pronoun *Hic, hac, hoc*. To these Genders is added The *Common of Two*, because it belongs to both Sexes, as *hic & hac Parens* the Father and Mother: The *Common of three*, because declined with three Articles, as *hic, hac & hoc Fælix* Happy. The *Doubtful*, because declined now with one Gender, and then with another, as *hic vel hac Dies* the Day. And the *Epicene* declined with one Article, under which both kinds are signified, as *Hic Passer* a Sparrow,

row, *hæc Aquila* an Eagle. See *Lane's* speedy Method of attaining to the Latin Tongue. For a larger explanation of Genders, See *Clare's* compleat System of Grammar, and for a Table of the Genders of Latin Substantives and Exceptions, see *Lane* aforefaid.

The 6th is *Comparison*, of which there are three Degrees. The *Positive*, which signifieth the thing without Excess and Comparison, as *Sanctus* Holy : The *Comparative*, which compareth one thing with another, and exceeds its positive in signification, as *Sanctior* more Holy ; and the *Superlative*, which signifieth the thing in the highest Degree, and is formed from the same, by adding *ssimus* as *Sanctissimus* most Holy. The Adjectives in *er* make their Superlatives in *rimus*.

The 7th thing is *Species*, which is twofold ; *Primitive* which is not taken from any other word, as *Pater* a Father ; and *Derivative* derived or formed from another word, as *Paterne* Fatherly.

The 8th and last is *Figure*, which is also twofold, that is to say *Simple*, as *just* ; and *Compound*, as *unjust*. And here observe that a word which is Compounded of two Nominative Cases

is declined in them both, as for Example. N<sup>om.</sup> Voc. *Rei-publica*, Gen. *Rei-publica*, Dat. *Rei-publica*, &c. See more Examples in the Grammars.

And now we come to the second part of Speech; which is

II. A *Pronoun* is that part of Speech which we use in relating or rehearsing any matter, as instead of naming Persons we say *Ego* I, *Tu* thou, *Ille* he, and they are called *Pronouns*, because used for or instead of Nouns, and they Regulate Verbs and Adjectives, and therefore have the same use as Nouns, There are Nineteen Pronouns to be found in *Clare's* System of Grammar; *Berault* maketh them but fifteen, Eight Primitive, *Ego, tu, sui, ille, ipse, iste, hic, is*, and seven Derivative, *viz. meus, tuus, suus, noster, vester, nostras, vestras*. The Accidents of a Pronoun are seven, *viz. Person, Number, Case, Declension, Gender, Species and Figure*. In *Logick* a Person is nothing else but one single or intellectual Man or Angel; but in Grammar it is otherwise, for Persons are either in speaking the Speaker called the *First Person*, Or the spoken to called the *Second Person*, Or the

C

spoken



spoken of, called the *Third Person* : And of this Person are all things except by some Figure we either speak to them or feign them speaking, and then it is understood *Tu* or *Ego*. The Numbers and Cases are the same as in Nouns. The Declensions are four. *Ego, tu, sui* are of the first Declension. *Ille, ipse, is, idem, qui* are of the second. *Meus, tuus, suus, noster, vester, cujus* of the Third, and *nostras, vestras* of the Fourth. Genders are three as Nouns Adjectives are. And the Figure of a Pronoun is *Simple*, as *Ego* I. and *Compound*, as *egomet* I my self.

III. A *Verb* is a word that signifies the Action, Passion or Being of a thing and is declinable by Moods and Tenses, as *Amo* I love, *Amabam* I did love, *Amavi* I have loved, &c. And a Verb is twofold *Personal* and *Impersonal*. *Personals* are declined with three Persons as *Ego Doceo* I teach ; *tu doces* thou teachest ; *ille docet* he teacheth. *Impersonals* are declined without Persons, as *oporet* it behoveth, and wants the first and second Person in both Numbers, but a Verb impersonal of the Passive Voice may indifferently be taken for every Person of either Number as *ubi*  
*inci-*

*incipitur à me* where do I begin; *à te*, *ab illo*, *à nobis*, *à vobis*, *ab illis*, and a Verb impersonal wants the Supines and Gerunds, but hath Eight Accidents, *viz.* Kind, Mood, Tense, Conjugation, Number, Person, Species and Figure.

There are four kinds of Verbs. 1. A *Verb Active* which endeth in *o* and denotes an ACTION, as *Amo* I Love; and becomes 2. A *Passive* by putting an *r* to it, as *Amor* I am loved. 3. The *Verb Neuter* ends in *o* or *m*, as *Bibo* I drink, *Sum* I am, but can neither become wholly Active nor Passive both in Signification and Termination, 4. A *Verb Deponent* ends in *or* but hath usually an Active signification, as *loquor* I speak; but *r* is never taken away as in Passives. A Deponent hath also *Gerunds* and *Supines* like an Active which a Passive hath not. Some to these add a Verb Common which ends in *or* but hath both Active and Passive signification, as *Osculor* I kiss thee, *Osculor à te* I am kissed of thee.

A Verb hath four Moods, 1 *Indicative* in which Mood Verbs of mentioning, affirming, denying and demanding are put, and this Mood sheweth either the thing or the Person. 2 *Con-*  
C 2
junctive;

*junctive*, in which Mood are put Verbs of wishing and desiring wherein also is signified a thing able or willing, or which ought to be done. 3. *Imperative*, in which Mood are put Verbs of commanding, advising, praying, forbidding and permitting. It hath a double present Tense, the first signifies more immediately than the latter, as, *Lege, legito* do thou read, all other Tenses are wanting, and so is the first Person Singular. 4. *Infinitive*, in which Mood are put the latter of two Verbs having no Conjunction between.

All Verbs are of one Conjugation in the Tenses of the perfect Root, some Verbs are irregular in the Tenses of the present Root, but in the Tenses of the perfect Root there is not one Irregular Verb. There are *five Tenses* or Times, *The present, The imperfect past, Perfect past, More than perfect past,* and *the Time to come.* In the *English* Tongue the Tenses are known by their Signs, but in Latine by the Terminations in the Moods. The English Signs of Tenses are,

<i>Present Tense.</i>	<i>Imperfect Tense.</i>
<i>Active</i> do, dost, doth.	<i>Act.</i> did, didst.
<i>Passive</i> am, art, is, are.	<i>Pas.</i> was, wast, were.
	<i>Per-</i>

*Perfect Tense.*      *Pluperfect Tense.*

*Act.* have, hast, hath. *Act.* had, hadst.

*Pas.* have been, &c. *Pas.* had been, &c.

*Future Tense.*

*Active* shalt, wilt.

*Passive* shalt be, wilt be.

The *Present Tense* speaketh of the time present, as *Amo* I Love.

The *Preterimperfect Tense* sheweth the time not perfectly past, as *Anabam* I did Love.

The *Preterperfect Tense* sheweth the time is perfectly past, as *Amavi* I have Loved.

The *Preterpluperfect Tense* sheweth the time is so perfectly past it can't be interrupted, as *Amaveram* I had Loved.

The *Future Tense* sheweth the time to come, as *Amabo* I shall or will Love.

The *Gerunds* end in *di, do, dum*, and have both *Active* and *Passive* signification, as *Amandi* of Loving or of being Loved.

The *Supines* are two in *um* and *u*; the first hath an *Active* signification, as *Eo Lusum* I go to Play, the latter mostly a *Passive* as *hoc est difficile dictu* that is

*ndus*, the English ending is *d. t. n*; as *praised, knit, seen*. A Participle hath seven things belonging to it, *viz. Person, Number, Case, Declension, Gender, Time* and *Figure*. And Participles of the present Tense be declined like Adjectives of three Articles, the rest like Adjectives of three endings.

V. An *Adverb* is a part of Speech undeclined, which being joyned to a Verb perfects and explains its Sence by *Whither? How? When? How long? How often? How much? Wherefore? Where? From whence? Whether?* and are joyned to other words the better to declare their signification, for an Adverb signifies the *manner, time, place* or some other circumstance of *Doing, Asking, Calling, Affirming, Denying, &c.* The Adverbs *non* and *ne* go always before the Verb in Latine, but the English Particle *not* goes always after the Verb or its Auxiliary, as *non Amo I Love not*.

There be sundry sorts of Adverbs according to their sundry significations, for some signify

Time

Time	<i>Hodie</i> to day, <i>Cras</i> to Morrow, <i>Nunc</i> now.
Place	<i>Ubi</i> where, <i>ibi</i> there, <i>hæc</i> here.
Number	<i>Semel</i> once, <i>bis</i> twice, <i>ter</i> thrice.
Order	<i>Inde</i> thereupon, <i>deinde</i> af- terwards, <i>deniq;</i> lastly.
Asking	<i>Cur</i> why? <i>Quorsum</i> to what end.
Calling.	<i>Hæus</i> ho, <i>ehodem</i> come hither a little.
Affirming	<i>Certè</i> truly, <i>na</i> indeed, <i>maxime</i> yes.
Denying	<i>Non</i> not, <i>haud</i> scarce, <i>mi- nime</i> no.
Exhorting	<i>Age</i> go to, <i>sodes</i> if you dare.
Wishing	<i>Utinam</i> would to God, <i>ô si</i> O that.
Parting	<i>Secorsim</i> severally, <i>bifariam</i> two ways.
{ Gathering together	} <i>Simul</i> together, <i>una</i> in one, <i>non solum</i> not only.
Chusing	
{ A thing not finished	} <i>Pene</i> almost, <i>vix</i> scarce- ly, <i>fere</i> in a manner.
Shewing	
	<i>En</i> behold, <i>Ecce</i> lo.

Doubting	<i>Forsan</i> perhaps, <i>fortassis</i> peradventure.
Chance	<i>Forte</i> by chance, <i>fortuito</i> as it fell out.
Likeness	<i>Sic</i> so, <i>sicut</i> as, <i>quasi</i> as if.
Quality	<i>Bene</i> well, <i>male</i> ill, <i>docte</i> learnedly, <i>fortiter</i> valiantly.
Quantity	<i>Multum</i> much, <i>parvum</i> little.
Comparison	<i>Tam</i> as well, <i>quam</i> as, <i>aeque</i> alike.

VI. A *Conjunction* is a part of Speech or little Particle that joyneth Words and Sentences together, and for the most part is placed about the beginning of Sentences, as Adverbs about the middle. *Conjunctions* are principally used to tye the Clauses of a Sentence together, and therefore they make those which by the Logicians are called *Hypothetical Propositions*, and a great force of Speech depends upon them. According to their fundry significations they are *Copulatives* which couple both Sence and words as *Et* and, *nec* neither, *Disjunctives* sever the Sence not the words, as *aut* or, *vel* or.

*Dis-*

<i>Discretives,</i>	} imply	{	a difference as <i>sed</i> but, <i>at</i> but.
<i>Causals,</i>			a Reason <i>nam</i> for, <i>quia</i> because.
<i>Conditionals,</i>			a Condition as <i>si</i> if, <i>dum</i> so that.
<i>Exceptives.</i>			an Exception as <i>ni</i> unless.

There are also *Interrogatives, Illatives, Adversatives, Redditives, Electives Diminutives* and *Inclinatives* which may be found in the Grammars.

VII. A *Preposition* signifies some Relation of one thing or Person to another, either as *Distance, Situation, Casualty* or the like, and is put before other parts of Speech either in Composition, as *ad-monuit* he has admonished, or else in apposition, as *sedit ad Dextram* he sitteth at the right hand. Sometimes Prepositions are used both ways, as *adeo ad Patrem* I am going to my Father. Prepositions being set without a Case becomes Adverbs, as *Coram laudare & clam vituperare inhonestum est*. To a Preposition belongs *Case, Government* or *Construction*.

VIII. An *Interjection* declares the Affection of the Mind under a Confused Voice suddenly broke off as *O! Out! Alas!* and Interjections are questioned  
by



by some whether they are to be accounted parts of Speech, because they signify sudden motions or expressions of the Passions of the Soul, and are rather sounds only than words.

### S T N T A X.

*Syntax* is an agreeable disposition of the eight parts of Speech amongst themselves and speaks of words as they are united into Sentences. *Syntax* is twofold *Concord* which is the agreement of words amongst themselves, and *Government* which is the dependance of one word upon another.

To every Sentence are necessarily required 1. a *Suppositum* (most properly so called, which cometh before a Verb Active) *Subject* or *Noun* of the Nom. Case, of which the Speech is made, or something instead of it, to come before the Verb. 2. A Verb to agree with the Nom. Case, or Subject shewing the Relation of being, doing, or suffering, betwixt the *Subject* and the *Predicate* which is that spoken of the Subject. 3. Somewhat to follow the Verb which they call a *Predicate*, and is spoken of the other, and is many times

times included in the Verb ; as, *Rex Venit*, i. e. *Rex est Veniens*.

*Note*, that there are divers sorts of Sentences, 1. That which hath no more than one Verb and the Dependants upon it, which some Authors call *Periodus Supina* ; as, *Prosperum scelus, vulgò virtus vocatur*. 2. Which consists of more than one Member, and of more than one Verb, but so that each Member stands by it self ; as, *Christus è Cælo, glorificate : Christus in Terram, obviam prodite*. Which Period consists of four Members, the two latter corresponding elegantly to the two former, separated by an Half-period or Colon. 3. Which consists of divers Sentences, but some interposed between the parts of another, which interposition is either by a Conjunction ; as *Fortuna, cum blanditur, captatum venit. Quæ nocitura tibi, quamvis sint chara, relinque*. Or by a Relative ; as, *Deforme est, quos dignitate præstas, ab ijs virtute superari. Quem sæpe transit, casus aliquando invenit*. Or by a Participle, Or by a Parenthesis. And therefore in construing it is best for a young Scholar to dispose the words after the Natural Order, separating the Sentences one from another ; beginning  
with

with the Voc. Case, then the Nom. and what depends upon it, then the Verb with the Adverb joyned to it, next the Accusative with its dependants, then the Ablative or Dative as they follow. It is necessary also to supply all *Ellipsis's*, *Antecedents*, *Defective Cases*, One Verb applyed to divers Nom. Cases, or the same Nom. Case to divers Verbs, *Subauditurs*, &c.

*Ellipsis* or omission of a word is very frequent in the Latin, as it is in all Languages that affect brevity. Such words are of Noun Substantives which signify a thing common or well known, *Areolâ longa denum pedum [mensura.]* Verbs also, especially Substantives and Prepositions; *Vacuus [â] curis.* Note also that the Latines seem to speak many times rather according to the matter and signification, than the words and ordinary Construction; as, *Omni-um rerum mors est extremum. Duo Mil- lia viri.*

The *Concords* are three, the 1. between the Nom. Case and the Verb, the 2. between the Substantive and the Adjective, the 3. between the Antecedent and the Relative *Qui.* To which are

are added the Rules of the Cases of the Relative, and the Question and Answer.

*The Rule of the first Concord.* A Verb Personal agreeth with its Nom. Case in Number and Person; as, *Præceptor legit* the Master readeth, *vos negligitis* you neglect.

*The Rule of the second Concord.* The Adjective agreeth with its Substantive in Case, Gender and Number; as, *Amicus Certus* a sure Friend.

*The Rule of the third Concord.* The Relative *Qui* agreeth with its Antecedent in Gender, Number and Person; as, *Vir sapit qui scit tacere.*

*The Rule of the Case of the Relative.* When there cometh no Nom. Case between the Relative and the Verb, the Relative shall be the Nom. Case to the Verb; as, *Miser est qui nummos admiratur.* But if there cometh a Nom. Case between the Relative and the Verb, the Relative shall be governed of the Verb or some other word in the same Sentence; as *Felix quem faciunt aliena pericula cautum.* Happy is he whom others harms do make wary.

The *Rule of the Question and Answer*:  
 When a Question is asked, the Answer must be made by the same Case and Tense that the Question is asked by; as, *Cujus est fundus? Vicini*. Whose Ground is this? A Neighbours.

The Rules of the Verbs and all the six Cases, &c. may be found in all the Grammars.

There be six Figures (according to some Grammarians) belonging to *Syntax*; but *Clare* in his System of Grammar makes but four, *viz.*

1. *Pleonasm*, which is when there is a word in a Sentence more than needs; as, *Auribus his audiui*, I have heard it with these Ears, &c.

2. *Syllepsis* or *Synthesis* is when there is an agreement in Sence, but not in words; or is the comprehension of the unworthyer under the more worthy; as, *Tuq; puerq; eritis*. Both you and the Boy were:

3. *Hyperbaton* is when the Latines imitate a Greek construction, or changeth the order of words; as *mecum* for *cum me* with me.

4. *Ellepsis* is when a word is left out in any Sentence, that ought to be there to compleat the Sence. The thing

thing moveable is made Substantial. Whereas if it be fixed you may understand it; as; They say it is not in paying. What things more; *Quid plura.* What those Men; *Quid istis.*

### PROSODY.

*Profody* is the last part of Grammar, which teacheth how to make Verses well, and two things in *Profody* are especially to be observed, Namely the *Quantity of Syllables*, and the *Way to make Verse.*

*Verse* is a Speech bound to a just and lawful Number of Feet, and there are seven kinds of Verse, *viz. Hexameter* or *Heroic* which consisteth of six Feet in Number, but of two Feet only in kind a *Dactyl* and a *Spondee*, the fifth place claims properly a *Dactyl* to it self, the sixth place claims a *Spondee*, the rest this Foot or that even as we please.

2. *Pentameter* or *Elegiack.* 3. *Phaleutick* or of eleven Syllables. 4. An *Anclepiad Verse.* 5. A *Sapphick Verse.* 6. An *Adonick Verse.* 7. A *Iambick Verse.* The last Syllable of every Verse is accounted Common:

A *Foot* is the setting or placing together of two Syllables or more according

ing to the certain observation of the Quantities, and is fourfold, 1. A *Spondee* which consisteth of two long Syllables; as *virtus*. 2. A *Trochee* which consisteth of a long Syllable first and a short one after it; as *Collè*. 3. *Iambick* Foot which consists of a short Syllable first and a long one after it; as, *amans*. 4. A *Dactyl* which consisteth of three long Syllables; the first is long, the other two are short; as, *mitterè* to fend.

*Scanning* is the lawful measuring of a Verse, into every one or each of the Feet, and there are six Figures belonging to Scansion, viz. 1. *Eclipsis* takes away the Letter *m* with its precedent Vowel at the end of a word. 2. *Synalæpha* cuts off one Vowel before another. 3. *Synæresis* is the contraction of two Syllables into one; as, *Æripides* for *Aeripides*. 4. *Diaeresis* parteth a Syllable and of it maketh two Syllables; as, *Evoluisset* for *Evolvisset*, *Evohe* for *Eve*. 5. *Systole* makes a long Syllable short. 6. *Dyastole* maketh a short Syllable long; and these Figures are often used, *Carminis gratiâ*, a Liberty Poets take.

See

See the Treatise of Poetry in my Book called the *Gentlemans Treasury*.

Directions for *making Latine*, *Constraining Latine* and for *Parsing Latine*, &c. may be seen in *Hool's* and other Grammars.

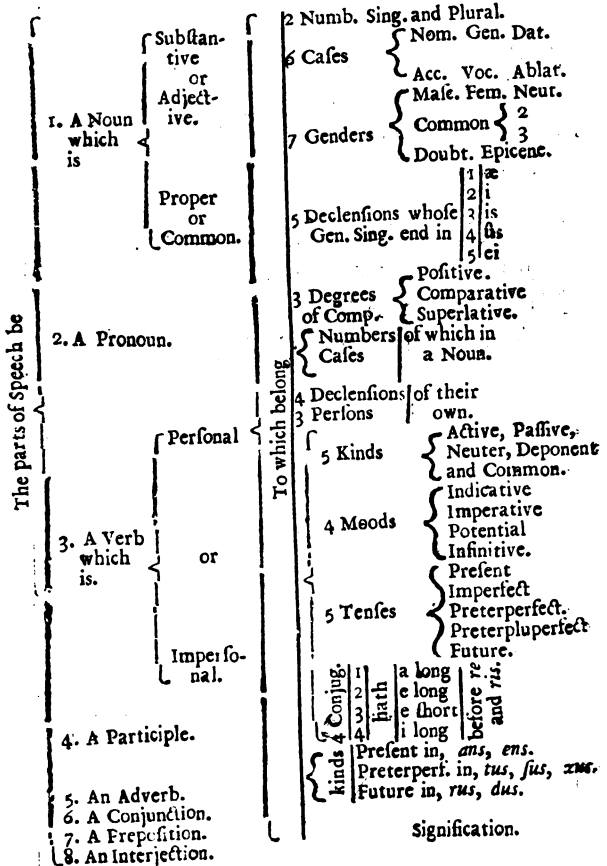
And here I will present you with a Verse in *Carm. Prov.* which names the Liberal Arts or Sciences, in their due Order.

Gram. *loquitur* ; Dia. *vera docet* ;  
 Rhet. *verba colorat* ;  
 Mus. *canit* ; Ar. *numerat* ; Geo. *ponderat* ;  
 Ast. *colit astra*.



A Synopsis or a short View of the Grounds of Grammar.

The Grounds of Grammar treat of Latine Words.



The Rules for joyning Words are

1	Of Concord, viz.	Of the First			
		Of the Second			
		Of the Third			
		To which is added that	Of the Case of the Relative Of the Question and Answer.		
		Of Nouns.	Adjectives with	Substantives.	
				A Genitive. A Dative. An Accufative. An Ablative where is also the Ablative absolute.	
		Of Verbs	with	A Nominative. A Genitive. A Dative. An Accufative. An Ablative. divers Cafes.	
		2	of Construction.	Of Gerunds and Supines.	
				Of Time, Space and Place.	
Of Impersonals and Participles.					
Of Words undeclined.					
Rules to know the Genders of Nouns.					
Rules to know the Preterperfect Tense and Supines of Verbs.					
Certain Figures in Latine words.					
Directions for	Making Construing Parfing Writing			Latine.	
Some Grammars have.					
A fhort View of	the Common			Accidents. Grammar. maribus. Propria quæ Quæ genus. As in prefenti.	

Henry Cornelius Agrippa in his *Vani-ty of Arts and Sciences*, saith *Grammar* as well as *Logick*, and *Rhetorick* are oft times the causes of more Mischief than delight, which notwithstanding (saith he) have no other Rule of Truth for their Establishment than the Decrees or Statutes of their first Inventors, which evidently appears in the Invention of Letters themselves, which are the Elements and Materials of all Arts, but such are the alterations happening thro' the Vicissitude of times that there are no Language or Letters that are able to make good the Antiquity or Truth of their first Original. And the *Latine Grammar* (saith he) is so barren and so much beholden to Greek Literature, that whoever understands not so much is to be ejected out of the Number of Grammarians. Therefore all the Foundation and Reason of Grammar consists only in the Use and Authority of our Ancestors, who have been pleased that a thing shall be so called, and so written, that words shall be so Compounded and Construed, which being so done they esteem well done. And not one of them have given any Account how the *Parts of Speech* are to be divided or distinguish-  
ed

ed or what order to be observed in Construction, &c. How it is Lawful to Pronounce in *um* Latine words terminating in *a* and *us*; as for *Margarita*, *Margaritum*; for *Punctus*, *Punctum*; and how *Jupiter* makes *Jovis* in the Genitive Case. Whether a Participle put by it self, be sometimes a Participle, or whether Gerunds are Nouns or Verbs. Why among the Greeks Nouns Plural of the Neuter Gender are joynd with a Verb of the Singular Number. Why many write most Latine words with a Greek Diphthong, others not, as *Felix*, *Questio*: Whether the Latine Diphthongs are only written and not pronounced; or whether there be a double Pronunciation in one Syllable: Likewise why in some Latine words, some use the Greeky, some the Latine *i*. as in *considero*. Why in some words some double the Letters, some not; as, *causa*, *caussa*; *religio*, *relligio*. Why *Caccabus* by Position long, by reason of the double *cc*. is notwithstanding by the Poets made a *Dactyl*. Whether *Aristotle's* word for the Soul ought to be writ *endelechia* with a *Delta*, or *entelechia* with a *Tau*, and many other never to be reconciled Contentions about

*Accents, Orthography, Pronunciation of Letters, Figures, Etymologies, &c.* Such a kind of Battle as this *Lucian* of *Samos* hath very elegantly described, about the Consonants  $\sigma$ . and  $\tau$ . whether should have the Victory in the word *Thalassa* or *Thalatta* : Answerable to which, one *Andreas Salernitanus* hath with great Wit compiled his *Grammatical War*. Neither is there any that ever wrote in Latine, whom *Laurentius Val-la* the Learnedst of all the Grammarians hath spared in his Anger, and yet him hath *Mancinellus* most cruelly Butchered. *Didymus* is said to have had 4 some say 6000 Books upon the Subject of Grammar, and *Priscian* could not learn this Art in the whole time of his Life.

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# LOGICK.

**L**ogick in Latin, *Logica vel Dialectica* in Greek λογική, ἡ λόγος, is an Art of Reasoning or Disputation, or according to *Blome* in his Philosophy, is the art of *right Thinking*, or of using our Reason aright. Now that a Man may use *right* reason, and be able to frame his thoughts aright, and interpret them to others; it is necessary for him to *perceive aright*, *Judge aright*, *Reason aright*, and *Order aright*. We are said to perceive a thing when we clearly and distinctly conceive the object offered to us. As when we present to our Thoughts, *God*, an *Angel*, a *Circle*, &c. and stop there without forming any Judgment concerning them. And the Form by the immediate perception whereof we are Con-

scious

scious of our knowing any Object is called an *Idea*. We are said to Judge when we affirm or deny any thing of the said known Objects ; or when we by the Action of our Mind joyning two Ideas assert the one to be the other ; or deny the one of the other. As when considering the Idea of the Sun, and that of Fire, we affirm the Sun to be Fire, or deny the Sun to be Fire. To *Reason* or *Discourse* is that Action of our Mind, which frames a Judgment of many others, or which from two Propositions, or from one infers another ; so observing that the Idea of a Man agrees with that of an Animal, but doth not agree with the Idea of a Plant, concludes that therefore neither can the Idea of a Man suit with that of a Plant ; wherefore finding that Man is an Animal, and that an Animal, is not a Plant it infers this third Proposition that therefore Man is not a Plant. This way of Thinking is called *Discourse* because by running from one Proposition to another it comes to a Third. To *Order* is an Action of the Mind whereby many things found in the same Subject, are disposed in a fit and congruous manner, As when the Mind after it

it has framed several Ideas, Judgments and Argumentations, digests them in the most convenient and fit manner for the ready and distinct conceiving of them. Tho' some may say that these things can be done by the conduct of Nature only, since sometimes Persons perform them more exactly (who are ignorant of the Rules of *Logick* than they who have studied them, yet is not *Logick* to be judged useless, for Wisemen considering the weakness of Mans Wit, Invented this Art to help us the better, by a just and natural Order to find out the truth of a thing, and tho' before *Adam's* fall, Knowledge was Natural, and came without Labour, yet no man can now of himself attain the Truth in all things without help, and diligent Learning. Who can deny but that the faculty of Painting is born with Man, and yet Art is necessary for the right forming of Images.

This Art is distinguished by some into *Natural* and *Artificial*. All Men are endued by Nature, with a power of speaking, and framing of words, whereby a Man may discourse well, but yet without due Order. *Artificial Logick*, is acquired by use and practice,  
and



and by certain Rules discovers all manner of Errors, Confusions, and Obscurities of our Conceptions, False and uncertain Judgments and undue Consequences in our Reasonings, the discerning and removing whereof is the whole Business of *Logick* : The other common Division of *Logick* is into *Doctrinal* and *Practical*. The first delivers the several Rules, directing us in Perceiving, Judging and Reasoning, the latter applies those Rules to use and practice.

Some *Logicians* divide this Art only into two parts. The *first part* called in Latine *Judicium* consisteth in framing of things aptly together. The *second part* consisteth in finding, and searching out matter, agreeable to the Cause, and in Latine is called *Inventio* , For when any one goeth to prove any thing he must first Invent somewhat to prove his Cause, in which Judgment must be used in framing the Reason so Invented, that he be sure it serve for the purpose.

Every *Question* is single or double, A *Single Question* resteth in a single word as, *What is Friendship? What is Philosophy?* A *Double Question* stands in two Sentences ; as, *Is the Study of Philosophy Praise worthy? Or is it not?* A *Propositi-*

or is a Sentence uttered in plain words expressly, signifying either Truth or Falshood, and is either single or double. A *Single Proposition* is, *Wicked Men care not to read the word of God*, of which you may make a double Proposition by adding something thereto; as, *Wicked Men not only cannot abide to read the word of God, but also seek by all means possible to overthrow the same.*

*Of the five Universals or Predicables.*

As the Child beginneth with his Cross Row, and the Scholar with his 8 parts of Speech, so the *Logician* first and foremost professeth to know *words*, none of which but are comprehended under one of these *Predicables* or common Words. And to this end were they made, that every thing might be known in his kind, for when you go about expounding any matter, first you ought to begin with the Definition, thereby to know the nature of the thing; which cannot be done except the *Predicables* be first learned, for they shew the limits of words, how far they do extend, and how much they comprehend in them, The *Predicables* are, *Genus*, *Species*, *Differentia*, *Proprium* and *Accidens*.

*Genus*

*Genus* is a General word under which divers kinds or sorts of things are comprehended, as under a *Living Creature* are comprehended *Men* and *Beasts*; under *Art*, *Logick*, *Grammar*, *Rhetorick*, &c. *Lapis* a Stone comprehends in it self a *Sapphire*, a *Ruby*, a *Chrystal*, a *Turcois*, a *Carbuncle*, &c. Every General word is considered two ways; The chief General, in Latine *Genus Summum* and the middle General, in Latine *Genus intermedium*. The chief General as being supreme, can never become inferiour, so the Substance, the Quality, the Quantity are ever chief General words, and cannot be comprehended under any other. The middle General or Genus Subaltern intervenes betwixt the highest Genus, and the lowest *Species*, as a Body, a Living Creature, a Precious Stone, the which three being compared with their Inferiours, are General words; being referred to their Superiours they are *Species*, that is to say shapes, kinds or sorts of things.

*Species* is a common word that is spoken of many which differ only in Number, as Man is spoken of *Socrates*, *Plato*, and of every proper Name belonging to a Man. Every *Species* is of two sorts;

forts ; The *lowest* or *most Special*, which is always spoken of every proper name, and ever is the kind, nor can it at any time be the General word, altho' it sometimes goes by that Name. The other is *Species intermedia*, that is, the kind placed between the highest and the lowest, which at divers times, and by divers considerations, may be both the general word and the kind, for that which is under the general word, that same may be called *Species* or kind, that which comprehendeth other may be called the General word. A Noun proper is that whereof a kind is rehearsed ; as, *Cato est homo*, *Cato* is a Man. In this Proposition *Cato* is the Noun proper, which belongeth to one Man only, and *Man* is the kind, which is more large, and comprehendeth all Men.

A Table shewing the order of every substance and kind as they are appointed by Nature may be seen in my Gentlemans Treasury.

*Difference* is an Universal which may be variously considered, 1. For as much as it is the constituent of *Species*, and then it may be Defined to be that whereby the Species doth exceed, or is more

more worthy than the Genus, as Man exceeds an Animal or Sensitive Creature by Rationality. 2. As it is something *Pradicable*, and so it is commonly defined to be an Universal, which is predicated of many different in *Specie* in the Question *Quale quid*, or of what kind of Essence a thing is, and this Definition agrees only to the intermediate difference. 3. In as much as it divides the Genus into differing Species; thus *Rational* and *Irrational* divide Animal, and Constitute two Species, *viz. Man* and *Beast*. 4. As it is an Essential part of the whole Compound, and so it makes a part of its Essence and belongs to its Definition: Wherein it differs from a Property and Accident, as being an actual part of the things to which it is attributed.

*Property* is taken in a fourfold Sence.  
 1. That which agrees alone to the Species, but not to all the Species, that is to all the Dividuals resorting under it; as to Cure by Art is attributable to Man alone, but not to all his individuals. 2. That which agrees to the whole Species, but not to it alone; as, It agrees to Man to walk on two Feet; for the same may also be said of other  
 Animals;

Animals, and yet not. of all. 3. That which is attributable only, and to the whole Species, yet not always but only at a certain time; as, Grey Hairs to a Man waxing old. 4. That which is attributable only, and to the whole Species, and at all times, as it is the Property only of a Circle, of every Circle, and at all times, that all the Lines drawn from the Circumference to the Center, are equal. And this last sort of Property is that which constitutes the Fourth Universal, the other three Modes being rather referrable to Accidents, because they do not agree necessarily, nor always, nor to the whole Species, but contingently, sometimes and in part only.

*Accidens* is that which is not part of a Substance, nor doth stand by it self, but is understood that it may be, and not be in the Substance; that is, may be away, and may be there sometimes more and sometimes less; as, *Mirth*, *Sorrow*, &c. in a Man; the Substance yet undestroyed, as a Man may be alive in whom these passions have been, but are not now. And altho no Substance doth altogether forsake, yet it doth often alter its Accidents, forsaking some  
E and

and taking other; as, Water being placed on the Fire, alters its Coldness, and becometh hot, whereby we Judge that coldness in the Water is not a Substance, but an Accident. *Accident* is two ways considered: *Separable*, as Frigidity may be taken from Water. *Inseparable*, as Stature or breadth cannot be taken from Man, nor heat from Fire, yet notwithstanding the heat of Fire is not separate from the Substance, yet the quantity or greatness is changeable, and seeing heat in other things may be separated from the Subject, we judge Heat is another thing than the very Substance of Fire.

### *The Ten Predicaments.*

A *Predicament* is nothing else in English but a shewing or rehearsing what words may be truly joyned together, or else a setting forth of the Nature of every thing, and also shewing what may be truly spoken, and what not. The advantage of these *Predicaments* are great, 1. whereas they are divided into *Substance* and *Accident*, we thereby know the Substance from the thing, which

which is Accidental. 2. Of these general words ariseth this good, that if you will define any thing or shew the nature thereof, you may know where the word resteth, which would express the nature of another. 3. If a man bestow a little diligence herein, minding where every word is setled, and knowing to which of all these most general words he may best refer it, he shall truly and soon know the Nature of all things. And this difference is between the five common words called *Predicables*, and these most general words called *Predicaments*; that the *Predicables* set forth the largeness of words, the *Predicaments* do name the very nature of things declaring substantially and really what they are. And since the cause of Controversy may be the not well understanding, or else the using of words which have a double meaning, all words ought to be considered according to their Natures, and those only received and used for to maintain the Truth, whose name and nature is all one, and can be taken but in one sort, as *Homo* signifies no other thing but a Man; but if any word be used that is ambiguous or hath a double



meaning, restrain the largeness of it, and declare how you will have it taken, by which means the Fraud shall be soon avoided. Of words of many significations take this Example.

A <i>Crown</i>	} Signifies the Kings Crown, Crown of the Head, 5 s. in Money.
A <i>Noble</i>	
<i>Time</i>	
<i>Sage</i>	
	} Signifies a Peer of the Realm, a piece of Money.
	} Signifies the space of an Hour, Day, Year; and an Herb.
	} Signifies a Wiseman, also an Herb.

The Predicaments are in Number Ten, *viz.* 1. *Substantia*, 2. *Quantitas*, 3. *Qualitas*, 4. *Relativa*, 5. *Actio*, 6. *Passio*, 7. *Quando*, 8. *Ubi*, 9. *Situs*, and 10. *Habitus*.

*Substance* or *Being* which *Cicero* calleth *Nature*, is a thing that subsists by it self, which Thing, Entity or Substance (for they are *Synonymous*) hath an Essence, and Existence distinct from all other things and containeth Accidents which happen thereunto. *Substance* is twofold Created or Increated. Of *Created Beings* some are Intellectual, others

others Corporeal. An *Intellectual Being* is a thinking Substance as the mind of Man ; A *Corporeal* is a Substance extended in length, breadth and depth. *In-created* is a Substance independant of all other things whatsoever ; as, God.

*Quantity* is the greatness of a thing, or the Number, and is two ways considered, 1. *Continua quantitas* that is when the Question is asked how great or how broad any thing is, the use whereof is seen in *Geometry*. 2. *Discreta quantitas* when the Question is asked how many things there be and being occupied in Numbring the use is perceived in *Arithmetick*.

*Quality* is a form or shape of the Body, or Mind whereof some Name is derived as of *Wisdom* Men are called *Wise*. There be three manner of Qualities whereof the first doth contain the Habit, otherwise called the perfect having of any thing, as he that often speaketh *French* shall by continuance obtain perfection, he that writeth much shall have a ready hand, and this is called *Habitus*. The second is a forwardness in any thing gotten by Labour and Travel not given by Natures Bounty.

ty. The third is the full attaining of any thing as to be fully Learned and this last is two ways considered, of the Body and of the mind, Perfection gotten by help of the Body, is when a Man can Leap, Wrestle, &c. better than any other: of the Mind when a Man is vastly increased in Knowledge.

*Relatives* are those, which are comprehended with other, and have mutual respect one to another. All the *Predicaments* before are known without being compared with another thing, but *Relatives* cannot be well understood without Comparison. As when I say *Father*, I cannot understand him so without he hath a Son, nor a Man a *Schoolmaster* without he hath *Scholars*. There is no word but we may consider the same to be a *Relative*, if we refer it to some other thing, and therefore we may go throughout all the *Predicaments* with this one place, and find relation of every one of them; but there are *Relatives* (improperly so called) which are known, and have their being, even when they stand alone, and yet considered with other they have divers respects; as, *Love* is the Love of the thing Loved, or *Love* beholdeth the thing Loved.

**Loved.** *Blome* saith, If we consider a Father and Son Materially without their Relation we shall call them *Subject*, but if we consider them with respect to one another, we shall call the one the *Relate*, and the other the *Correlate*; because as the Father is related to the Son by Paternity or Fatherhood, so is the Son to the Father by *Filiation* or Sonship, upon which account it is that *Relatives* are said to be or exist naturally both together, because you cannot suppose the one without supposing the other. For supposing a *Husband* you must suppose a *Wife* too, and supposing a *Master* he must have a *Servant*.

*A Table of Relatives.*

Relatives are com- pared one with ano- ther	By Nature.	}	As by the Cause and the Effect the Father and the Son are considered.
	By some manner or way used.	}	The Magistrate and the Mace, the King and his Sword car- ried before him are compar- ed together.
	By Degrees in calling.	}	The Lord and his Servant, the Advocate and his Client.
	By Kindred	}	The Brother and Sister.
	By Marriage.	}	The Son in Law, the Mother in Law.
	By Covenant	}	The Grantor of a Lease and the Tenant.
	By accidental happening.	}	A Poet to be a Lyer, A Phy- sician to be a Man-killer, or a Lawyer to be a Thief.
	By Natural kind.	}	A Man, a Woman.
	By years.	}	A Young Man and old Man.
	By Condition of Life.	}	A Poor Man, a Rich Man, a Free Man, a Bond Man.

*Action* is either Natural or Voluntary. That is called *Natural* which is done by the force of Nature as to beget, bring forth, to encrease, or Decrease. That *Voluntary* when a thing is done freely: as to teach, to read, to write, &c.

*Passio. Perpassio* called in English a suffering, is the effect of the Action, and to make it plain is a Verb Passive, and the same which the Grammarians use; as to be taught, to be encreased, &c.

*Ubi* is an Order or *Predicament*, which comprehendeth the Description of Places, wherein some thing is supposed or reported to be, has been, or will be done. As at *London, Cambridge, at home, in a Chamber above, beneath, on the right hand, &c.* and whatsoever is answered to this Question, when I ask where any thing is, or where any thing is done. This place serveth for Conjectures either in praising or dispraising.

*Quando*, This *Predicament* *When* containeth the difference, and diversity of times; as, *nunc* now, *heri* yesterday, *noctu* in the night time; this place also giveth light to confirm causes. As to  
prove

prove that one is painful, I may say such a one studies Day and Night, therefore he is a painful Man.

*Situm esse* is then considered, when a Mans Body is in any wise placed, as to lie aside, to stand upright, to sit, to lean, to lie groveling, &c.

*Habitus* : Some call this Predicament, *Habitus integumentum*, that is a Covering or Appareling of any Body, as to have a Coat, wear a Gown, Harness, Shirt of Mail, Coat Armour. Also to wear Chains of Gold, Bracelets, Rings, &c. Thirdly to possess Gold, Silver, Land, Wife and Children, or to contain any thing as a Barn, Corn, &c.

*The use* and Commoditys of these *Predicaments*, is to teach you to define any word, and know the nature of the same. As for Example, if you will know what a *Man* is, you must have Recourse to the place of *Substantia*, and there you shall learn that *Man* is a Living Creature, endued with Reason. If you would know what *Virtue* is, go to the place *Qualitas* where you shall see that *Virtue* is the constant Habit of a mind to good. If you would define the nature of a *Father* seek for *Relativa*,  
and

and there you may learn that he is a *Father* that hath a *Son*, &c.

There is nothing more necessary in the whole Art of Logick, than to learn diligently the Definition, and division of every matter. A *Definition* is two-fold, of a *Word*, or of a *Substance*. A *Division* of a word, is when any word that signifying divers things, is divided into every several signification it hath; as, *Canis* into a Dog, a Fish of the Sea, and a Star in the Heavens. A *Division* of a thing is three ways considered, as 1. When the general is divided into the kind, as *Element* into Fire, Air, Earth and Water. 2. When the whole is divided into parts, as the *Body* into the Head, Arms, Hands, Belly, &c. a *Man* into Body and Soul, and this kind of dividing is properly called a *Partition*. 3. When the Substance is divided into *Accidents*, as of *Men*, some are free, some bond men.

There is another manner of dividing as, 1. Of *Accidents* into their *Substances*; thus, of good things some are of the Body, some of Fortune, &c. 2. When *Accidents* are divided into *Accidents*, as of good things, some are Honest, some Profitable, some Pleasant. And there



there is an ancient Maxim worth remembrance. *Qui bene distinguit, bene docet.* He that doth divide well doth teach well.

We call that a *Whole* which consists of many things joyned together or which hath parts into which it may be divided. That is called a *Part* which together with its *Copart* or with many of them, doth constitute a whole. The word *Cause* is sufficiently known to all, but the Division of Causes is thus. The *Material Cause* is that out of which things are made or formed. The *Formal* is that which constitutes another thing, and distinguisheth it from all other as the Soul is the form of Man. The *Efficient* or *Effecting Cause* is that which produceth another thing; and the same is Manyfold. *Total* or *Adequate* which alone does produce the Effect excluding other Causes of the same rank: as God Creating *Adam* whom he produced without the Concourse of any other. But a Father and Mother, or Male and Female are said to be *Partial Causes* with respect to the Child they Generate. The Sun is the *Proper Cause* of Light, but only an *Accidental Cause* of the Death of a Man killed

killed by too great heat. A Father is the *Near Cause* of his Son, but a Grandfather the *Remote*. A Mother is the *Effective* or *Productive Cause* of her Son. A Nurse is only the *Conserving Cause*. A Father is an *Univocal Cause* with respect to his Children because they are of the same Nature with him. But God is only an *Equivocal Cause* with respect to his Creatures; because they are of a different Nature from his, and in Dignity inferiour to him. An Artificer is called the *Principal Cause* of his Work because he Acts voluntarily; and his Instruments only *Instrumental Causes* because managed by him. Water that springs up into divers water-works in the Gardens of Princes, and which moves variety of Machines is the *Universal Cause* of their Motion; but the Artificial disposition and figure of the Pipes is the *Particular Cause*. Bodily things when they Act, are said to be *Natural Causes*, because they produce an Effect from a Natural Propensity or Necessity: But Man is the *Intellectual Cause* of those things which he Effects by his Understanding and Will. A Man that walketh is a *Free Cause* because he Acts spontaneously

ously and not by force : But a Fire burning wood is a *Necessary Cause* because where those things are present which are required to its Action, as dry wood, application of them to the Fire, and Ventilation or Blowing, it cannot but burn them, neither can it exert any other Action instead of it. The Sun whilst it enlightens a Chamber is the proper cause of the Light that is in it, but the opening of a Window, or taking down of the Shutters, is only a Cause *Sine qua non*, or without which such an effect would not follow ; which Cause is also called the *Condition* without which a thing cannot be. A Fire that burns Houses is the *Physical Cause* of that Burning or Consuming, because the Fire properly and of its own Nature burns. But a Man who sets Houses on Fire, or exhorts or commands others to do so, is only a *Moral Cause* of this Burning, because he hath only Morally contributed to that effect, *viz.* by Exhorting or Commanding. Thus the Serpent or the Devil was the Moral Cause of the Fall of our first Parents. The form which a Man proposeth to himself in going about to make a work is called the

the *Exemplary Cause*. The *Final Cause* is the end for which any thing is. Notwithstanding all these Causes, the Logicians reckon but 5 Genera or kinds of Causes, *viz.* The Material, The Formal, The Efficient, The Exemplary and the Final.

That is called a *Subject* to which something is adjoyned, or to which something accrues, besides its Essence. So Cloaths are put on the Body; the Soul of Man is joyned to his Body; Writing is applied to Paper; A Subject is sometimes taken for an Object, as when we say, to Subject a thing to the Eyes of any one.

That is called an *Adjunct* which is considered to be in a thing besides its Essence, as something added, accrued or happening to it, whether the same bring along with it some proper Reality, as Fire in the Pores of hot Iron. A *Concrete Adjunct* denotes the accidental form together with the Subject, as White, Learned, Great, &c. An *Abstract Adjunct* is that which signifies only the Accidental or Modal form; as Whiteness, Learning, Greatness, wherefore an *Adjunct* is predicated of its Subject in the Concrete,  
Snow

Snow is White, *Socrates* is Learned, Great: But by no means in the Abstract, as *Socrates* is Whiteness; Learning, Greatness.

In the handling of any single Question, the Question should be eight ways examined; 1. Whether the thing be or no, as *Is there any Law?* 2. What a thing is, and this cometh from the Definition which is twofold: either of the Substance, or the name of a thing. The *Name* as a Realm is a Country ruled by a King. The *Substance*, as a Realm, is an Assembly or gathering of People together, being able to Live, and withstand Enemies. 3. Is when the parts and every several kind is considered, and for this Question the Division and Partition doth much good. 4. What are the Causes, and especially what is the Efficient and what the Final Cause. The Efficient Cause of all good Laws, is God and his Minister. The Final Cause is to live upright in the fear of God. 5. When the Effect and Office is examined as the Effect of the Law is to Conserve the State of Man, &c. 6. When things be asked that are to follow, as we see much Neighbourhood and good Will to help the  
the

the needy. 7. What are 'Disagreeing.  
8. To shew by whose Authority the Law, &c. taketh place.

A *Proposition* or *Enunciation* according to *Aristotle* is an Oration of Speech, which Affirms or Denies; or an Oration that signifies either true or false. From which Definition it appears (saith *Blome*) that to every Proposition two forms at least are required; the one of which something is affirmed or denied, which Term is called *Subject*, the other which is said or denied of another, which Term is called the *Attribute*, as when it is said God is Existing, *God* is the Subject, and *Existing* the Predicate. *Propositio Categorica* (otherwise called a *Single Proposition*) is divided into true, and false Propositions, *Propositio Hypothetica* is a double Proposition, as, If Justice be a Virtue, it is praise worthy. There are also Affirmative Propositions, Negative Propositions; and Universal, Particular or Singular Propositions,

Some *Logicians* make 4 kinds of Arguments, viz. A *perfect Argument*, An *Imperfect Argument*, An *Induction* and an *Example*. Others divide Argumentation in General only into *Perfect*, and

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Imper-

*Imperfect.* *Imperfect Argumentation* is a Syllogism, which forasmuch as it consists of three Propositions duly disposed is of a perfect form and most proper to persuade. An *Imperfect Argumentation* is either an *Enthymeme*, an *Induction*, an *Example*, a *Dilemma*, or a *Sorites* of which hereafter. If there be just three Propositions in the Argumentation the first is called the *Major*, because in it the Major Term is disposed with the Mean or *Medium*. The second the *Minor*. The third, *Conclusion* in which the Minor and Major Terms are disposed.

A *Syllogism* being a perfect Argument there ought to be more words in the Conclusion, than was before Rehearsed, as for Example which *Antonius* maketh in the first Book of *Tully de Oratore*.

*Unprofitable things are not to be taught,  
In Philosophy are unprofitable things,  
Ergo, Philosophy is not to be taught.*

This Argument is to be denied, because there is more in the Conclusion, than was rehearsed in the two first Propositions. Some unprofitable things which

which be in Philosophy are not to be Learned, not that Philosophy it self is to be rejected, for else this Argument would also stand good.

*Drunkennes is not to be allowed  
In Drinking is often Drunkennes,  
Therefore Drinking at all is not to be  
(allowed.*

*Syllogisms* are *Simple* or *Conjunct*, and the *Figures* are three, the *Modes* reckoned 21, but reduced to 14. The *Modes* of the first figure are *Barbara*, *Celarent*, *Darij*, *Ferio*; of the second *Cesare*, *Camestres*, *Festino*, *Baroco*; of the third, *Darapti*, *Felapton*, *Disamis*, *Datisi*, *Bocardo*, *Ferison*. Examples of all which may be seen at large among the *Logicians*, as also the difference of *Complex Syllogisms*, *Conjoyned* or *Compound Syllogisms*, and *Proportional* or *Analogical Syllogisms*.

For the better knowledge how to place an *Argument* in *Mode*, Note, that in the *Modes* there are four *Vowels* to be considered, *viz.* *A. E. I.* and *O.* *A.* signifies an universal affirming, *E.* an universal denying, *I.* a particular affirming, and *O.* a particular denying



nying Proposition according to the Common Distich, framed for to help the Memory.

*A. Affirms, E. Denys, but Generally both.  
I. Affirms, O. Denys, but Specially both.*

*An Enthymeme is an unperfect Argument consisting partly of likelyhoods, and partly of infallible reasons, as*

*Such a Young Man talks often, and alone with such a Young Maid.  
Ergo, He is in Love with her.*

This may be true and may be false, but an Infallible reason is always true, as

*Such a Woman is brought to Bed,  
Ergo, She hath had the Company of a Man: Or  
The Sun is risen,  
Ergo, It is Day.*

An *Induction* is an Argumentation which from many Singulars concludes an Universal; as,

*Athanasius lived unmarried,*  
*Ambrosius lived unmarried,*  
*Basilus had no Wife, nor many more.*  
 Ergo, *All Bishops heretofore were un-*  
*married.*

Which Conclusion Universal is not Lawful, for divers have been married in the Primitive Church, as, *Spiridion, Hermes, Hilarius, Polycrates, Tertulian, &c.*

*Socrates's Induction* was by asking many Questions, which being Granted, he thereupon brought his Confirmation; as for Example,

How many Good People were there when the World was Drowned? Not past 8.

How many good when *Sodom* was burnt? Not 6 as appears, *Gen. 18. 19. ch.*

How many in the Land of Promise, when 600000 fighting Men went out of *Egypt*, but 2.

How many bowed to an Idol in the time of *Elias*? All, but *Elias* and 7000.

How many Tribes of the *Israelites* followed God, but 2, the other 10 forsook him.

How many did the Lord count in the Land of *Syria*? But 2 *Naham*, and the Widow of *Sarepta*.

How many feared God when *Tobias* was persecuted? But one, *viz. Tobias*.

How many found Christ when upon Earth? But 12, and 1 was a Traitor.

Therefore may be concluded the Godly in all Ages are but small in Number.

An *Example* proves one thing by another, because of a likeness of Reason that is between them, as *Cæsar* subdued the People of *Rome* more by his Clemency than his Arms, from whence I gather and say, a Prince ought rather to have recourse to Clemency, than to Arms.

A *Dilemma* is a *Horned Argument*, whereby whatever you grant returns upon your self, and consists of repugnant Members, as *If you Marry, your Wife will be Beautiful or Deformed, if she hath Beauty, she will make you Jealous, if Deformed you will loath her*, therefore you ought not to Marry at all. A *Dilemma* ought to be used with Care, that it may not be retorted, which its said *Protagoras* did, to whom *Evathlus* his Disciple

Disciple having promised a certain Sum of Money in consideration of his instructing him in Logick, to be paid on that Day he should first get the better in the Cause he pleaded; and chusing that for his first Cause, to plead whether he was to pay that Sum of Money he had promised him, made use of this *Dilemma*. *Either I shall lose this Cause or win it: If I lose the Cause then according to our agreement, I am to pay you nothing; if I win it, then I shall owe you nothing by the Sentence of the Judges. Which Argument* Protagoras thus retorted. *Either you will lose the Cause or win it, if you lose it you will by Sentence be obliged to pay me; if you win it you must pay me according to our agreement.*

*Sorites* is a heaping Argument where the last rehearsed word of the first Proposition, is repeated in the first part of the second Proposition, necessarily agreeing thereto, as

*Where the Law is, there is Transgression,  
Where there is Transgression, there is  
Fear,  
Where there is Fear, there is Remorse of  
Conscience,*

*Therefore where the Law is, there is Remorse of Conscience.*

No Arguments be made Negative by this kind of Argumentation, as

{ *The Gospel is not the Law,*  
 { *The Law teacheth us the Fear of God,*  
 { *Therefore the Gospel doth not.*

{ *Fish is no Flesh,*  
 { *Flesh is Meat*  
 { *Therefore Fish is none.*

*Disputation* is when certain Persons debate a cause together, opposing each other, in which, each ought to stand close to his Argument, and by the Rules in the first part of Logick, and his Wit, and the use of the second part of Logick called *Invention*, he may so open the Truth as to give full Judgment to the content of both, but all possible care is to be taken, that there be no Errors in Words, or Phrases; &c. In the words are these following, 1. The Doubtfulness of Words. 2. The double meaning of a Sentence. 3. The joyning of words that should be parted. 4. The parting of words should be joyned

ed. 5. The manner of Speech. 6. The Accent.

For an Example of the Ambiguity of Sentences, and doubtful writing which by reason of Pointing may have a double Sence, I shall insert these following Verses taken out of an Enterlude made by *Nicholas Udall*, about 150 Years ago, desiring the Reader to excuse the English being according to that time.

*Sweet Maistress, whereas I Love you : no-  
 (thing at all  
 Regarding your Riches and Substance :  
 (chief of all  
 For your Personage, Beauty, Demeanour  
 (and Wit  
 I commend me unto you : never a whit  
 Sorry to hear report of your good Welfare,  
 For as (I hear say such your Conditions  
 (are  
 That you be worthy favour ; of no living  
 (Man  
 To be abhorred ; of every honest Man  
 To be taken for a Woman, enclined to  
 (Vice  
 Nothing at all : to Vertue giving her due  
 (Price*

*Where-*

## Logick.

Wherefore concerning Marriage, ye are  
 (thought  
 Such a fine Paragon as ne'er honest Man  
 (bought.  
 And now by these Presents I do you ad-  
 (vertise  
 That I am minded to Marry you; In no  
 (wise  
 For your Goods and Substance; I could  
 (be content  
 To take you as you are. If you would be  
 (my Wife  
 You shall be assured for the time of my  
 (Life  
 I will keep you right well: From Good  
 (Rayment and Fare  
 You shall not be kept: But in sorrow and  
 (care  
 You shall in no wise live: At your own  
 (Liberty  
 Do and say what ye list; Ye shall never  
 (please me  
 But when ye are merry: I will be all  
 (sad  
 When ye are sorry: I will be very glad  
 When you seek your hearts ease: I will be  
 (unkind  
 At no time: In me shall ye much gentle-  
 (ness find.

But

*But all things contrary to your will and*  
*(mind*  
*Shall be done otherwise: I will not be*  
*(behind*  
*To speak: and as for all them that would*  
*(do you wrong*  
*I will so help and maintain, ye shall not*  
*(live long*  
*Nor any foolish Dolt shall cumber you;*  
*(But I*  
*I (who e're say nay) will stick by you till*  
*(I dye.*  
*Thus good Maistress Cuffance the Lord*  
*(you save and keep*  
*From Roister doister whether I wake or*  
*(sleep*  
*Who favoureth you no less ye may be*  
*(bold*  
*Than this Letter purporteth which ye*  
*(have unfold.*

The Contrary Sence in the same words.

*Sweet Maistress whereas I love you no-*  
*(thing at all*  
*Regarding your Riches and Substance*  
*(chief of all.*  
*For your Personage, Beauty, Demeanour*  
*(and Wit,*  
*I commend me unto you never a Whit.*  
Sorry



Sorry to hear report of your good Wel-  
 (fare,  
 For (as I hear say) such your Conditions  
 (are,  
 That ye be worthy favour of no living  
 (Man:  
 To be abhorred of every honest Man.  
 To be taken for a Woman enclined to  
 (Vice,  
 Nothing at all to Vertue giving her due  
 (price.  
 Wherefore concerning Marriage ye are  
 (thought  
 Such a fine Paragon as never honest Man  
 (bought.  
 And now by these Presents I do you ad-  
 (vertise,  
 That I am minded to marry you in no  
 (wife.  
 For your Goods and Substance I could be  
 (content  
 To take you as you are. If you will be  
 (my Wife  
 Ye shall be assured for the time of my  
 (Life,  
 I will keep you right well from good Ray-  
 (ment and Fare,  
 Ye shall not be kept but in sorrow and  
 (care.

Ye shall in no wise live at your own  
 (Liberty,  
 Do and say what ye list ye shall never  
 (please me.  
 But when ye are merry I will be all  
 (sad,  
 When ye are sorry I will be very glad,  
 When ye seek your hearts ease I will be  
 (unkind,  
 At no time in me shall ye much gentle-  
 (ness find.  
 But all things contrary to your will and  
 (mind  
 Shall be done : Otherwise I will not be  
 (behind  
 To speak : and as for all them that would  
 (do you wrong  
 I will so help and maintain you shall not  
 (live long.  
 Nor any foolish Dolt shall cumber you  
 (but I  
 I (who e're say nay) will stick by you till  
 (I dye.  
 Thus good Maistress Custance, the Lord  
 (you save and keep  
 From me Roister doister ; Whether I wake  
 (or sleep

Who

*Who favoureth you no less, Ye may be  
(bold,  
Than this Letter purporteth which ye have  
(unfold.*

An Example of joyning words that should be parted, called *Conjunctio distrahendorum*.

*Whosoever knoweth Letters now hath learned them.*

*A Grammarian knoweth Letters :*

*Ergo. a Grammarian now hath learned them.*

In which the Adverb (*now*) should be referred to the first point, as

*Whosoever knoweth Letters now, hath learned them.*

*A Grammarian knoweth Letters now:*

*Ergo, a Grammarian hath learned them.*

An Example of parting words that should be joyned, called *Disjunctio conjunctorum*.

*The Law and the Gospel are two divers things.*

*The Word of God is the Law and the Gospel.*

*Ergo, the word of God is two divers things.*

*Secundum non causam ut causam* is a Cause that is not put for a Cause; Or is when a Cause is brought in that is not able to prove the matter, but the Ground being considered the fault is easily found; as,

*Drunkennes is Evil :*  
*Ergo, Wine is naught.*

Another Example.

*Paul warned us we should not be deceived by Philosophy :*

*Ergo, Philosophy is naught some will say.*

Wherein he only reprov'd the abuse not the use of Sciences. And there is a Rule, *A posse ad esse non est bona consequentia*, which is, because a thing may be, it shall not follow that it is.

*Plures interrogationes*, is when by many Questions you intend to deceive any one, or bring him to an inconvenience by his former granting some particular

lar things, and it is two ways considered. First when we ask of many things one, and again of one thing many things, and put forth divers Questions before we come to the purpose. An Example of the first, *Is Water and Wine hot or no?* This Question is asked so that he must answer to them both, which he cannot do at one time, but taking this distinctly it is easily answered. An Example of the second take in this following Story. A Gentleman promised a Lawyer (for his pleading a Suit of his) a Horse, which when the Lawyer claimed, the Gentleman denyed the Debt and Argued thus. *All Horses are not of one Colour, but different, some black, some white, some Bay, some Dapple, if I owe you any by Promise, I owe you none of one Colour more than another, and as I promised you no more of one Colour than another, I may be discharged as well in delivering a Horse of one as another Colour. Therefore I owe you Horses of all Colours, or else I owe you none at all: but I do not owe you Horses of all Colours (considering I promised you but one) therefore I owe you none.*

*Repetitio principii*, The Cuckoes Song is repeating of that wholly in the Conclusion which before was only spoken in the first proposition; or else by things doubtful to prove things that are as doubtful, as

*Every Slanderer must be Banished the Court.*

*Such a Man is a Slanderer :*

*Ergo, every Slanderer must be Banished the Court.*

The Conclusion is not well gathered for it should not be Universal but particular.

*Ignoratio elenchi* (that is the mistaking of contradictory Propositions) is a deceitful Argument. The reason of which Error ariseth from not knowing what is Contradiction: Contradiction therefore is a Repugnancy of one and the same, not Substance only, nor yet Name only, but of the Substance and Name together. This Deceit is used when Contradiction is made, according to divers Respects; as thus,

{ *The Law is to be followed in Moral Pre-*  
*cepts, and not in Ceremonials, nor yet*  
*always in Judicials neither.*  
 } *Ergo, The Law is to be followed, and*  
*not to be followed.*

Another Example.

{ *To work upon the Sabbath is forbidden,*  
*and yet not to work upon other Days*  
*is also forbidden :*  
 } *Ergo, to work and not to work, are*  
*both forbidden.*

It is easy to avoid these Deceits. Therefore is there this Rule in Logick, *That two Contradictions can never be both either true or false at one and the same time.*

*Crocodilites* is such a kind of subtlety that when we have granted a thing to our Adversary, being asked before what he will say, the same is by Argument converted to our harm.

*Antistrephon* is in the Nature of a Dilemma, and may be understood the same.

*Cacosystata* are such Arguments that being proponed between two Persons, they serve as well for the one as the other, as *You must forgive him because he is but a Child, No marry therefore will I beat him, because he is but a Child.*

*Asystata* are such Arguments as are impossible to be true, as A Child two years old accused of Adultery.

*Pseudomenos* is a lying Argument, for whatsoever is said, must be amiss, as *Epimenides* a *Cretan* said, the People of *Crete* were *Lyers*, if they were so, then *Epimenides* lyed, and his saying was not true, if they were not lyers, then *Epimenides* said truth, because he himself was a Man born in *Crete*.

*Note*, No Man ought to argue on things which to doubt deserves Punishment, as to reason whether there be a God or no. Secondly it is ridiculous to reason of those things which our Senses judge to be true, as whether Fire is hot. Thirdly it is evil to reason of unnecessary things, and which cannot be known or resolved, as what God the Father is in Person, what hour he put *Adam* into Paradise, &c. Fourthly it is needless to dispute of things undoubt-



edly true ; as in Arithmetick three and three make six.

*Blome* in his Institution of Philosophy saith, there are many things he cannot approve of in the Constitution of the *Predicaments* in *Logick*, First he saith the Logicians divide *Ens* into Substance and Accident without any reason, for as much as an Accident is no Entity. Secondly in that they constitute Nine supream *Genera* of Accidents, *viz.* *Quantity*, *Quality*, *Action*, *Passion*, *Relation*, *When*, *Where*, *Situation* and *Habit*. Where first (saith he) they mistake in this, that they make those to be the supream *Genera*, and distinct too, which truly are not so, as *Quantity* and *Quality*: For the greatest part of Physical or Natural Qualities arise from *Quantity*, *Figure* and *Motion*. Secondly *Relation* doth not in the least belong to the Genealogy of things, because it is no absolute thing, but only an affection framed by reason, *viz.* an opposition with or under some respect. Thirdly *Action* and *Passion* in Bodies are reducible to *Motion*, whose Species or Modes they are. Fourthly the division of *Ens* into Substance and Accident invented  
by

by *Aristotles*, deviates from the Rules of a good Division, because the parts of it are not opposite. Fifthly if any attributes be found amongst them, the same may be more fitly deduced from other Genealogy; as for Example, *Quantity* belongs to the first Mode of an Extended Being. *Quality*, if it be mental to the Modes of Intellection and Volition if it be Physical or Corporeal, to the fifth Mode of an extended Being, or to others. *When* and *Where* to Duration and Place, which are the general attributes of things. *Situation* is the Mode of an extended thing, or the respect of one Body to others, considered as near to it. And *Habit* is the Common Adjunct or Accident of some things, as of a Human Body or some other. See *Blome, Part I. Ch. 8.*

*Cornelius Agrippa* in his *Vanity of Arts and Sciences*, saith, *Logicians* promise to find out the Essential difference of every thing, but cannot render themselves Masters of their word, in making things so clear, but that they may be asked why they cannot as well call a Man, a Man, as *Animal Rational*, or a *Mortal*

*Rational Creature*, more of which may be found in *Boetius*, whose works are not esteemed, but yet are beyond all the *Predicaments*, *Topicks*, *Analyticks*, and other Trifles of *Aristotle*, whom the *Peripateticks* following, believe nothing can stand or be known unless by his Syllogisms, who never observed in all his Maxims, how all his Arguments are deduced from suppositions or things granted before. It is a certain experiment of the truth of Speech, as *Averroes* saith, when the words agree with the things thought: And that is most known to the Knowledge of which most Senses concur. Where is the Fruit of this Scientifical Demonstration (saith *Agrippa*) which when we are forced to consent to, will be things rather perfectly known than Demonstrated. By help of their Ten Predicaments which they call most *General Genus's* they hope to comprehend and understand all things. To which adding five *Predicables* so called, because they are Predicated of themselves, and of their parts. And assigning four Causes of every thing, They Com-  
pound

pound every Syllogism or Demonstration, of three Terms. The first is the Subject of the Question and is called the *Major* ; the second is the Predicate of the Question and is called the *Minor* ; the third is middle participating of both. With these Terms they form two Propositions which they call the *Premises*, out of which at length springs the Conclusions. This is that Egregious Engine and these are Terms, and parts thereof by which they undertake to joyn, divide, and conclude all things by help of certain Axioms which they deem impossible to be refuted. These things are the deep and profound Mysteries of Artificial Logick, invented with so much care by these Fallacious Doctors, and are not to be exposed, or learnt by any. but those who are able to be at great Expences, and give great Rewards to purchase Authority among the Schoolmen. See the Vanity of Arts and Sciences in *Logick*, 41. 42.

*Feltham* in his Resolves, saith nothing hath spoiled Truth more than the Invention of *Logick*. 'Tis reason

drawn into too fine a thread, tying up Truth in a Twist of Words, which being hard to unloose carry her away as a Prisoner; That it is a Net to entangle her, or an Art Instructing you how to tell a reasonable lye. When *Diogenes* heard *Zeno* with subtle Arguments, proving that there was no Motion, he suddenly starts up and walks. *Zeno* asking him the cause, *Diogenes* answered, I but confute your Reasons. The same *Diogenes* having once heard *Plato* to Define a Man, to be a living Creature having two Feet, and without Feathers. The Definition not being plain and open, took thereby an opportunity when *Plato* was earnestly teaching his Scholars, to clap into the School a Cock with all his Feathers plucked off, Crying, *Lo! Behold Plato's Man.* Truth in Logical Arguments is like a Prince in a Masque, where are so many other presented in the same Attire that we know not which is he, and as we know there is but one Prince, so we know there is but one Truth, yet by reason of the Masque, Judgment is distracted and Deceived. Nature  
her

her self makes every Man a Logician: they that brought in the Art, have presented us with one that hath over acted her, and something strained her beyond her genuine plainness. See *Feltham's Resolves*, Page 172. 173.

**R H E-**



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# R H E T O R I C K .

**R** *Hetorica* in Greek  $\rho\eta\tau\omicron\rho\iota\kappa\acute{\alpha}$ , à péw i. *flao, acsi áicas, affluenter loquor*, or the Art of Eloquence, being a Collection of Precepts from whence proceed the flourishing varnishes of fine Language, and the perswasive power of Oratory, of such force as to allay or incite the affections of Men, and Charm even Truth it self asleep ; So *Demo- sthenes* used to boast among his Friends, That he could sway the opinion of the Judges by vertue of his Eloquence, which way soever his will and pleasure inclined him, and for that reason, *Cicero* was at *Rome* called King because he rul'd the Senate wholly by his Orations, and wrought their minds to his purposes just as he would himself,

it



it being a Magick to the Mind, subduing even Tyrants in their Anger, and gaining Conquest over our firmest resolutions, according to that of the Poet.

*Thou mayst give Smiles, or Tears  
which joys will blot;  
Or Wrath to Judges, which themselves  
have not.*

A good Orator should pierce the Ear, allure the Eye, and invade the mind of his hearer. But before I proceed to the parts of Rhetorick it will not be amiss to let you know that

All *Discourses* are either of Persons, Things, or Facts. In *Persons* are considerable their Descent, Nation, Country, Sex, Age, Fortune, Manners, Education, Relations of Father, Brother, &c. In *Things*, (that is Substances and Qualities) the *An sit, Quid sit, Quale, Quotuplex*, &c. its Genus, Species, Properties, &c. In *Facts* the Cause, Place, Instrument, &c. In Gross for all Subjects, Proofs are derived from Persons, Causes, Times, Places, Antecedents, Consequents, Efficients, Effects, Events, Conjugates, Similies,  
Con-

Contraries, Comparifon, with Things Greater, Leffer, Equal, from Correlates, Examples, Suppofitions, and Reducti-  
on, *ad absurdum* (as is ufed in the Mathematicks) to a confequence that all grant to be falfe; from their Genus, Definition, Divifion, &c. The Natural parts of a Difcourfe are, 1. An Exordium or Preface. 2. Declaring and proving the Pofitions. 3. Refuting the contrary. 4. A fhort Recapitulation and Conclufion, called *Peroratio*.

### *The Parts of Rhetorick.*

*Rhetorick* may be divided into two chief parts, *viz.* *Elocution* and *Pronunciation*, for Invention, Style, Words, Ornaments of Speech, Figures, &c. are but parts dependant thereon, and ferve but to refine and model the Difcourfe.

*Elocution* is a proper and good utterance, or an Elegant order of words and Sentences, for the true attaining of which we are to take great notice of

The

The ornaments of Speech called *Figures*, necessary for the adorning Oration, and *Modes* of lively and more passionate expression, as well for the setting out any matter more spaciously, as to render the Theme more vivand and plausible, and with a grave and due decorum of words to incline, soften or persuade. Such are,

1. *Epithets* very useful, especially in Descriptions and Metaphors, without which Speech seems naked, and with too much is burthened, causing harsh superfluity of like Terminations, occurring soon in the Latine Tongue, but not in the English, who have a more dexterous decomposition of two or three words together, as [*Heaven-blest—Sea-thron'd—Thetis—God-like-goodness*].

2. *Metaphors* (used chiefly in descriptions) are Similitudes of words, whereby we endeavour to paint a thing to the Auditors sense with more Illustration and significancy than the bare word it self seems to have, as Man is called *Microcosmos* or the Little World.

3. *An Allegory* is a long prosecuted Metaphor. As [*The Common Law would punish Treason in the very heart, if the Eye of Inquisition could extend so far*]

By

By some an Allegory is accounted a dark Speech, or a Sentence with a double understanding.

4. *Similitudes* are various, for Poetical Fictions, Apologues or Fables, &c. are called Similies. But a true Similie bears some affinity with a thing expressed. As [*Vessels never give so great a sound as when they are empty*] which may be applied to a Man who makes large Flourishes upon little matter. *Dis-similitudes* or Comparisons with, and Illustrations by contraries are thus [*each place handsome without curiosity, and homely without loathsomeness*].

5. *Amplification* is an enlarging and may be done many ways, especially,  
 1. By repetition. 2. By multiplication of the expression, whereby you form the thing in divers shapes, which is an excellence in Rhetorism. 3. By enumeration of parts, *i. e.* of all particular Circumstances, Antecedents, Consequents, Adjuncts, Causes, Effects, Matter, Form, Time, Place, &c. Under this some comprehend *Ethopæas* and the decyphering and character of Manners, Passions, Moral habits, &c. as well as of any other works of Nature. As [*of a Fountain, an Earthquake*] interpretation

tion or Comment, by way of Parenthesis, is very common in this part of Amplification. 4. By *Atiologies* or giving reasons for what is said. And *Note* the Rhetorician, or Orator discourseth and argueth as the Logician by Syllogisms or Enthymems, Inductions and Examples only in a little different manner. Proving the Premises (where weak) as he lays them down, before he infers his Conclusion from them, and if the discourse be long, making a repetition of the Premises. As in that instance in *Cic. de Inventione.* 1. To prove the World governed by Providence he shews first. That the best governed things are ruled so, then proves this in a House, a Ship, or an Army; far better managed where there is advice, &c. Then next shews that the Heavens, Earth, &c. are as wisely and regularly ordered as any of these, proving this again from the constant course of the Stars, &c. and thus descends at last to his *Thesis* or Conclusion.

6. *Metonymie* is a Transnominatio or using one name for another, as [*This Ring is Right Alphonso, for, of Alphonso's making.*]

7. *Synecdoche* is when a part is understood by the whole ; or the whole by the part, the General for the Special, *è contra*. As for the first let this example suffice [*I am censured by many Tongues, for many Men.*] Contrariwise for the second [*The World is all Censure, for many Men use Censure*].

8. *Catacreſis*, is when a word is abusively put for another. The Poet by this Figure takes the liberty of inventing words often, tho sometimes foreign to the matter.

9. *Epizuxes*, is the doubling of any word, or words, by repetition, without the interposition of another, and is seldom or never used but in Passion, as [*O mercy, Mercy I Crave, &c.*]

10. *Anadiplosis*, is also a repetition bearing this difference from the other, that this is at the end of a former Sentence; and beginning of that that follows.

11. *Sorites*, is an imperfect Syllogism, where after many propositions, the first Subject and last Prædicate are joyned, which may be with an *Ergo*, as [*Ergo you cannot hope to win that Woman which ever avoideth men.*] And in this Figure the last word or some one word

in the last Sentence doth often beget the next Clause.

12. *Anaphora* is when in the beginning of every Sentence the same word is repeated, as [*Thou that did, &c. Thou that hast, &c. Thou that refusedst, &c.*]

13. *Epistrophe* is when many Clauses conclude with the same word, as [*Thou whose Aim is at Riches, whose slavery is for Riches, that thinkst all happiness consists in Riches, &c.*]

14. *Epanadiplosis* is when a Sentence beginneth and endeth both in a word.

15. *Epanalepsis* is a Repetition after a long Parenthesis.

16. *Epanados* is when two things rehearsed together are spoken of afterwards severally, and *Epanaphora* is the same with *Anaphora* before.

17. *Antimetabole* or *Commutatio* is a Sentence inverted or turn'd back, as [*You are the Son of a good Father, and may be the Father of a good Son.*]

18. *Paranomasia* is a running upon one Letter very much that begins words; as [*O Tite Tute Tati tibi tanta Tyrannulisti,*] and [*Rhimes running in ratling rows.*]

19. *Agnomination* of Syllables is to be understood by this Example [*A Man as good at Fasting as Feasting, and hath a Wife loves to have comfort as well at Bed as Board.*]

20. *Proleptoton* or *Traductio*, is a Repetition of words of the same lineage, that differ only in Termination, as [*Exceedingly, Exceeding,*] and the like in other Cases with difference of a word; as, for *Love, concealed his Love, &c.*

21. *Comparisons* are of things contrary, or equal, or things different, which need not be here explained, being easily understood.

22. *Hyperbole* is a Figure sometimes expressing a thing *Superlatively* beyond the Truth, that in Descending you may find the Truth. Sometimes in flat Impossibilities that you may rather conceive the unspeakableness than the untruth of the Relation; so saith Mr. *Blount* who giveth this Example of the latter [*Though a thousand Deaths followed it, and every Death were followed with as many Dishonours; the World sooner wanted occasions, than he Valour to go thro' them.*]

23. *Paralepsis* is when you say you let pass that which notwithstanding you touch as full.



24. *Afyndeton* is when many words are joynd together without a Conjunction, as [*Veni, vidi, vici, pro Veni & vidi & vici.*]

25. *Zeugma* is where many Clauses are joynd with one Verb.

26. *Prosopopæia* is where you suppose or feign the Dead to speak, as [*Were your Father alive, and saw you commit so, &c. would he not say thus ———.*]

27. *Apostrophe* is when we convert our Speech from the Judge or Persons to whom we speak, to some that are Absent, or sometimes present, as to People or Witnesses, Interrogating and Intreating 'em, as [*Did you mark his looks? Did you note his behaviour?*] Intreating, as [*Let me request any present to imagine himself in my Case, &c.*]

For many Examples of these Figures and others much more easier to be understood, as *Interrogation, Exclamation, Acclamation, Diminution*, of Sentences, &c. I refer you to those Books which treat thereof at large.

*Words* ought to be chose that are most Polite, for any Oration or Discourse. So *Mirror* runs sweeter than *Looking-glass*, and words least common, for their rarity are more observed (tho' some-

sometimes sooner forgotten) those derived from the Latine merit preference of any of the Saxon-English. So *Inter-vene* sounds better than *come between*, and the like of many other Latin Compounds, yet some English Prepositions may be prefixed at pleasure, *Seneca's* opinion is, *Fit words are better than fine ones.*

Too many Consonants or Vowels coming together are to be avoided, as causing an ungrateful Sound, and words of extraordinary length, as well as Monosyllables (where Polysyllables may be had) are to be rejected, the first making the Language dull and slow, the other by reason of their many Consonants abrupt and hardly fluent.

*Tautology* or the often Repetition of one word, is by no means to be used for surely the Oration is most powerful where the Tongue is diffusive and speaks in a Native Decency even in every Limb. So also

*Circumlocution* or many words are to be avoided where fewer will serve, and be as expressive, for long compassed Language unless very judiciously made will rather pain than please the hearer.

*Omoptota's* and words of like Termination being a sound next to Tautologies are to be severed to a certain distance, and where they cannot, to be omitted, for as divided they make in the Sentence a sweet and grateful Rhime, so concurring they have a harsh and jarring Accent.

The weightiest words should be placed in the beginnings and ends, because they make deepest Impression, there being some stay still before the one and after the other. Therefore 'tis usual to commence with *Things* rather than *Persons*, with the Accusative rather than the Nominative which also may have more reference to what next precedes. And to conclude with that, without which the Sence is not perfect (to keep the Auditor in an Attentive suspence until all is said) and upon which the rest chiefly depend.

Transposition of Words, are more incident to the Learned Tongues, yet the Modern are not wholly destitute, tho seldom used, and then rather by Chance than Design.

A Multisyllable better answers a Monosyllable precedent, than a Monosyllable  
lable

able a Multifyllable, yet Monofyllables correspond better to Monofyllables, as the words *Fear* and *Love* correspond better than *Fear* and *Affection*, and words of like Cadence better than of a different, as the words *Experience* and *Science* correspond better than *Experience* and *Knowledge*.

Synonymous words are words having signification alike, as [*Ensis, Mucro, Gladius*, a Sword.]

*Style* ought to be varied according as it is prepared for the Ear, or for the Eye; for an Auditor or for a Reader. An open and free *Style* is necessary in speaking, a stricter in Writing but in the latter must be used great Caution and Decency according to the matter you handle or Man you write to, for the same Schemes become not a *History* and *Panegyrick*, a *Letter* and an *Oration*, a *Controversy* and *Moral Discourse*, a *Poem* and a *Fable*; in some must be used lofty Metaphors, frequent Interrogations, &c. while others must have more serious Language, some must be Heroical, others Submissive, some Smart, others Grave, some Jocund, others sober. All of these having their Graces and Defects, some suiting with Rea-

sons, others with the Passions best: One being sweet, another powerful; some more Learned, but others more Natural and unaffected. In all which you should addict your self rather to that Stile to which your Natural Abilities incline you, and endeavour a sufficient perspicuity therein.

In all Compositions after the last hand added to the Style, yet ought there to be an audible recitation to try whether the words be well placed, and the Numbers well fitted, and to sound them distinctly, and as you would do before an Audience. To take the experience of your Voice also (and after the contrivance of them in the Brain, and the examining of them again, when set down in writing by the Eye) to bring them at last by their Sounds to the Test and Tryal of the Ears, in which if the Oration please not, it is much less Effective on the Passions: This Office *Pliny* the more exactly to perform, procured his own Compositions to be recited to him by some other than himself. Nor is it improper or inconvenient to try them before a Friend or Company, since those that are short in Fancy may yet exceed in Judgment  
and

and *Pliny's* diligence herein may be seen *Lib. 7. Ep. 17.* For none is an Orator to himself but others. And undoubtedly the Rhetorician ought well to consult the order of his Stile, for the Beauty of it consisteth principally in this, That he make not a fair Entry and Introduction to lose his Vigour and Faculty presently, prosecuting his Argument faintly, and ending it more coldly, but it is requisite that he so proceed that by little and little his Stile and Method grow into more Grace and Majesty, for they that do otherwise, as saith *Joshua Silvester*, resemble violent Winds which by little and little abate themselves, after their first furious Blusterings are past.

*Extemporal Eloquence* must be careful to use a long and compassing Stile that whilst he slowly Effunds what is already prepared in his Memory, the Fountain of his Wit may have the more time to replenish it with more, and never suffer himself to be quite Exhausted, therefore such ought to make use of Metaphors, Similies, and Descriptions, and Paraphrase upon their Matter and Digressions, and not be too Concise for acute Sentences and  
florid

florid Discourse, but rather strive to imitate *Tully* than *Tacitus*. Nor must they be too curious for Transposition of words for the Emphasis or Numbers sake from their natural place, nor take too large a Random for fear they lose their Subject, or by too much o'erburthen their Memory, the sense also suffering much Obscurity from that length, nor does it suffer less prejudice from Parenthetical Sentences, whose interposing does disioynt the Discourse, and disproportion the matter to the Auditor, so as to leave in him an imperfect Impression. And altho' our Luxuriant Wits (affecting Brevity) often make use of Parenthesis in their Writings, yet too many, or too much in one of them may easily disturb the uniformity of Style, and prove sometimes an Enemy to the Readers Understanding. Tho Parentheses are not half so troublesome to a Reader as to an Auditor because they are marked out in the Paper to the Eye, but cannot be so in the Voice to the Ear: Therefore in Compositions intended to be spoken they are much more carefully to be avoided.

For

For the Acquiring of Eloquence and good Stile you ought to be familiar and frequent in the reading not only of the Rhetoricians and Orators Books, but also conversant with the Elegant Historians, from whom you will find no small improvement, no less encouragement to imitate their excellency of Stile, not relying too much, nor yet rejecting the exercise of your own Invention, in which take care of torturing your Fancy too much at first, either in overcurious matter, or setting it down in the most exact form. For besides that the Mind doth more heavily and less accurately perform many things at once; the Wit especially is of so delicate a sharpness that any forcing presently turns the Edge. So many things are as easier so sooner done severally than at once: as our Strength, in Parcels quickly takes up the Weight which united in one we cannot possibly move. Let your Invention therefore work with Liberty and no Restraint, and let your Stile be furnished with solid matter, and compact of the best, choice, yet most familiar words, which many times natively fall in, to  
matter



matter well contriv'd according to *Horace* in *Arte Poet.*

*Rem bene dispositam vel verba invita sequuntur.*

To matter well disposed words of themselves do fall.

Whatever *Stile* you entertain before you endeavour a sufficient perspicuity therein ; which as it ought to be the chiefest care of a Rhetorician (the design of whose speaking is certainly to be understood) so is it often hindered by the Ornaments of Speech, you are not every where to use either flourishing Metaphors, as some of our Moderns ; or grave Sentences, as *Seneca*, or acute and exactly according Periods, as *Tacitus* ; or sweet and consenting Cadences, as *Isocrates*, but interchangeably something of them all, that each Auditor may be delighted with something suitable to him, whereby the Audience will be pleased and the Orator be commended. But now referring you to *Aristotles Rhetoriques*, also *Butler's*, *Farnaby's* and others for your further Improvement in this first part of Rhetorick

tōrick I shall proceed to say something of the second part, which is Pronunciation and Action.

*Pronunciation* ought to be accompanied with some decent Action and Comportment of the Body. In speaking let your words be laid down distinctly, which not only giveth a Grace to the Speaker but helpeth the Memory of the Hearer, yet the heighth, length and distance between words are still to be varied, some being to be spoken higher, some lower, some swifter and with some force, some slower and more mollified, else nothing said is made more considerable than another, and perpetual variety and change in Pronunciation yields a delight to the Ear, as well as great ease and refreshment to the Voice, what gives Singing such a ravishing power over us but a well proportioned variety of Notes? Or what advance the Verse above Prose but a perpetual change of the Feet? Always take care to begin in a Middle Key that your Voice may have its true Compass, as the words and Passions do require, so may you either raise or depress your Notes, else put in a Base how can it descend or ascend in a Treble.

ble. And as a Singing Tone and Verse-like Cadence are always to be avoided, so *Monotonia* or the same continued Tone is by no means to be used, and tho' Ease and Modesty incline some to a low Tone, yet ought it not to be practis'd making but a weak impressi-  
 on upon the Auditor, and is by some accounted worse than the other extream of a loud Voice; which yet ought not to be too raging, thereby interrupting the Grace and smoothness of the Discourse, and filling the Ear rather with sound than Sence; great care ought also to be taken in the delivery of your words that you strain not too much just before a Conclusion, thereby drowning that which follows, for the Articulation of each Syllable ought to be with some (more or less) distinction, and in such a Key as that all may be perfectly heard and clearly understood, and particular Regard is to be had to the true Emphasis or Cadence of a Word, and the true disposing of a Sentence for some words flow not so gracefully in one place, as being posited in another, as this Verse.

*In the Summer of thy favour these grow.*

Runs better thus,

*These in the Summer of thy favour grow.*

Those words which the Voice is chiefly to stay upon and give an extraordinary Emphasis to, are such in which there lies some Figure, as all *An-theta's* and *Correspondents* and words relating to another, and generally the Mediums (in which lies the greatest Burthen) of our Arguments.

*Action* is especially of the Eyes and Right hand. Of the hand, thus *Scaliger*. *Ratio est manus intellectus; Oratio Rationis; Orationis manus & manus membrum hominis loquacissimum.* The hand helps to keep time in Speech, the several Motions whereof I find thus stated by a certain Author.

The hand is to be *held out* when we speak of Begging: *Up* when we speak of Praying: The hand *beating* on any thing, is used when a thing is spoke of Anger: *Clapping* the *Hands* together when speaking of Wonders: *Opening* one or both hands, when making a  
thing

thing plain or explaining : *Arms* drawn back close to the sides, when requesting : Putting out the *Forefinger* when demonstrating and as it were shewing a thing (therefore is that Finger called the Index,) The *first Finger* turned down for urging and pressing as it were : *Put up* for Threatning : The *middle Finger* put out for reproaching : The *left Thumb* touched by the Index of the right hand for reasoning and disputing : The *touching a Finger* with the other hand for Distinguishing and for Numbring : The *hand* brought *towards one* in saying any thing of himself : *towards the Head* when speaking of the Understanding : to the *Breast* when of the Soul, Will or Affections : *Folding the Arms* in sadness, &c. Yet must a Rhetorician and Orator be cautious of too much Finger Action, being not grave ; he must be free from any Imitations of Levity as of a Fidler, Dancer, &c. he must not indecently extend his Arms too far any way either upward above the Eye, or downward below the Breast, or much sideways, or backward or circularly. He must turn the Action of the Hand the same way as the Voice. He must withdraw and end the Action of his Hand  
with

hand with his Sentence and in the same Sentence must not often change it. Lastly he must avoid all affected Gesture and screwed Postures, and use his left hand but when it needs, which is but seldom.

And now for the Readers satisfaction and delight I will insert three small Orations made by three young Students who spoke them in the year 1671.

*An Oration in Praise of Publick Schools  
above Private.*

*Gentlemen and Ladies.*

‘ There is a great Controversy this  
 ‘ Day to be decided concerning Schools,  
 ‘ Whether Parents had best to educate  
 ‘ their Children in *Publick Schools* or  
 ‘ *Private*. If I may speak my mind in  
 ‘ this place without offence I would  
 ‘ give the Preheminence to *Publick*  
 ‘ *Schools*, and have a perfect Number of  
 ‘ Reasons for it, that is, *Seven*, and I  
 ‘ hope my Reasons are as perfect as their  
 ‘ Number.

I

‘ *First*.

' *First.* The ablest Masters are in  
 ' Publick Schools (at leastwise we need  
 ' not fear to say so,) for who that is  
 ' Master but of a Private School, will  
 ' be so Presumptuous to compare him-  
 ' self to one of them, any more than a  
 ' Petty Prince to compare with the  
 ' Grand Seignior.

' *Secondly.* Publick Schools make the  
 ' best Scholars, great Linguists, brave  
 ' Orators, excellent Poets and what  
 ' not? When they come to the Univer-  
 ' sity are they not like Children that are  
 ' born very Great, of which they use  
 ' to say that they are half brought up  
 ' so soon as they are born.

' *Thirdly.* In Publick Schools there  
 ' is the greatest *Emulation*, which makes  
 ' some Boys tug at their Oars like Wa-  
 ' termen that Row for a Wager, and  
 ' strain their parts as *Lutanists* some-  
 ' times do their strings, till they even  
 ' Crack again; and whet the Edge of  
 ' their Souls till it be ready to cut the  
 ' Scabbard of their Bodies.

' *Fourthly.* It is a great Reputation  
 ' to be of a Publick School, and to be  
 ' Captain in such a School is to be a  
 ' little Vice Chancellor: All the Mis-  
 ' chief is every Boy hath not Capa-  
 ' city

city to arrive to it, (as they say *E quo-  
vis ligno non fit mercurius.* Every Stick  
will not make a Mercury.

*Fifthly.* Some Publick Schools allow  
Maintenance to those who are sent by  
them to the University. This I con-  
fess is or should be no motive to them  
that need it not, but a very great one  
to them that do; nor doth it signify  
any thing to them that are not intend-  
ed for the University, but to poor  
Lads who are so designed, it makes  
great Amends for all the hardships  
they commonly endure in Schools.

*Sixthly.* Publick Schools have the  
best Discipline. There Boys do stand  
in the greatest Awe. Some Boys will  
be Ranters in Private Schools but in  
Publick Schools they are as Demure  
as Quakers.

*Seventhly* and Lastly, Publick  
Schools do furnish Boys with due bold-  
ness and confidence; and are not a-  
fraid or ashamed to look a Man in the  
Face, no nor spit in his Face upon a  
good occasion. Now the Lord Bacon  
tells us, Confidence can do Wonders:  
When *Mahomet* had promised to make  
a Mountain at a great distance, to come  
to him at his call, and Multitudes



' waited to see the performance which  
 ' he could not effect : He did but say  
 ' with a good laudable Confidence, if  
 ' *that Mountain will not come to Mahomet*  
 ' *I tell you what, Mahomet will go that*  
 ' *Mountain*, and it passed for a Miracle  
 ' among the common People. And  
 ' many Professions require a great deal  
 ' of Confidence, *Lawyers* must sometimes  
 ' set a good Face upon a bad Cause  
 ' or it will be the worse for their Cli-  
 ' ents. *Physicians* must have a conve-  
 ' nient boldness to be out-braved by  
 ' Mountebanks, out-talked by Mid-  
 ' wives, Nurses, Old Women and eve-  
 ' ry meddling Gossip, but if any Man  
 ' can answer these seven Reasons I  
 ' shall content my self with a Private  
 ' School.

*An Oration in praise of Private Schools  
above Publick.*

*Gentlemen and Ladies.*

' The foregoing Orator delivered his  
 ' Judgment (if that were indeed his  
 ' Judgment) in preference of Publick  
 ' Schools. I profess my self to be for  
 ' Private Schools rather than Publick,  
 ' and shall endeavour to shew you the  
 ' weak-

‘ weaknefs of his Reasons (though they  
 ‘ were poffibly the beft that his Caufe-  
 ‘ would bear) and then give you mine  
 ‘ for the contrary opinion.

‘ He told us that Publick Schools have  
 ‘ the beft and ableft Mafters. Surely  
 ‘ it ought to be fo, and many times is,  
 ‘ but if the incomparable *Farnaby*, *Brin-*  
 ‘ *ftey*, *Hoole*, &c. and fome others fuch  
 ‘ as they were Mafters but of Private  
 ‘ Schools, the moft Publick Schools can  
 ‘ have no better.

‘ His next Argument was that Pub-  
 ‘ lick Schools do make the beft Scholars,  
 ‘ he ought to have faid, they make  
 ‘ more good Scholars than Private  
 ‘ Schools do, and well they may for  
 ‘ they have more Scholars to make.  
 ‘ But if a School confifting of but 20  
 ‘ Lads, fhall every Year as fufficiently  
 ‘ fit 2 for the Univerfity, it is as much  
 ‘ in proportion as if a School of 200  
 ‘ fhould fit 20.

‘ That Lads are more excited by *E-*  
 ‘ *mulation* in Publick Schools than in  
 ‘ Private was another of his Arguments.  
 ‘ ’Tis true they may be fo ; but what  
 ‘ is the Emulation he fpeaks of but  
 ‘ Pride, Vain-glory and Ambition ;  
 ‘ whereas Fear and Love whereby Boys

' are managed in Private Schools are no  
 ' Vices but meer natural Passions. More  
 ' over this may be said, those Lads who  
 ' out-strip others, by how much more  
 ' Publick the School is, by so much more  
 ' they are lifted up with Pride; and so  
 ' much more discouraged and beaten  
 ' out of heart, if others do much out-  
 ' strip them, which answers his fourth  
 ' Argument.

' Would you think that one of his  
 ' Arguments should be that Publick  
 ' Schools do make Boys Bold and Con-  
 ' fident? To that I answer, if Boys be  
 ' Meek and Shamefac'd, such Schools  
 ' are apt to daunt them more, and those  
 ' that are naturally Bold they make  
 ' quite Impudent. Thus weak are all  
 ' the Reasons he hath given, on the  
 ' behalf of Publick Schools, and easie  
 ' to be retorted upon himself. The  
 ' few Reasons I shall present you with  
 ' on the behalf of *Private Schools* are as  
 ' follow.

' Where fewer or lesser Scholars  
 ' are, it may be strongly presumed  
 ' there will be fewer and less Vices.  
 ' Amongst many Scholars there will be  
 ' many Vices and the greatest Vices  
 ' commonly amongst the Greatest Lads  
 ' who

‘ who to the Vanity of Children do of-  
 ‘ ten add the Vicioufness of Men.

‘ Then a more constant and particu-  
 ‘ lar Inspection, as to Life and Learn-  
 ‘ ing may be expected in a Private School  
 ‘ than in a Publick. As Sick People must  
 ‘ needs have better looking after in a  
 ‘ Private House, where each have a  
 ‘ Nurse to him or her self, than in a  
 ‘ great Hospital, where one Nurse hath  
 ‘ the charge of many Patients : And  
 ‘ Guests are better entertained when but  
 ‘ few are Invited than at the Catholick  
 ‘ Wedding of a *Quaker* that bids Thou-  
 ‘ sands, or sets the Door open for all  
 ‘ Comers.

‘ Great and Publick Schools seem not  
 ‘ so fit for the smaller sort of Boys, who  
 ‘ are not able to defend themselves from  
 ‘ those abuses and injuries which a great  
 ‘ number of Lads bigger than themselves  
 ‘ will be ready to offer them upon all  
 ‘ Occasions (when they are out of the  
 ‘ School) sending them home many  
 ‘ times by Weeping-Crosses.

‘ *Private Schools* do best discover the  
 ‘ Humours and Tempers of Children  
 ‘ which the severity of Publick ones  
 ‘ makes them to conceal. Children in  
 ‘ Private Schools are like Bees in Glas-

‘hives, where all their Works and Hu-  
 ‘mours may easily be discerned, and  
 ‘when an ill-humour or inclination is  
 ‘once well known, it is half-cured. I  
 ‘therefore observing that there are no  
 ‘real conveniences in a Publick School  
 ‘(of all that have been alledged) but  
 ‘what may be had in a Private, and  
 ‘many conveniences may be had in a  
 ‘Private School which cannot be en-  
 ‘joyed in a Publick, shall therefore con-  
 ‘clude for the former, as deserving in  
 ‘many respects preference to the  
 ‘latter.

*The Moderators Oration,*

*Gentlemen and Ladies.*

‘Since it hath fallen to my share to  
 ‘be this day a Moderator, and a kind  
 ‘of a Judge betwixt those two Orators  
 ‘which have opposed each other, one  
 ‘pleading for Publick Schools above Pri-  
 ‘vate, the other for Private above Pub-  
 ‘lick, it will become me to acquit my  
 ‘self as Impartially as I can, and you  
 ‘must judge whether I do or no.

‘Pub-

‘ *Publick Schools* are certainly the best  
‘ in some respects, and upon some ac-  
‘ counts. First, their Masters are the  
‘ best Masters, and do most good, be-  
‘ cause they have most to do good to. If  
‘ they be not greater *Lights* than other  
‘ Masters (as the Moon is not than o-  
‘ ther Stars) yet they are greater *Lu-*  
‘ *minaries* (as the Moon is.) If they  
‘ have not greater Abilities, yet they  
‘ have greater opportunities. If they  
‘ are not better Soldiers, yet they are  
‘ greater Officers and Commanders.  
‘ Now there is an honour due to Per-  
‘ sons, not only for their internal worth  
‘ and merits, but also for their external  
‘ place and quality. Publick Schools  
‘ are best for some sort of Boys, but not  
‘ for all. First stout and sturdy Boys  
‘ that cannot be governed elsewhere,  
‘ as Marshal-Law is best for Soldiers,  
‘ Little-ease for Servants that will not  
‘ be subject to their Masters. I fancy  
‘ that the Masters of some Publick  
‘ Schools would tame the Great Mo-  
‘ gul or the Grand Seignior if he were  
‘ their Scholar, and should contend with  
‘ them; so wickedly would they bela-  
‘ bour him, for you know, *Labor om-*  
‘ *nia vincit improbus*. Secondly, For  
‘ Boys

‘ Boys that |will greatly answer to the  
 ‘ Spur of Emulation more than to any  
 ‘ thing else; great Schools are best  
 ‘ because there is the greatest Emulati-  
 ‘ on, provided always that their metal  
 ‘ and strength can hold that Gallop  
 ‘ which it will put them upon, and  
 ‘ they not break their Winds. But  
 ‘ some Boys there are that have no  
 ‘ Emulation to excell others, either be-  
 ‘ cause they content themselves with  
 ‘ this, that it is well known they could  
 ‘ excell other if they would, or else be-  
 ‘ cause they think if they would excell  
 ‘ others they cannot. Then as for Lads  
 ‘ that are poor and want Exhibitions,  
 ‘ they must take Publick Schools, as  
 ‘ Men take their Wives for better for  
 ‘ worse, for if they be worse to others,  
 ‘ yet they are best to them. These  
 ‘ are the advantages of a Publick School.  
 ‘ But,

‘ *Private Schools* are better in other  
 ‘ respects, and for another sort of Lads.  
 ‘ If Boys be given to Vice, Private  
 ‘ Schools are better for them than Pub-  
 ‘ lick, because in the latter of these,  
 ‘ there are more to infect them, and  
 ‘ more for them to infect; more to make  
 ‘ them worse, and more to be made  
 ‘ worse

worse by them. Moreover in a Private School, vicious Boys may be more easily detected, as it is easier to find a Thief in an open Forest than in a thick Wood. If Lads be young, tender, meek and softly, Private Schools are best for them. Again, if Boys be dull and unapt to Learn, Publick Schools will but disgrace and disparage them. The less they can do there, the more they will suffer. For of them that cannot make Scholars they will make Examples, and they that cannot themselves learn through incapacity are made to teach others to learn that will not through negligence. Again if Parents desire that their Children should learn any thing out of the usual rode of Schools, as *Musick*, *Dancing*, *Mathematicks*, other *Oriental Languages* besides the *Hebrew*; Private Schools are best for that purpose, because Publick Schools will not go out of their Rode. Lastly, Private Schools do usually send their Scholars to the University before their Beards be grown, which Publick Schools many times do not. There Scholars many times do begin to suck their Mother the University, when it is high-time they



‘ they were Weaned ; and are but A-  
 ‘ cademick Children. These five last  
 ‘ are the advantages of a Private  
 ‘ School.

‘ But upon the whole matter I think  
 ‘ it just and fit to say that as healthy  
 ‘ Constitutions can live and thrive much  
 ‘ what a like in any tolerable Air, be it  
 ‘ sharp or mild, open or close, Country  
 ‘ or City, so the matter is not great  
 ‘ whether the School a Child is put to  
 ‘ be Publick or Private, provided the  
 ‘ Master be good, and the Scholar in-  
 ‘ genious and towardly.

But now fearing my Reader over-  
 wearied with these less curious Orations I  
 would have him to divert himself with  
 a more Banquetlike variety to be found  
 in many Roman Histories, *Caussin's Holy  
 Court* and others, where are many ex-  
 cellent Orations full of Elegant sweet-  
 ness, of admirable Texture and Com-  
 position, these being but the easie pro-  
 ducts of an inferiour study, and the Off-  
 spring of Infant years.

*Cornelius Agrippa* in his *Vanity of Arts  
 and Sciences*, saith it remains to this  
 day a question undetermined whether  
 Rhetorick

Rhetorick be an Art or no. For *Socrates* in *Plato* by most found Reasons argues it to be neither an Art nor a Science, but a certain kind of Subtlety, and that neither Noble nor Honest, but meer low, illiberal and servile Flattery, and as for *Memory*, *right Pronunciation* and *Invention* they are meerly Natural Effects which is indeed not a little evident in *Antonius* the Prince of the Latin Orators. And altho' before *Thisias*, *Coraces* and *Gorgias* there was not any one who had either taught or wrote of Rhetorick, yet were there many Men who through the strength of their Natural parts became very Eloquent. It hath been an Ancient opinion that the Precepts of Oratory are more hurtful than useful to the Life of Man. For this deluding Mystery is that from whence all Prevaricators, Jugling Shufflers, Back-biters, Sycophants and all other Lewd and Vile-tongued Persons derive their Malice and Knavery. With this Art many Persons endued raised Seditions and Commotions in Nations, while by their Nimble Tongues some are Deceived, some Flattered, some over-persuaded usurping as it were a kind of Tyranny over Men not so subtle

subtle as themselves, and *Æschylus* writes that *Composed Orations are the greatest Evils in the World.* Also *Raphael Volaterraneus* a most studious Lover of Histories and Examples, confesses that upon due consideration of all that he had read or seen either of Ancient or Modern Stories or Examples, he finds very few Eloquent Men to be good Men. Hath not (saith *Agrippa*) this thing called *Eloquence* not only greatly disturbed most Potent Commonwealths but also wholly ruined them? Witness the Examples of *Brutus*, *Cassius*, *Gracchus*, *Cato*, *Cicero*, *Demosthenes*, who as they were accounted the most Eloquent, so were they the most Seditious and Turbulent of their time, For Censorious *Cato* being himself forty times accused, seventy times accused others, being nothing but a continual disturber of the Peace with his Mad Declamations all his Life long. The other *Cato* called *Uticensis*, by provoking *Cesar*, was a great occasion of the utter Subversion of the *Roman* Liberty. In like manner did *Cicero* provoke *Anthony* to the great Mischief of the Empire; and *Demosthenes* Incensed *Philip* to the Ruin of the *Athenians*; so that there is no State or Govern-

Government, but has been highly injured by this Art. By Eloquence bad Causes are defended, the Guilty saved from the Punishment of the Law, and the Innocent Condemned. *Marcus Cato* the most prudent among the *Romans* forbade those three *Athenian* Orators *Carneades*, *Critolaus* and *Diogenes* to be admitted to publick Audience in the City being Men endued with such Acuteness of Wit and Eloquence of Speech that they could with great ease make Evil, Good, and Good, Evil. From this Art flow those Numberless Sects, Heresies and Superstitions that Contaminate Religion, and Men are so affected with the Charms of Eloquence that rather than not be *Ciceronians* they will turn *Pagans*. See more in *Agrippa* p. 33. to 40.



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# M U S I C K.

**M**<sup>usick</sup>, in Latine *Música*, in Greek *μουσική ἀρτή*, i. *Musa*, i. *Cantus*, is here to be understood that part of Musick which relates to the Knowledge of Sounds, by which a true Concordance or Harmony is produced by means of the Voice or Hand, and not that part which teacheth the Laws and Rules of Poetry to which it is accounted a Sister, and an Art Unsearchable, Divine and Excellent; A Mistress that moderateth the Affections of the Mind; The Soul of the World (according to the *Platonicks*;) The President of the Spheres, and so highly esteemed (according to *Plutarch*) that the Ancient Philosophers placed Musical Instruments in the Hands of their Gods. *Joseph*

*Silvester* faith, in his Commentary upon *Du Bartas*, she is the Rapture of the Soul, the Mistress of Affections, the Genius of good Wits and the Type of Felicity. And the Heathens did not without some sufficient Reasons Invent those Fables of *Orpheus* moving wild Beasts and Trees to Dance, and *Amphion* whose Musick drew Stones to the Building of the Walls of *Thebes*. Venerable *Bede* writeth that no Science but Musick may enter the Doors of the Church, and Holy *David* was seldom without an Instrument in his Hand; we also read in the first Book of *Samuel Chap. 10.* touching *Saul*, who meeting with a Company of Prophets with Musical Instruments, Prophesied incontinently; and in the 2d. of *Kings Chap.* where *Elizeus* is spoken of, who caused a Player upon Instruments to be brought to him, and as the Musician sounded, the Spirit of God came upon the Prophet. The Ancient Britains had Musicians before they had Books, and the *Romans* that Invaded them, Confessed what Power the *Druids* and *Bards* had over the Peoples Affections, by recording in Songs the Deeds of Heroick Spirits; and many wonderful Re-

lations

lations are to be found in the Books of Musicians and others, of the Charms of this Science.

The Object of this Science is Sound, and that Sound is two ways considered: as first whether *Grave* or *Acute*; secondly, whether *Long* or *Short*, as to duration of time. The first of these is regulated by the *Scale of Musick*, the latter by certain *Notes, Marks* or *Signs* invented for that purpose. And these two (called *Tune* and *Time*) are the Subject of the first part of Musick, and the Foundation upon which the other parts are raised. The second part shews how *Grave* and *Acute* sounds are joyed together in *Musical Concordance*. And brings *Discords* into *Harmony*; and out of these two, *viz.* *Concords* and *Discords* is formed another part, called *Figurate Descant*, which *Figurate Descant* being brought into *Canon* is the *Culmen* or highest Degree of *Musical Composition*, according to the Proem in *Mr. Symphon's Compendium of Practical Musick*.

The end and Office of the *Scale of Musick* called the *Gamat*, is to shew the Degrees by which a *Voice Natural* or *Artificial* may either *Ascend* or





reduced the Greek Scale into this Form, did place at the bottom to signifie from whence he did derive it ; and from this Letter the Scale took the name of *Gamina* or *Gam-ut*. On the middle of the Scale are three Letters in different Characters ; of which some one is set at the beginning of every Song. The lowest is the F  $\text{̄}$ . Cliff, which is peculiar to the *Bass*. The highest is a G Cliff, made thus,  $\text{̄}$  and signifies the *Treble* or highest part. Between these two stand the C Cliff  $\text{̄}$ , which is a fifth below the G Cliff, and a fifth also above the F Cliff, as you will find by counting the Degrees of the Scale, reckoning both Terms inclusively. This Cliff standing in the middle serves for all Inner parts. When we see any one of these, we know thereby what part it is, and also what Letters belong to each Line and Space, which tho' (for Brevity) not set down at large, are notwithstanding supposed to be in those five Lines and Spaces, in such order and manner as they stand in the Scale it self

## Example.

Bass.                      Inner part.

The image shows three musical staves. The top staff, labeled 'Bass.', has a treble clef and a scale of notes G, A, B, C, D, E, F, G, A. The middle staff, labeled 'Inner part.', has a bass clef and a scale of notes G, A, B, C, D, E, F, G. The bottom staff has a bass clef and a scale of notes G, A, B, C, D, E, F.

The whole Gamut or Scale on the Five  
Lines.

The image shows three musical staves, each with a treble clef. Each staff contains a scale of notes with their names written below. The first staff has notes G, A, B, C, D, E, F, G with names G folreut, Alamire, Bfäbemi, Clölia, Dlaföl, Ela, Ffaut, Gfolreut inalt. The second staff has notes A, B, C, D, E, F, G with names Alamire, Bfäbemi, Clöliaut, Diölre, Elami, Ffaut. The third staff has notes B, C, D, E, F, G with names Gamut, Are, Bmi, Ciaut, Diölre, Elami, Ffaut, Gfolreut.

G folreut, Alamire, Bfäbemi, Clölia, Dlaföl, Ela, Ffaut, Gfolreut inalt

Alamire, Bfäbemi, Clöliaut, Diölre, Elami, Ffaut,

Gamut, Are, Bmi, Ciaut, Diölre, Elami, Ffaut, Gfolreut.

To sing the Notes you cannot use the words *Gamut*, *Are*, &c. they being too long, therefore there meaning was Contracted to these Syllables *Sol*, *la*, *mi*, *fa*, *Ut* and *Re* being left out, and are with less Confusion supplied with *Sol* and *La*.

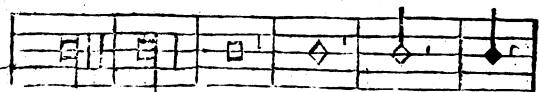
Now

Now altho' there are but 22 Notes set down, Musick is not confined to that Number, for sometimes you will meet with Notes both below and above what is hereset down (according to the Will of the Composer) and then is added a Line or two more as the Song requires, those Lines so added being called *Ledger-Lines*, and observe that all such Notes in the Bass are called *Doubles*, as one Note below *Gamut*, *Double Ffaut* two Notes below *Double Elami*, and so Descending to *Double Gamut*. Likewise all Notes above *Ffaut* in the upper Line of the Treble are called *Inalt*, as *G solreut in alt*. *Alamire in alt*, and so on. You see also that all Notes are placed gradually, so that if you would write down 8 Notes in order ascending one above another, and the first Note to be *G solreut* in the Treble Cliff, which is upon the Line, the next in order must be *Alamire* in the Space, the next *Bfabemi* on the Line, and so on till you come to *G solreut in alt*. By which you may observe that every 8th Note bears the same Denomination, as from *Gamut* to *G solreut*, from *Are* to *Alamire*, and to *Alamire* again, and thus might they ascend if 'twere possible to a Thousand, it being

only the same over again, and as it bears the same Name so it gives the same Sound, only shriller as it Ascends; but if 10000 Persons were to sound a Note just 8 Notes above one another, it would all sound like one Note.

Of Notes the *Large*, the *Long*, and *Breve* were used formerly; but since Musick grew to more perfection, they have added other Notes not so long, for the *Breve* is twice the length of a *Semibreve*, a *Long* twice the length of a *Breve*, and a *Large* twice the length of a *Long*, and is a Sound of too much durance to be held by any Voice or Instrument, but an Organ.

*The Characters and Names of the Notes.*



Large. Long. Breve. Semibr. Minim. Crotchet.



Quaver. Semiqua. Demisemiquaver.

These are the several Marks to which they apply the Syllables *Sol*, *la*, *mi*, *fa*, and the Measure or Proportion of Time each Note requires is thus: A *Semibreve* (which is called the Master Note, it being the longest Note for quantity of Time now in use,) is performed while you with leisure tell, 1, 2, 3, 4. The *Minim* is but half the time of the *Semibreve*, the *Crotchet* but half the length of the *Minim*, The *Quaver* half the *Crotchet*, the *Semiquaver* half the *Quaver*, the *Demisiquaver* or *Demi-quaver* but half the *Semiquaver*.

*Time* hath 2 Moods or Characters by which it is distinguished, *viz.* *Common Time* and *Tripla Time*, all other Variations and Distinctions of Time take their Original from these two, the Marks of which are always placed at the beginning of your Song or Lesson.

*Common Time*, is of three sorts, the first and slowest marked thus C: is Measured by a *Semibreve*, and divided into four equal parts, telling 1, 2, 3, 4, distinctly putting your hand or foot down when you tell 1, and taking it up when you tell 3; and observe to  
have

have your hand or foot down at the beginning of every Bar. Every down and up is called a *Time* or *Measure*. The second sort of Common Time is a little faster, which is known by the Mood having a stroke through it  $\frac{C}{\text{—}}$ . Third sort of Common Time is quickest of all, and then the Mood is thus  $\frac{C}{\text{—}}$ , you may tell 1, 2, 3, 4. in a Bar almost as fast as the Regular Motions of a Watch. The French Mark for this retorted Time is a large Figure of 2. There are two other sorts of Time for the equal Division of the Bar with the hand or foot up and down. The first of which is called six to four, each Bar containing six Crotchets or six Quavers, 3 to be sung with the hand down, and 3 up, and is marked thus  $\frac{6}{4}$ , but very brisk and always used in Jigs. The other sort is called twelve to eight, each Bar containing 12 Quavers, six with the hand or foot down, and six up, and marked  $\frac{12}{8}$ . Before you rightly can keep time you must learn the length of your Notes perfectly.

*Tripla Time* may be distinguished into two sorts. The first and slowest of which is measured by three Minims in each

each

each Bar, or such a quantity of lesser Notes as amount to the Value of three *Minims*, or one pointed *Semibreve* telling 1. 2. with your hand down, and up with it at the third, so that you are as long again with your hand or foot down as up. This sort of Time is marked thus  $\frac{3}{2}$ . The second sort is faster, and the *Minims* become *Crotchets*, so that a Bar contains three *Crotchets*, or one pointed *Minim*; 'tis marked thus 3, or thus 31, or three to four, marked thus  $\frac{3}{4}$ . Sometimes you'll meet with three Quavers in a Bar, which is marked as the *Crotchets*, only sung as fast again.

There is another sort of Time used in Instrumental Musick, called nine to six, marked thus  $\frac{9}{8}$ , each Bar containing nine Quavers or *Crotchets*, six to be played with the foot down and three up. This Mr. *Playford* in his Introduction to the Skill of Musick reckons amongst *Tripla Time*, because there is as many more down as up.

In the middle of some Songs or Tunes are found Quavers joyned together three by three, with a figure of three marked over every three Quavers, or perhaps only over the first three. Those  
are



are to be performed each three Quavers to the value of one Crotchet, which in *Common Time* is the same with twelve to eight and in *Tripla Time* the same with nine to six. A Perfection in these Moods must be learned which cannot be without diligent Practice.

For Tuning the Voice you must have assistance of some Tunable Voice or Instrument at first, and for tuning your Notes, take this Lesson of Plain Song upon 5 Lines in the Treble, or *G sol re ut Cliff*, consisting of eight Notes gradually Ascending and Descending, agreeing with the 8 uppermost Notes in the *Gammut* with the mark of *Common Time* placed in the beginning.



When a Sound is given to the first Note called *Sol*, you rise to *La* (the next in order above it) one whole Tone or Sound, and another whole Tone to *Mi*, from *Mi* to *Fa* is but a half Tone; from *Fa* to *Sol*, and *Sol* to *La* are whole Tones, from *La* to *Fa* but half a Tone; from *Fa* to *Sol* a whole Tone, and you might Ascend, if your Voice would permit

mit you Ten Thousand Octaves in the same Order as this one. The difference of whole Tones and half Tones in rising and falling are, whole Tones are *Cheerful* to the Ear, and half Tones *Melancholy*. And there are always two half Tones either rising or falling within the Compass of eight Notes, and those two are called *Fa*; for to rise from *Mi* to *Fa*, and from *La* to *Fa* are Melancholy Sounds; also to fall from *Fa* to *La*, and from *Fa* to *Mi* are Melancholy Sounds.

When you have sounded the first Note, you rise by whole and half Tones, (as before observed) till you Ascend to the top of your Lesson, and then down again, laying your hand down when you begin to sound the first Note, and taking it up when you have half sung it then laying it down at the next, and up again, so consequently of all the rest that are of the same quality according to the Directions before in *Common Time*.

To learn to sing in Tune at first, you must get the assistance of one either skilled in the Voice or Instrument, and let him Sing or Play the 8 Notes over with you, till you have fully learned  
ed

ed them, which being perfect in, you proceed to a Lesson somewhat more difficult called *Thirds*, because of skipping from first to third and so missing a Note upon every Bar as you rise and fall.



This Lesson put in *Minims* are to be Measured one with the hand or foot, down and one up. More Examples of Leaping and Skipping in General may be seen in Mr. *Simpson's* Compendium of Musick, and Mr. *Playfords* Introduction to the Skill of Musick, a Book very necessary, and very useful for all young Practitioners and other that intend to learn the Rudiments of this Science, which Book is Cheap and very valuable.

*Rests* or *Pauses* are a Character of Silence, or an Artificial Omission of the Voice or Sound proportioned to the measure of other Notes, according to their several distinctions; which that the Performer may not Rest or Pause too long or short before he Plays or Sings again, there is a Rest assigned to every

every Note. As for Example the *Semibreve Rest* is expressed by a stroke drawn downwards from any one of the five Lines half through the space between Line and Line. The *Crotchet Rest* is turned of like a Tenterhook to the Right hand and the *Quaver rest* to the Left. The *Semiquaver Rest* is with a double stroke to the left, and the *Demisemiquaver Rest* with a Triple stroke to the left. At any of these Rests, you cease Playing or Singing till you have counted them silently according to their Value in time before you Play again ; as when you meet with a *Semibreve Rest*, you must be as long silent as you would be performing the *Semibreve*, before you Sing or Play again, and so of a *Crotchet*, a *Quaver*, &c. If the stroke be drawn from one Line to another then 'tis two *Semibreves* ; if from one Line to a third then 'tis four *Semibreves*, as in this following

*Exam.*

## Example.

8 Semibreves    4    2    1    Minim.    Crotchet.

Quaver: 1    Semiquaver.

*Note* when you meet with any *Semibreve Rest* made in *Tripla Time*, or in any other sort of *Time* besides plain *Common Time*, it serves for a whole Bar of that time which you Sing or Play in, altho' the *Time* may be longer or shorter than a *Semibreve*; or if it is drawn from *Line* to *Line* (like two *Semibreve Rests*) it serves for two Bars and no more or less; so for 4 or 8 Bars or more according as marked down.

The *Prick of Perfection*, or *Point of Addition* is a little point placed always on the right side of the *Note*, and adds to the *Value* of the *Sound* half as much as it was before; for as one *Semibreve* contains two *Minims*, when this point is added to the *Semibreve*, it must be held as long as three *Minims*; so of *Crotchets*, *Quavers*, &c. as in this

Exam<sup>a</sup>

*Example.*

Sometimes a Prick or Point is placed at the beginning of a *Bar*, which belongs to the last Note in the preceding *Bar*.

*As for Example.**The same Example by Notes.*

*Notes of Syncopation* or *Driving Notes* are when your hand or foot is taken up or put down while the Note is sounding, which is awkward to a young

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Practi-

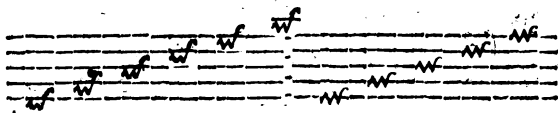
Practitioner but once doing it well, he is pretty perfect in keeping Time.

*Tyed Notes* are of two sorts, 1. An Arch or stroke drawn over or under two or three or more Notes which signifies in Vocal Musick so many Notes to be Sung to one Syllable, in Musick made for Viols and Violins it signifies so many Notes to be played with one Motion of the Bow. The 2d. sort of Tyed Notes are with a strait stroke drawn thro' the Tails of two, three or more Notes: Examples whereof may be seen in almost all Tunes whatsoever.

The *Flat* marked thus  $\flat$ , and the *Sharp* marked thus  $\sharp$ : are to Flat and Sharp any Note they are placed before. For Example, if you were singing up your eight Notes and coming to *Csolfa* or the first *Fa* above your *Mi*, you should find a sharp in that space, it must not be Sung as half a Note (as is directed before) but a whole Tone above, the quality of a Sharp being to raise any Note, and add a *Semitone* to make it more Acute and Sharp. When you descend to a *Sharp*, as from *La* to *Sol* and a Sharp should be in *Sol* then you fall but half a Note which is a *Melancholy*

cholly Sound as is said before, and is like falling from *Fa* to *La*, or *Fa* to *Mi* A Flat when placed before any Note, which you should sound a whole Note or Tone higher than the Note just before it, obliges you to sound it but half so high in the same manner, as from *Mi* to *Fa* or *La* to *Fa*. And observe when these Flats and Sharps stand at the beginning of your five Lines, it makes all the Notes in that Line or Space to be sharp, that is half a Tone higher throughout the Lesson without changing their Name. In any other place they serve only for that particular to which either of them is applied.

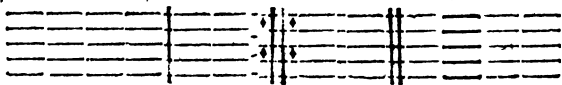
A *Direct* is usually put at the end of the Line and serves to direct to the place of the first Note on the next Line, and are thus made.



*Bars* are single and double. *Single Bars* divide the Time according to the Measure of the Semibreve. *Double Bars* Divide the several Strains or Stran-



za's of the Songs and Lessons. If they have Pricks on each side the Strains are to be repeated.



A Repeat thus made  $\underline{\text{X}}$ , signifies a Repetition from that place only where it is set.

A *Key* is a Song or Tune depending on a Sound given as suppose you have a Lesson or Song pricked down, observe in what Space or Line the last Note of it stands on, and that is the Key. Now it very often begins in the Key, but sometimes a third or fifth above it, and so it cannot be so well known but it certainly ends in it. There are but two Keys in Musick, one *Flat* and the other *Sharp* which is sufficient to write down any Melancholy or chearful Song whatever. They produce several Alterations of Keys or Tones by being placed at the beginning of the five Lines. The Melancholy or Flat Key without either Flat or Sharp at the beginning is *Are* or *Alamire*, the Sharp or Chearful Key without Flat or Sharp at the beginning is *Cfaut* or *Csolfa* they are called the

two

two Natural Keys, because a Song may be set in either [of them without the help of *Flats* or *Sharps*, which cannot be done in any other Key, but there must be either *Flats* or *Sharps* placed at the beginning. The Principal Keys made use of are *Gamut* Flat and Sharp, *Are* Natural and Sharp, *B mi* Natural and Flat, *Cfaut* Natural and Flat, *De sol re* Natural and Sharp, *Elami* Natural and Flat, and sometimes Sharp, *Ffaut* Natural and Flat and sometimes Sharp. There are more but not of much use. The Keys must always be named in reference to the Bass, which doth always conclude the Key. The surest way to understand the several Keys is first to get Lessons in the two Natural ones, till you are perfect in them, and then proceed to one Flat, and so on to two or more till you have conquered all. The like method is to be observed in the Sharps. For more large Instructions and Examples of the Melancholy and Cheerful Keys see Mr. *Playford's* Introduction to the Skill of Musick. It being my design to treat only of the Rudiments of this Science.

The *Trill* or *Shake* is the principal Grace in Musick and most used, the Directions for learning it, being only to move your Voice easily upon one Syllable, the distance of a Note, First moving slow then faster by degrees, and so will it come to you with little practice; but beware of huddling the Voice too fast, for *B fabemi* and *Alamire* ought both to be sounded distinctly, your shake being compounded either of a whole or half Tone. The *Trill* ought to be used on all Descending Pricked Crotchets, also when the Note before is in the same Line or Space with it, and generally before a Close, either in the middle or the end of a Song. Some Notes that ought to be shaken have Crosses over them thus x, but Practice and good Observation will instruct you fully therein.

To the *Viol*, *Lute*, *Theorbo*, &c. are *Frets* or *Stops* upon the Neck which are put for stopping the various Sounds according to the several Notes of the *Gammaut* both *Flat* and *Sharp*, and Letters are set for the *Frets* as for Example of the Bass *Viol*, in the way of *Tablature* stand six Lines for the six strings of the *Viol*, the highest for the highest or *Treble*



divers Voices sounding in the same Tone, which *Unison* as it is the first term to any Interval, so it may be considered in Musick as Unite in Arithmetick, or a Point in Geometry not divisible. Sounds more or less distant from any supposed Unison, make greater or lesser Intervals. such as are contained within the Common Scale of Musick, may be divided into so many Particles or Sections only, as there be *Semitones* or *half Notes* contained in the Scale, viz. twelve in every Octave as may be observed in the stops of Fretted Instruments, or in the Keys of a Common Harpsicord or Organ. Their Names are as follow.

12 Diapason	12 Octave or 8th
11 Semidiapason	11 Defective 8th
11 Sept major	11 Greater 7th
10 Sept minor	10 Lesser 7th
9 Hexachordon ma	9 Greater 6th
8 Hexachordon mi	8 Lesser 6th
7 Diapente	7 Perfect 5th
6 Semidiapente	6 Imperfect 5th
6 Tritone	6 Greater 4th
5 Diatessaron	5 Perfect 4th
4 Ditone	4 Greater 3d
3 Semiditone.	3 Lesser 3d

2 Tone

2 Tone	2 Greater 2d
1 Semitone	1 Lesser 2d
Unison.	One Sound.

*Note* the Defective 8th and Greater 7th are the same Interval in the Scale of Musick, also the Defective 5th and Greater 4th. Also observe that the Particle *Semi*, in *Semidiapason*, *Semidiapente*, &c. doth not signify the half of such an Interval in Musick, but only imports a Deficiency as wanting a Semitone of Perfection. Out of these Semitones or half Notes arise all those Intervals, called *Concords* or *Discords*, which substitute and make Harmony in Musick

*The Art of Descant or Composing Musick  
in parts.*

In the Scale or Gamut are seven Notes G. A. B. C. D. E. F. for their Eighths are the same in Nature of Sound. Of these seven some are called *Cords* or *Concords* and other *Discords*.

The *Concords* are four in Number, *viz.* An Unison, a third, a fifth and a sixth. (*Sympson* maketh them the third, fifth, sixth and eighth by which he also means their Octaves, as 10th, 12th, 13th, 15th,

1 5th, &c.) The *third*, *fifth* and *sixth* are either Perfect or Imperfect. The *Imperfect* is less than the *Perfect* by half a Note, as

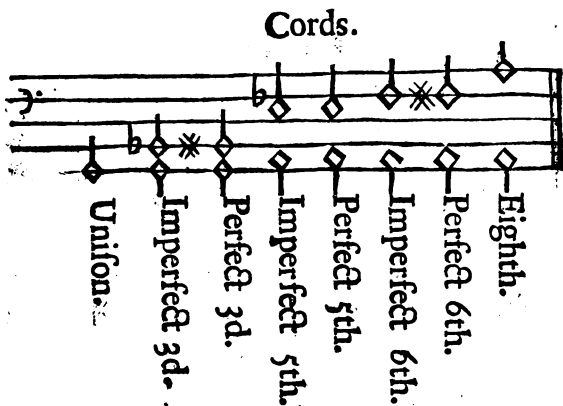
*A third Minor includes four half Notes.*

*A third Major includes five half Notes.*

*A sixth Minor includes nine half Notes.*

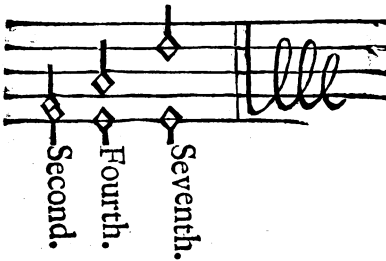
*A sixth Major includes ten half Notes.*

*Perfects* of the same kind, as two 5ths or two 8ths rising or falling together, are not allowed in Composition, but with either of the Perfect Cords you may begin or end a piece of Musick. The same with a third which is an Imperfect, but it must not be with a sixth.



Discords

Discords.



An Example of the Perfect and Imperfect Cords and Discords, with their Octaves.

Examples how in composing of two or more parts the parts do either stand still, or the one doth stand still and the other move, or

they both ascend together, or descend together, or the one ascends and the other doth descend, with several Rules that direct how the Concoords are to be taken or applyed, the use of Discords on Holding Notes, alio Examples of taking Discord

Discords.						
Imperfect Cords.						
Perfect Cords.						
Discords.						
Imperfect Cords.						
Discords.						
Perfect Cords.						
	1	2	3	4	5	6
	7	8	9	10	11	12
	13	14	15	16	17	18
	19	20	21			



Discords elegantly and of Cadences and Bindings in three parts with many other Rules and Principles of Composition may be seen in Mr. *Playford's* Introduction to Musick and many others.

Also the Composition of three parts, four parts, and how a fifth and sixth may stand together in a Counterpoint. Composition of 5, 6, and 7, Parts. Of two Basses and Composition of 8 parts. How Discords are admitted into Musick. Syncopation of two parts Passage of Discords, Discords Note against Note, Of Transition or breaking a Note, and Discords, in Double Transition with Relation Inharmonical, and three Scales of Musick, &c. may be seen in Mr. *Sympson's* Compendium of Musick, and the works of several Musicians Named in the Treatise of Musick in my *Gentlemans Treasury*. This being enough to invite you to further inquiry in those Books which treat wholly and only on that Excellent Science of Musick to perfect you in that Art, to which I refer you for the General and Particular Rules of Composition, and here shall only tell you

You from *Henry Van Ettens* Mathematical Problems.

*How to make a Consort of Musick of many Parts with one Voice or Instrument only.*

This Problem is resolved so that a Singer or Musician be near an *Echo* which Answereth his Voice or Instrument, and if the *Echo* answereth but once at a time he may make a Double, if twice then a Triple, if three times, then an Harmony of four parts: for it must be such a one that is able to exercise both Tune and Note as occasion requires. As when he begins *at* before the *Echo* answer, he may begin *sol*, and pronounce it in the same Tune that the *Echo* answereth, by which means you have a fifth agreeable Consort of Musick: then in the same time that the *Echo* followeth to sound the second Note *sol*, he may sound forth another *sol* higher or lower to make an eighth, the most perfect Consort of Musick, and so of others if he will continue his Voice with the *Echo*, and Sing alone with two parts. Now Experience sheweth this to be true, which often comes

to pass in many Churches making one believe there are many more parts in the Musick of a Quire, than truly there are because of the resounding and multiplying of the Voice, and redoubling of the Quire.

*Agrippa* in his Vanity of Arts and Sciences, saith, There never was any Musician could pretend to know all the Consonances of Sound, or the true reason of Proportions, and that there is no end of this Art, for that every day produces new discoveries therein, which in another Sence *Anaxilas* wittily hints, saying that Musick is like *Libya* which every year produceth some new sort of venomous Creature, and we read that *Augustus* and *Nero* were much condemned for giving their minds so much to Musick, the latter of which pursuing it was for that cause more hated and derided, and none of the Poets ever made *Jupiter* to Sing or Play upon the Harp, but *Pallas* is positively said to hate all manner of Piping. Nor did *Ephorus* spare to condemn this Science as an Art Invented only to delude and deceive Men, according to *Polybius*, but the same *Polybius* takes notice that the  
Com-

Commonwealth of the *Cynethenses* in *Arcadia* falling from the delight they had in Musick, grew into Seditious Humours and Civil Wars, and thus from many occasions, are advantages taken by the Sciential Warriours to write *Pro* and *Con* upon all Subjects and Sciences.

**ARITH.**



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# ARITHMETICK :

**A** *Rithmetick* in Latine *Arithmetica*, in Greek *αριθμητική*, *hoc est à numerando*. The Art of Numbring consisteth of five common parts, Numeration, Addition, Substraction, Multiplication and Division, but because Numeration together with the Figures and places whereof it consisteth, are counted rather as first Elements, and principles of Arithmetick, therefore it is generally accounted no part of this Science.

Numeration is that part of Arithmetick, whereby is known and expressed the value of any Figure according to his place. The Figures are, 1. 2. 3. 4. 5. 6. 7. 8. 9. and 0. a Cypher which is no Number of it self, but only serveth to fill up a Number, and increase the value. As a Cypher standing with f thus (10) maketh it signify Ten, to  
M which,

which, if another Cypher were added, thus (100) it stands to make the Number signify one Hundred, as by the following Table will appear,

1	Unites.	1
12	Tens.	10
123	Hundreds.	100
1234	Thousands.	1000
12345	X Thousands.	10000
123456	C Thousands.	100000
1234567	Millions.	1000000
12345678	X Millions.	10000000
123456789	C Millions.	100000000

The first Figure or Place to the right hand is always the place of Unites, the second Tens, the third Hundreds, the fourth Thousands, &c. And if there be a Sum having many Figures or places, begin from the right hand, and count three Figures, then put this Mark (,) which there signifies Thousands, then counting three Places or Figures more, put the like mark above, and if there be more Figures, still at every distance of three, put the like mark, under and above still alternately changing, so shall you easily be able to count or express your Sum, as for Example.

254,890,456,321, which is Two Hundred Fifty Four Thousand, Eight Hundred and Ninety Millions, Four Hundred Fifty Six Thousand, Three Hundred and Twenty one, the true value of this Number.

*Addition.*

*Addition* teacheth to bring several Sums into one, which is done by placing every several Number, one right under another, under which you must draw a line, that done, you must add together the Numbers of the first Rank, beginning on the right hand with the lowest Figure of same rank, and so going upwards to the highest Figure of the same Rank, and so from Rank to Rank, till you come to the last.

$$\begin{array}{r}
 2320 \\
 1575 \\
 1436 \\
 \hline
 5331
 \end{array}$$

As for Example, I spent in one year 2320 Pounds, in another 1575 Pounds, in another 1436 Pounds; setting these Sums down one under another. I add the first row of Figures saying 6 and 5 is 11, then setting down 1 I carry 1 for the Ten to the next row, saying 1 which I bring and 3 is 4 and 7 is 11 and 2 is 13; wherefore I set down 3 and carry one to the next row, saying 1 which I bring and 4 is 5

M 2

and



and 5 is 10 and 3 is 13, I set down 3 and carry 1, saying 1 and 1 is 2, and 1 is 3, and 2 is 5: So have you the whole Sum. An Example of Sums, being in Columns of Pounds, Shillings, Pence and Farthings

	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>q.</i>
takethus. Having set	1675	10	08	$\frac{3}{4}$
'em down one under	983	16	10	$\frac{1}{2}$
another, I say 3 Far-	58	19	05	$\frac{1}{4}$
things and 1 is 4 and	<u>07</u>	<u>04</u>	<u>06</u>	$\frac{3}{4}$
2 is 6, and 3 is 9 Far-	<u>2725</u>	<u>11</u>	<u>07</u>	$\frac{1}{4}$
things which being 2				

Pence Farthing, I set down the Farthing and carry 2 to the place of Pence, saying 2 and 6 is 8 and 5 is 13 and 10 is 23 and 8 is 31 Pence, which makes 2 Shillings 7 Pence, therefore set down 7 and carry 2 to the place of Shillings, saying 2 and 4 is 6, and 19 is 25, and 16 is 41, and 10 is 51 Shillings, which is 2 Pounds 11 Shillings, therefore set down 11, and carry 2, saying 2 and 7 is 9, and 8 is 17, and 3 is 20, and 5 is 25, set down 5, and carry 2, saying 2 and 5 is 7, and 8 is 15, and 7 is 22, set down 2 and carry 2, saying 2 and 9 is 11, and 6 is 17, set down 7 and carry 1 saying 1 and 1 is 2, which set down as you see here done, and you have the whole.

*Subtraction.*

*Subtraction* sheweth by taking a lesser Number out of a greater what remaineth; as for Example, I have lent one 987 18 11  $\frac{1}{4}$ , and he  $l. \quad s. \quad d. \quad q.$  hath paid me 598 Pound 987 18 11  $\frac{1}{4}$  19 Shillings, and 7 598 19 7  $\frac{1}{2}$  Pence Halfpeny, setting 388 19 4  $\frac{1}{4}$  down these two Sums,

the greater above, and the lesser underneath, I begin and say 2 Farthings from 3 and there remains 1, which I set down, then I say 7 from 11 and there remains 4, which I set down, then 19 from 18 I cannot have, wherefore I borrow 1 from the Pounds which is 20 Shillings, and say 19 from 28 and there remains 9 which I set down, then say 1 which I borrowed and 8 is 9, 9 from 7 I cannot take therefore borrow 1 (which now is but 10) and say 9 from 17 and there remains 8 which I set down, then say 1 which I borrowed and 9 is 10, which from 8 I cannot take, but (borrowing 1) from 18 there remains 8 which I also set down and then going to the last row I say one which I borrowed and 5 is 6, from 9 there remain 3, which if they agree

M 3

with

with the first Sum your Subtraction is right.

*Multiplication.*

*Multiplication* is instead of many Additions, by which any Number of a greater Denomination is brought into a less as Pounds into Shillings, Shillings into Pence, &c. which is done by multiplying the Number of Pounds by 20, the Number of Shillings by 12, &c. and Multiplication consists of three Numbers. 1. The Multiplicand or Number to be Multiplied. 2. The Multiplier or Number by which we Multiply. 3. The Product or Number made by the Multiplication. For the true order of Multiplying, and the more readiness therein, it is necessary this Table be committed to memory.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

In 1256 Pounds it is required to know how many Shillings. I set them down as you see, and because the Figure of the Multiplier is a Cypher, I set a Cypher under the first Figure and go to the next, saying 2 times 6 is 12, I set down 2 and carry 1, then 2 times 5 is 10, and one which I bring is 11, therefore I set down 1 and carry 1, then 2 times 2 is 4 and 1 which I carried is 5, so I set down 5, then I say 2 times 1 is 2, and therefore set down 2 last of all, and thus the Multiplication is finished, for 25120 Shillings makes

1256  
 20  


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 25120

M 4

1256

1256 Pounds. The proof of Multipli-  
cation is by Division, for if you dividé  
the Number produced by the Multipli-  
cation of the Multiplier, you will find  
the like Number with the Multipli-  
cand.

### Division.

*Division* is that whereby any Number  
is divided into as many parts as you will,  
serving instead of many Substractions,  
by which any Number of a less Deno-  
mination is brought into a greater De-  
nomination, as Farthings into Pence,  
Pence into Shillings, Shillings into  
Pounds, &c. by dividing the Farthings  
by 4, the Pence by 12, the Shillings by  
20. Division consists of three parts,  
1. The Dividend or Number divided.  
2. The Divisor or Number dividing.  
3. The Quotient or Number sought for.

In 8928 Ells  
*English* of *Holland*  
Cloth, how many  
pieces of *Isingham* Hol-  
land, each piece con-  
taining 36 Ells Eng-  
lish. Setting down  
the Figures as you see

Divisor.	Dividend.	Quotient
36)	8928	(248
	72	
	172	
	144	
	288	
	288	
	288	

I ask how many times 3 the first Fi-  
gure

gure of the Divisor I can have in 8 the  
 first Figure of the Dividend, the An-  
 swer is 2 times, then I set down 2 in  
 the Quotient, multiplying the Divisor  
 by the same, saying 2 times 6 is 12,  
 setting down 2 under the 9 [and carry-  
 ing 1, then 2 times 3 is 6 and 1 which  
 I carried is 7, which I set under 8, then I  
 subtract 1 from the other, so there re-  
 mains 17, which set under the Line,  
 then draw down the next Figure of  
 your Dividend which is 2, and place it  
 to the right hand of your Remainder,  
 setting a Prick under the Figure 2 to  
 signify it is already drawn down. Then  
 I ask how many times 3 in 17, an-  
 swer 5, which is 15 from 17 there re-  
 mains 2, but 5 times 6 being 30 will  
 not go in 22, therefore it must go but  
 4 times, setting 4 in the Quotient I  
 multiply the Divisor by it, and the Pro-  
 duct is 144 which I set under 172 draw-  
 ing a Line, and subtract one from the  
 other, and there will remain 28 which  
 set under the Line, then draw down 8  
 the next Figure and last of the Divi-  
 dend, setting a Prick under that in your  
 Dividend, and set 8 to the right hand of  
 your last remainder 28, then say again  
 how many times 3 in 28, Answer 9  
 times

times, but since it cannot go in the next Figure I therefore take but 8 times, and therefore I set down 8 in the Quotient, and multiplying the Divisor by 8, the Product is 288, which I set down underneath, and subtract one from the other, and there remaining nothing I find 248 is the Quotient and the number of pieces contained in 8928 Ells English of *Holland* Cloth. Another Example.

Suppose you were to divide  $34\overline{)3}$  by 10, you cut off the first Figure towards your right hand which  $346\overline{)3}$  is 3 being the Remainder, and so many parts of 10, and 346 is your Quotient, for you must understand 1 by it self can neither divide nor multiply. Note, if you are to divide by 20 as in reducing Shillings into Pounds, you need do no more but cut off the last Figure, and half the Remainder shall be your Quotient, and if the last Figure of what remains after you have cut off the said Figure be an odd Figure, there will remain more than your Quotient 10 Shillings, besides the Figure cut off, which will be so many Shillings more.

Admit

Admit it were required to reduce 7355 Shillings into Pounds ; cut off the Figure next to your right hand which is 5, then there will remain 735, then take the half thereof, saying the half of 7 is 3 and there remains 1, the half of 13 is 6, and there remains 1, and the half of 15 is 7 and there remains 1, which is 10 Shillings, which with the 5 Shillings was cut off makes 15 Shillings, so 367 Pound is the Quotient and 15 Shillings remaining.

#### IV Progression Arithmetical.

Is a brief way of adding together divers Numbers, every one surmounting the other by equal difference, as 1. 2. 3. 4. 5. where every one exceeds the former Figure by one. And for the ready performance thereof you are to work thus, first set down the Figures as 2. 5. 8. 11. 14. then count the Number of their places, which are 5, then set down 5 in a place apart, and then add the first Number and the last together, which here makes 16, take the half thereof, viz. 8. which multiply by 5 and the Product is the full Sum of all those Figures ;



gures; And if the first Number and last added together make an odd Sum, and the Number of the Places be even, then you may multiply the Addition by half the Number of Places which produce the same as the other way, and thus your Progression is finished.

*Progression Geometrical*

Differeth from the other, the Excess of that being only in Quantity but in this of Progression Geometrical the Excess is in Proportion as when the 2d. Number containeth the first in any Proportion, as 2, 3, or 4 times.

A Merchant hath sold 15 Yards of Sartin, the first for 1 Shilling, the second for 2 s. the third 4 s. &c. Now to know how much the Merchant was to have for his Sartin, set down all the Terms or Numbers to the 8th Term, then multiply the last Number (which is 128) by it self, and thereof cometh 16384 for the 15th Term, which multiplying by 2, because the Progression is double, and thereof will come 32768 from which subtract the first Term 1 there remains 32767 Shillings the Sum of the 15 Terms which

which is 1638 *l.* 7 *s.* 0 *d.* and so much the 15 yards of Sattin cost.

*Reduction*

Teacheth how to reduce a Sum or Number of a greater Denomination into a less, or on the contrary a Number of a lesser Denomination into a greater, as to turn Pounds into Shillings, Shillings into Pence, and Pence into Farthings, as you may learn before in Multiplication and Division, and hereafter in working the Rules of Proportion.

*The Rule of Proportion.*

*The Rule of Three* so called, because by 3 Numbers known, we are to find the fourth which is unknown, is likewise for its Excellency called the Golden Rule, and by some the Rule of Proportion, for that the fourth Number is found out by the Proportion it hath to other Numbers. For what Proportion the first number hath to the second, the same will the Third have to the fourth, as,

If

$$\text{If } \left\{ \begin{array}{l} 1 \\ 2 \\ 3 \end{array} \right\} \text{ cost } \left\{ \begin{array}{l} 2 \text{ s.} \\ 4 \text{ s.} \\ 9 \text{ s.} \end{array} \right\} \text{ then } \left\{ \begin{array}{l} 2 \\ 8 \\ 9 \end{array} \right\} \text{ will cost } \left\{ \begin{array}{l} 4 \text{ s.} \\ 16 \text{ s.} \\ 27 \text{ s.} \end{array} \right\}$$

Here you see the first Number is contained in the second as often as the third is contained in the fourth. First by Reduction bring your first and third Number into one Denomination, and if your second Number have any odd Money or Number, reduce them into the least Denomination, then multiply your second and third Number together, the Product divide by your first and the Quotient will be your desire or Number sought, and must always be of the same Denomination with the second Number. To prove the truth of your Operation state your Question backward.

$$\text{If } \left\{ \begin{array}{l} 4 \\ 16 \\ 27 \end{array} \right\} \text{ cost } \left\{ \begin{array}{l} 2 \text{ s.} \\ 8 \text{ s.} \\ 9 \text{ s.} \end{array} \right\} \text{ then } \left\{ \begin{array}{l} 2 \\ 4 \\ 9 \end{array} \right\} \text{ will cost } \left\{ \begin{array}{l} 1 \text{ s.} \\ 2 \text{ s.} \\ 3 \text{ s.} \end{array} \right\}$$

Working thus backwards you will find the fourth agreeable unto your first Numbers, and therefore you may conclude your work is right.

*The*

*The back Rule of Proportion.*

The back Rule of Three is so called because it produceth a Proportion quite backward or reverse to the Rule of three direct. For here in this Rule so much greater your third Number is so much less will be your fourth; as,

If 15 Shillings worth of Wine will serve for the Ordinary of 69 Men, when the Tun is worth 12 Pounds, for how many Men will the same 15 Shillings worth of Wine be sufficient when the Tun is worth 18 Pounds.

If 12 *l.* suffice 69 Men. How many 18 *l.*

Answer 46 Men.

Here you multiply your first Number by your second, or 2 Number by your 1, *viz.* 69 by 12, and the Product will be 828, which you must divide by your third Number, *viz.* 18, and the Quotient will be 46 the Number of Men required.

*The*

*The Rule of Proportion Compos'd.*

The Rule of Three Compos'd is so called because it is a Composing of two Questions or Operations of the Common Rule of three into one. Which two Questions may require a Direct Proportion or a Reverse Proportion, or one part may be Direct and the other Reverse, and so require a different Operation.

There belongs to this Rule always five Numbers, the first three contain a supposition, the two last a Question to which the Number found or sixth Number must be the Answer.

*First part in the Rule Direct.*

The five Terms or Numbers given, must be so placed that the first and fourth may be of one Denomination, the second and fifth of another, but like to one another, and the Answer in the sixth, the same with the third. And then multiply your first Number by your second and the Product shall be your Divisor, then multiply the other three Numbers together, and the Pro-

Product shall be your Dividend. And then Divide and the Quotient is the Number; as,

If 100 Crowns in 12 Months gain 15 Pounds what 60 Crowns in 8 Months? Answer 6 Pounds.

*The second part of the Rule.*

The third Number is like unto the fifth and the Operation is thus. Multiply your third Number by your fourth; and the Product shall be your Divisor; then Multiply your first Number by your second, and the Product by your fifth; and the Product shall be your Dividend, then Divide and the Quotient is your desire; as,

If 60 Crowns, 8 Months gain 6 Pounds; in how many Months will 100 gain 15 Pounds? Answer 12 Months.

Multiply your third Number 6 by the fourth 100, and the Product is 600 for your Divisor, then Multiply the other 3 Numbers together, and the Product 7200 is your Dividend, then divide and the Quotient will be 12, the Number of Months required.

*The third part of the Rule.*

In this third part of the Rule may be five Numbers or more, and the first and last Number are always different. The Operation whereof is thus.

The Question being from the last Number to the first, multiply the Number you would know by the Numbers which you give the value by the Multiplication of the Numbers already valued, and the Quotient is the Number required ; as for Example,

*If 4 Deniers Paris be worth 5 Deniers Tournois, and 10 Deniers Tournois be worth 12 Deniers Savoy ; how many Deniers Paris are 8 Deniers Savoy worth ?*

Multiply 8 Deniers *Savoy*, being the Number you would know, by 4 Deniers *Paris*, and the Product by 10 Deniers *Tournois*, those being the Numbers which give the value, the Product is 320. Then Multiply the five Deniers *Tournois* by 12 Deniers *Savoy*, being the Numbers already valued, the Product is 60. Then Divide 320 by 60, the Quotient is 5 and  $\frac{2}{3}$  *Paris*, and so much are 8 Deniers

Deniers Savoy worth. And they will stand thus.

Paris. Tournois. Tournois. Savoy. Savoy. Paris  
 4      5      10      12      8      5  $\frac{1}{2}$

*The fourth part of the Rule:*

Here the first and last Numbers are always of one Denomination. And the Operation is thus. The Question is from the last Number to the last saving one.

Multiply the Number you would know, by the Multiplication of the Number already valued, and the Product thereof Divide by the Product of the Multiplication of the Numbers which give the value; and the Quotient is the Number required; as,

If Paris. Tournois. Tournois. Savoy. Paris. Savoy.  
 4 d.      5 d.      10 d.      12 d.      15 d.      22 d.  $\frac{1}{2}$

Multiply 15 den. Paris by 5 Tournois, and the Product by 12 Savoy, being the Numbers already valued, and they make 900, which divide by 40, the Product of the Multiplication of the Numbers, which give the value, and the Quotient will be 22 d.  $\frac{1}{2}$ , the Number required.



*Numeration of Fractions.*

In Fractions are always two Numbers which are always placed with a Line drawn between them thus  $\frac{1}{2}$  ;  $\frac{1}{3}$  ;  $\frac{1}{4}$  , &c. whereof that above is called the Numerator, and that Figure or Figures underneath is called the Denominator.

And Fractions or broken Numbers are either Properly so called, or Improperly so called. They are properly so called when there are one or many parts of a Number, which yet do not amount to a whole Number, but are only Progreding or Augmenting parts, as  $\frac{1}{2}$  ;  $\frac{2}{3}$  ;  $\frac{3}{4}$  ;  $\frac{4}{5}$  ;  $\frac{5}{6}$  &c. which do proceed Infinitely, yet never amount to a whole Number. Or else are progreding or diminishing parts, as  $\frac{1}{2}$  ;  $\frac{1}{4}$  ;  $\frac{1}{8}$  ;  $\frac{1}{16}$  ;  $\frac{1}{32}$  ;  $\frac{1}{64}$  ;  $\frac{1}{128}$  ;  $\frac{1}{256}$  , &c. which do likewise proceed infinitely, yet never amount to a c, or come to signify nothing. Fractions Improperly so called, are those which have the Denominator lesser than the Numerator, as  $\frac{6}{4}$  ; &c. where the Numerator being greater than the Denominator, you may subtract the Denominator from the Numerator, which you may do taking once 4 out of 6 and there remains 2, which remain-  
ing

ing 2 is  $\frac{2}{4}$ , so that the improper Fraction  $\frac{6}{4}$  being reduced, is properly one whole Number, and  $\frac{2}{4}$ , that is two fourth parts of the whole Number. And all Fractions are expressed after this manner,  $\frac{1}{2}$  one half,  $\frac{2}{3}$  two thirds or two third parts of a whole Number,  $\frac{3}{4}$  three fourths,  $\frac{4}{5}$  four fifths, &c. which you may extend infinitely as Practice and Experience will inform you.

### *Reduction of Fractions.*

Forasmuch as we may not work the other Rules of Arithmetick in Fractions without the help of Reduction, we therefore place Reduction before 'em, whose usefulness will appear in the Operation, which is in manner following.

#### 1 Rule.

*Reduction of Fractions of several Denominations, into one common Denomination.*

Multiply the Denominators one by the other, and the Product is your common Denominator which common Denominator you must divide by the particular

N 3

ticular

ticular Denominators of every Fraction, and Multiply every Quotient by his own Numerator, and the Product is your new Numerator, for every of those Fractions you would reduce. As for Example.

If you will reduce  $\frac{2}{3}$  and  $\frac{4}{5}$  together, Multiply your Denominators, saying 3 times 5 is 15 for your common Denominator, then divide 15 by 3, the Quotient is 5, which Multiply by 2 your first Numerator and the Product is 10, which I place over 15, and so I find  $\frac{10}{15}$  equal to  $\frac{2}{3}$ . Then I divide 15 by 5 the Quotient will be 3, which I Multiply by 4 its Numerator, and the Product is 12, which I set over 15, and so find  $\frac{12}{15}$  equal to  $\frac{4}{5}$ . And this may suffice for the first Rule in Reduction.

### 2 Rule.

*Reduction of Fractions or Broken Numbers.  
Of Broken, is thus :*

Multiply all the Numerators together to make thereof one Numerator, then Multiply the Denominators together for your Denominator; as, If you would reduce  $\frac{2}{3}$  of  $\frac{1}{4}$  of  $\frac{4}{5}$  into one Fraction

on, Multiply your Numerators, they make 8. Then Multiply your Denominators and the Product is 60, thus you find  $\frac{8}{60}$  equal in value to  $\frac{2}{3}$  of  $\frac{1}{4}$  of  $\frac{1}{5}$ . And if you will reduce several parts of Fractions together, as if you will reduce  $\frac{2}{3}$  of  $\frac{1}{4}$  of  $\frac{1}{5}$ , and  $\frac{1}{4}$  of  $\frac{1}{5}$ , and the  $\frac{1}{2}$  of the  $\frac{1}{3}$  of  $\frac{2}{3}$  of  $\frac{1}{4}$ . First you must of every part make one Broken Number, by this second Rule of Reduction as before. And afterwards you must by the first Rule of Reduction, reduce them all into one Denomination. As your first part which is  $\frac{2}{3}$  of  $\frac{1}{4}$  of  $\frac{1}{5}$  being reduced will be  $\frac{8}{60}$  as above. Your second part being  $\frac{1}{4}$  of  $\frac{1}{5}$  will be  $\frac{15}{60}$ . And your third part which is the  $\frac{1}{2}$  of the  $\frac{1}{3}$  of  $\frac{2}{3}$  of  $\frac{1}{4}$  being reduced will be  $\frac{2}{30}$ , which by the first Rule you must reduce into one Denomination, and so will find  $\frac{4}{60}$  for the  $\frac{2}{30}$ , and  $\frac{32400}{60}$  for the  $\frac{15}{60}$ , and  $\frac{32400}{60}$  for the  $\frac{8}{60}$ , which may be Abbreviated, but we deferr that till we come to the Rule of Abbreviation.

## 3 Rule.

*Reduction of Broken Numbers, and the parts of Broken together.*

If you would reduce the  $\frac{1}{2}$  and  $\frac{1}{3}$  of  $\frac{1}{6}$  together, you multiply the two Denominators together, which here maketh 6, and set that down for the Denominator. Then Multiply the first Numerator by the last Denominator, which here makes 2, then add the last Numerator to it, which here makes 3. And thus you will find that  $\frac{3}{6}$  is in one Fraction equal to  $\frac{1}{2}$  and the  $\frac{1}{3}$  of  $\frac{1}{6}$ . Likewise if you will reduce  $\frac{2}{3}$  and  $\frac{1}{4}$  of  $\frac{1}{12}$ , you must work as before and you will find  $\frac{11}{12}$ , which are worth, or are of the same value with  $\frac{2}{3}$  and  $\frac{1}{4}$  of  $\frac{1}{12}$ . And being Abbreviated make or is the same with  $\frac{11}{12}$  as by the Rule of Abbreviation will appear.

## 4 Rule.

## 4 Rule.

*Reduction of whole Numbers and Broken,  
into Broken Numbers, which may be called  
Improper Fractions,*

If you would reduce  $17\frac{5}{8}$  into one Improper Fraction, you Multiply the whole Number 17 by the Denominator 8, which will make 136, and thereto add your Numerator 5, and it will be 141, which you must set down for your new Numerator over the Line, then set your old Denominator under the Line, and thus have you  $17\frac{5}{8}$  in an Improper Fraction equal unto the whole Number and broken  $17\frac{5}{8}$ .

Again if you would reduce a whole Number and broken with a broken Number, as to reduce  $10\frac{2}{3}$  and  $\frac{4}{7}$  together, you must reduce the whole 10 into its broken  $\frac{2}{3}$  as by the last Rule above, which will be  $12\frac{2}{3}$ . Then Reduce  $12\frac{2}{3}$  and  $\frac{4}{7}$  into one Denomination by the first Rule of Reduction, and you have  $22\frac{4}{21}$  for the  $12\frac{2}{3}$  and  $12\frac{2}{21}$  for the  $\frac{4}{7}$ , as appeareth by the Operation and Practice.

And

And thirdly if you have as well whole Numbers as broken in both parts, then you must reduce every whole Number into its broken as above by this fourth Rule of Reduction is directed. And then reduce them into one common Denomination by the first Rule in Reduction, and you shall find Improper Fractions equal to your whole Numbers and Fractions, as if you would reduce  $12\frac{1}{2}$  and  $14\frac{2}{3}$  into one Denomination. First reduce  $12\frac{1}{2}$  all into fourths, and you shall find  $49\frac{2}{4}$ , then reduce  $14\frac{2}{3}$  all into thirds and you shall find  $47\frac{2}{3}$  then reduce  $49\frac{2}{4}$  and  $47\frac{2}{3}$  together by the first Rule in Reduction and you will find them to be  $91\frac{2}{12}$  and  $91\frac{8}{12}$  as by the Operation appears.

*Proof of Reduction.*

If you Abbreviate the Broken Numbers which be reduced, you shall return them into their first Estate, as if you reduce  $\frac{2}{3}$  with  $\frac{2}{3}$ , you shall find  $\frac{1}{3}$  and  $\frac{1}{3}$ , then Abbreviate  $\frac{1}{3}$  you will find  $\frac{2}{3}$ , Abbreviate also  $\frac{1}{3}$  and thereof cometh  $\frac{2}{3}$  as before.

*Abbre-*

*Abbreviation of Fractions.*

*Abbreviation* is by expressing or setting down a Fraction of many Figures in a lesser Number of Figures without diminishing the value, and the Operation is thus. Divide the Numerator and the Denominator by the greatest whole Number you can, and the Quotient of your Numerator shall be your Numerator, and the Quotient of the Denominator shall be the Denominator; as if you would Divide or Abbreviate  $\frac{54}{81}$ , you shall find 27 the greatest Number you may divide by, which you may have twice in the Numerator 54, therefore I set down 2 for the Numerator; and I may have 27 three times in 81, and therefore I set down 3 for the Denominator, and thus is  $\frac{54}{81}$  Abbreviated to  $\frac{2}{3}$  which is of equal value.

Now to find out the greatest Number you may divide by, your Rule is first to divide the Denominator by your Numerator, and if any thing remain, divide your former Divisor by that Number, and so continue to divide your Divisor by your Remainder till  
nothing



nothing remain, then your last Divisor is the greatest Number by which you must Abbreviate; that is thus, in the first Example of  $\frac{81}{54}$  Divide 81 by 54, there will remain 27, then divide 54 by 27 and there remains 0, wherefore 27 is the Number by which you must Abbreviate.

And there is likewise another way of Abbreviating, which is by taking half of the Numerator and likewise of the Denominator as often as you can; Or otherwise by dividing the Numerator and likewise the Denominator by 3. 4. 5. 6. 7. 8. 9. or 10. as you find you may. And if your first Figure or Figures be a Cypher, you may Abbreviate by 10 by cutting off the Cyphers and leaving the rest for the Fraction, as  $\frac{30}{100}$  which makes it  $\frac{3}{10}$ , or by 100, as  $\frac{300}{1000}$  which makes  $\frac{3}{10}$ , and altho' all Numbers may not be Abbreviated by this Rule, yet all Fractions or broken Numbers may by the first Rule be well Abbreviated.

*Proof*

*Proof of Abbreviation.*

If you Multiply the Number Abbreviated by the Number or Numbers you did Abbreviate by, you shall return them again into their first Estate, as if you Abbreviate  $\frac{3}{4}$  by 16, you will find it  $\frac{2}{3}$ , then Multiply the Numerator and the Denominator by 16, and you will find  $\frac{3}{4}$  as before.

*Addition of Fractions.**1 Rule.*

The Rule for Addition of Fractions is if the Denominators be unlike, to reduce them into one common Denomination. Then add the Numerators together and set down the Sum of the Addition for the Numerator, and if the Numerator be greater than the Denominator, then divide the Numerator by the Denominator, and the Quotient is the value of the Addition in whole Numbers, and if any remain that is to be placed as a Fraction with the Common Denominator, as if you would add  $\frac{3}{4}$  and  $\frac{2}{3}$  together, you must reduce  
into

into one Common Denominator by the first Rule of Reduction, and they will be found to be  $\frac{8}{12}$  and  $\frac{9}{12}$ . Then add the two Numerators together, and they will make  $17$  which is your Numerator, and  $12$  being your Denominator it will be  $\frac{17}{12}$ . Now the Numerator being greater than the Denominator you must divide it by the Denominator, and you will find  $1$  for your Quotient and  $5$  remaining, which you must place as a Fraction with the common Denominator, and then you will find  $1$  and  $\frac{5}{12}$  to be the Sum of the Addition.

### 2 Rule.

#### *Addition of many broken Numbers together.*

And if you would reduce many broken Numbers together, first reduce and add the two first together, and then the two latter as by the Rule last above. then add those two Fractions which come thereof together as by the same Rule, and you have the Sum of the Addition, as if you would add  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{3}{4}$  and  $\frac{4}{5}$  together. First add the  $\frac{1}{2}$  and  $\frac{2}{3}$  together

ther, and you shall find them to be  $\frac{2}{3}$ , then add the  $\frac{1}{3}$  and  $\frac{1}{3}$  and they will make  $\frac{2}{3}$ , then add  $\frac{2}{3}$  and  $\frac{2}{3}$  together by the same last Rule, and you will find them to be  $\frac{4}{3}$ , which then divide 326 by 120, and thereof cometh 2 and 86 remaineth, which is  $\frac{86}{120}$ , and being Abbreviated is  $\frac{43}{60}$ , and thus  $2\frac{43}{60}$  is the Sum Total of that Addition as by the Operation will appear.

3 Rule.

*Addition of Fractions of Fractions or Broken Numbers.*

Reduce the first Numbers according to the second Rule of Reduction, Multiplying the first Numerators for to produce a Numerator, and the Denominators of the same for the Denominators, then do the like by the latter Numbers. Then Abbreviate the said Fractions, or which of them will be Abbreviated, and then add them together

$$\begin{array}{r} 24 \qquad 25 \\ \hline \frac{2}{3} \quad \frac{1}{4} \quad \frac{1}{5} \quad \frac{1}{6} \quad \frac{1}{8} \quad \frac{1}{9} \\ \hline 60 \quad 5 \quad 96 \end{array}$$

$$\begin{array}{r} 192 \qquad 125 \\ \hline 317 \\ \hline \frac{2}{5} \qquad \frac{25}{96} \\ \hline 480 \end{array}$$

as

as by the first Rule of Addition. As to add  $\frac{2}{7}$  of  $\frac{1}{4}$  of  $\frac{3}{8}$  with the  $\frac{5}{8}$  of the  $\frac{1}{2}$  of  $\frac{1}{2}$ , first Multiply the Numerators of the first 3 Fractions for the Numerator, then Multiply the Denominator of those 3 Fractions for the Denominator, and you will find them to be  $\frac{30}{224}$ , which Abbreviated is  $\frac{15}{112}$ . Then do the like by the other 3 Fractions, and you will find them to be  $\frac{25}{112}$ , which cannot be Abbreviated then add the  $\frac{15}{112}$  to  $\frac{25}{112}$  by the first Rule of Addition, and you will find the whole to be  $\frac{40}{112}$  which cannot be Abbreviated, and therefore the Addition is ended as may appear.

#### 4 Rule.

*Addition of Broken Numbers and Parts of Broken, with Broken and Parts of Broken.*

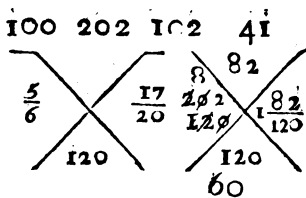
As if you would add  $\frac{3}{7}$  and  $\frac{1}{2}$  of  $\frac{1}{7}$  with the  $\frac{1}{2}$  and  $\frac{1}{7}$  of  $\frac{1}{2}$  reduce the  $\frac{3}{7}$  and  $\frac{1}{2}$  into one Fraction by the third Rule of Reduction and thereof cometh  $\frac{5}{14}$ , then re-

$$\begin{array}{r} 20 \\ \times 5 \\ \hline 100 \\ \times 4 \\ \hline 400 \\ \hline 17 \end{array}$$

$$\begin{array}{r} 6 \\ \times 3 \\ \hline 18 \\ \times 2 \\ \hline 36 \\ \hline 5 \end{array}$$

duce

duce the  $\frac{4}{5}$  and  $\frac{1}{5}$  by the same Rule, and there- of cometh  $\frac{17}{20}$ . Lastly add  $\frac{1}{5}$  and  $\frac{17}{20}$  together by the first

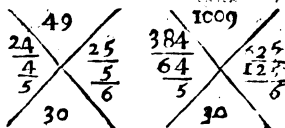


Rule of Addition; and you will find the Sum to be  $\frac{120}{60}$ , which being divided maketh one whole Number, and  $\frac{60}{60}$ , which being Abbreviated makes  $\frac{1}{60}$ , as by practice appears, and is  $1\frac{1}{60}$ .

5 Rule.

*Addition of whole Number and Broken; with whole Number and Broken.*

If you will add  $12\frac{4}{5}$  with  $20\frac{1}{6}$ , you may add 12 and 20 which make 32



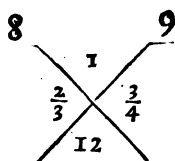
and set them apart. Then the Broken Numbers  $\frac{4}{5}$  and  $\frac{1}{6}$  by the first Rule of Addition and they make  $\frac{19}{30}$ , therefore divide 49 by 30 and it makes 1 and 19 remaining, which is  $1\frac{19}{30}$  and in the Sum of Addition is  $33\frac{19}{30}$ , or otherwise may reduce  $12\frac{4}{5}$  into an Improper Fraction by

by the fourth Rule of Reduction and they will be  $\frac{2}{3}$ , then reduce  $20\frac{1}{2}$  and they will be  $\frac{41}{2}$ , then add  $\frac{2}{3}$  with  $\frac{41}{2}$  by the first Rule of Addition, and you will find  $\frac{82+84}{6} = \frac{166}{6}$ , therefore divide 1009 by 30, thereof cometh  $33\frac{1}{2}$  as before, and as by practice of the same both ways will appear.

### Subtraction of Fractions.

#### 1. Rule.

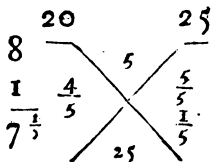
If you will subtract  $\frac{2}{3}$  from  $\frac{3}{4}$  reduce both into a common Denomination by the first Reduction and you will find  $\frac{8}{12}$ , for that and  $\frac{6}{12}$  for the  $\frac{2}{3}$ , then subtract the 6 from 8, there will rest 2 which is the Remainder of that Subtraction as here appeareth.



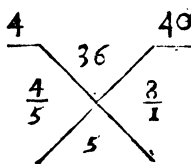
#### 2 Rule.

2 Rule.

If you have a Broken Number to be Subtracted from a whole, borrow an Unite from the whole Number, and Reduce it into a Fraction of like Denomination with the Fraction you would abate, and then abate the Fraction therefrom, and you will find the Remainder. As to abate  $\frac{2}{5}$  from 8, or to subtract  $\frac{2}{5}$  from 8, borrow 1 from 8 and resolve it into fifths, making thereof  $\frac{8}{5}$ , then abate  $\frac{2}{5}$  from  $\frac{8}{5}$ , there will remain  $7\frac{1}{5}$  as appeareth.



Or otherwise you may put down  $\frac{2}{5}$  with  $\frac{2}{5}$  and reduce them into a common Denomination, and you will find them to be  $\frac{4}{5}$  and  $\frac{8}{5}$ , then Subtract  $\frac{4}{5}$  from  $\frac{8}{5}$ , there will remain  $\frac{4}{5}$ . As by the Operation appears.







by the Operation, then divide 90 by 8 the Quotient will be 11 and 2 remaineth, which is  $\frac{2}{8}$  or  $\frac{1}{4}$ ; and thus you find the Remainder to be  $11\frac{1}{4}$ , as by the Example appears.

5 Rule.

To subtract Broken Numbers of Broken from Fractions of Fractions. If you would subtract  $\frac{1}{2}$  of  $\frac{2}{3}$  of  $\frac{3}{4}$  from the  $\frac{1}{2}$  of  $\frac{3}{4}$  of  $\frac{1}{2}$  first bring the Numbers of the first part into one Fraction, and likewise the Numbers of the latter part by the second Rule

$$\begin{array}{r|l} 6 & 105 \\ \hline \frac{1}{2} \times \frac{2}{3} \times \frac{3}{4} & \frac{1}{2} \times \frac{3}{4} \times \frac{1}{2} \\ \hline 30 & 192 \end{array}$$

$$\begin{array}{r} 64 \qquad 175 \\ \hline \text{III} \\ \frac{1}{5} \times \frac{35}{64} \\ \hline 520 \end{array}$$

of Reduction, and you will have  $\frac{3}{8}$  for the first three Broken Numbers, and they being Abbreviated do make  $\frac{1}{2}$ , and for the other three Numbers  $\frac{1}{9}$  which likewise Abbreviated do make  $\frac{1}{6}$ , then reduce them into a Common Denomination, and subtract them by the first Rule of Subtraction and you will find  $\frac{1}{3}$  remaining; as by the Example appears.

*Proof of Subtraction.*

Add the Number which remaineth with the Number you did subtract, and you will find the Total Sum, as if you subtract  $\frac{1}{4}$  from  $\frac{1}{3}$  there will remain  $\frac{1}{12}$ ; the Proof is thus, add  $\frac{1}{12}$  and  $\frac{1}{4}$  together, you will find  $\frac{1}{3}$  which being Abbreviated doth make  $\frac{1}{3}$  which is the greatest Number.

*Multiplication of Fractions.***I Rule.***To Multiply Two Broken Numbers.*

Multiply the Numerator of the one by the Numerator of the other, and the Denominator of the one by the Denominator of the other, and then divide the Product of the Numerator if it may be; or else Abbreviate them if it may be Abbreviated and your Multiplication is done. As if you would multiply  $\frac{2}{3}$  by  $\frac{3}{4}$  setting them down, Multiply the two Numerators, saying 2 times 3 is 6 which you must set above, then Multiply the Denominators together and they will make

make 12 which set down underneath. Now because the Numerator is less than the Denominator you cannot divide it, and therefore you must only Abbreviate it, and you will find it to be  $\frac{1}{2}$  as here you see.

$$\begin{array}{r} 6 \\ \hline \frac{2}{3} \overline{) 12} \\ \underline{6} \phantom{0} \\ 6 \phantom{0} \\ \underline{6} \\ 0 \end{array} \quad \begin{array}{r} 1 \\ \frac{2}{3} \\ \hline 2 \end{array}$$

2 Rule.

*To Multiply a Broken Number by a whole Number, or a whole Number by a Broken.*

Reduce or make your whole Number into a Broken, as to multiply 8 by  $\frac{2}{3}$ , or else 18 by  $\frac{2}{3}$ , set down 8 and  $\frac{2}{3}$  and then multiply your Numerators together, and your Denominators together and you will find  $16\frac{2}{3}$ , then divide 72 by 5, and you will find  $14\frac{2}{5}$  in the Quotient for the whole of your Multiplication, or otherwise abate from  $18\frac{2}{3}$  part which is  $3\frac{1}{3}$  and there remaineth  $14\frac{2}{3}$  as before.

$$\begin{array}{r} 72 \\ \hline 4 \quad 18 \\ \hline 5 \end{array} \quad \begin{array}{r} 22 \\ 72 \left( 14\frac{2}{3} \\ 55 \end{array}$$

$$\begin{array}{r} 18 \\ \hline 18 \quad 1 \\ \hline 5 \end{array} \quad \begin{array}{r} 3 \\ 18 \left( 3\frac{3}{5} \\ 5 \end{array} \quad \begin{array}{r} 18 \\ 3 \frac{3}{5} \\ \hline 14\frac{2}{3} \end{array}$$

3 Rule.

To Multiply a whole Number by whole Number and Broken, or whole Number and Broken by a whole Number.

As to Multiply 15 by  $16\frac{3}{4}$ , or  $16\frac{3}{4}$  by 15, first reduce your  $16\frac{3}{4}$  and that will make  $6\frac{2}{3}$ , which you must Multiply by  $1\frac{1}{2}$  by the Rule above, and you will find the Product to be  $25\frac{1}{4}$  as by practice will appear.

$$\begin{array}{r} 1005 \\ \hline 4 \quad 2 \quad 12 \\ \hline 4 \end{array} \quad \begin{array}{r} 201 \\ 1005 \left( 25\frac{1}{4} \\ 444 \end{array}$$

4 Rule.

4 Rule.

To Multiply a Broken Number by whole Number and Broken, or else whole Number and Broken by a Broken Number.

As if you would Multiply  $\frac{1}{4}$  by  $18\frac{2}{3}$ , or else  $18\frac{2}{3}$  by  $\frac{1}{4}$ , reduce the whole Number into its Broken, and you will find  $\frac{56}{3}$ , which you are to Multiply by  $\frac{1}{4}$  according to the Doctrine of the first Multiplication and it amounteth to  $\frac{56}{12}$ , then divide 56 by 12, the Quotient is  $4\frac{2}{3}$  which is the Sum of that Multiplication, as by Example appears.

$$\begin{array}{r} 56 \\ \hline \frac{1}{4} \\ \hline 12 \end{array} \quad \begin{array}{r} 18 \\ 56 \left( 4\frac{2}{3} \right. \\ \hline 12 \end{array}$$

5 Rule.

To Multiply whole Number and Broken with whole Number and Broken.

As if you would Multiply  $12\frac{2}{3}$  by  $6\frac{1}{4}$  reduce each whole Number into its Fraction, and you will find them  $\frac{26}{3}$  and

and  $\frac{2}{4}$ , then multiply them by the Doctrine of the first Multiplication and they will produce  $\frac{1728}{20}$ , then divide 1728 by 20, thereof cometh  $86\frac{2}{5}$  for the whole Multiplication, as by Example.

$$\begin{array}{r} 1728 \\ \hline \frac{2}{4} \quad \frac{2}{4} \\ \hline \end{array} \quad \begin{array}{r} 20 \\ 1728 / \\ \hline 200 \quad 86\frac{2}{5} \\ 2 \end{array}$$

### 6 Rule.

*To Multiply one Broken by many Broken Numbers.*

As to Multiply  $\frac{2}{3}$  by  $\frac{1}{7}$  and by  $\frac{2}{5}$ , Multiply all the Numerators together for the numerator, and all the Denominators for the Denominator, and you will find them to be  $\frac{40}{105}$ , which is the Sum of this Multiplication. And this is your Rule for all others of the like nature.

$$\begin{array}{r} 40 \\ \hline \frac{2}{3} \quad \frac{1}{7} \quad \frac{2}{5} \\ \hline 105 \end{array} \quad \begin{array}{r} 40 \\ 189 \end{array}$$

*Proof*

*Proof of Multiplication of Fractions.*

Divide the Product of the Multiplier by the Multiplier you shall find in your Quotient the Multiplicand. Or divide the Total Sum of the Multiplication you shall find in the Quotient the Multiplier, as the Product of  $\frac{2}{3}$  multiplied by  $\frac{4}{7}$  will be  $\frac{8}{21}$ , divide  $\frac{8}{21}$  by  $\frac{4}{7}$  you will find  $\frac{2}{3}$ , or divide  $\frac{8}{21}$  by  $\frac{2}{3}$  thereof cometh  $\frac{4}{7}$  as by practice will appear.

*Division of Fractions.***I Rule.***To Divide Broken Numbers by Broken.*

Set down your Divisor first towards your left hand and your Dividend after it, then Multiply Crosswise the Numerator of your Divisor by the Denominator of your Dividend, and the Product is your new Denominator. Then Multiply the Numerator of your Dividend by the Denominator of your Divisor, and the Product is your new Numerator. Then Divide your new Nu-



Numerator by your new Denominator if it may be divided or else Abbreviate them if they may be Abbreviated, and the Quotient or Abbreviation is your desire.

As if you would divide  $\frac{3}{4}$  by  $\frac{2}{3}$ , set them down in the order above directed, and Multiply them crosswise and you will find the Product to be  $\frac{9}{8}$ , then divide 9 by 8 you will find 1 and  $\frac{1}{8}$ , and so often is  $\frac{9}{8}$  in  $\frac{3}{4}$  as appears by the Operation.

$$\begin{array}{ccc} & 9 & \\ \frac{2}{3} & \times & \frac{3}{4} \\ & 8 & \end{array}$$

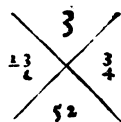
But if you will divide  $\frac{2}{3}$  by  $\frac{3}{4}$  set down your Divisor and Dividend in order accordingly, and Multiply Crosswise as before directed, and you will find them  $\frac{8}{9}$ , as by the Operation will appear.

$$\begin{array}{ccc} & 8 & \\ \frac{3}{4} & \times & \frac{2}{3} \\ & 9 & \end{array}$$

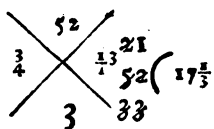
**2 Rule.**

To divide a Broken Number by a whole Number, Or a whole Number by a Broken.

As if you would divide  $\frac{3}{4}$  by 13 set  $\frac{13}{1}$  for your Divisor and  $\frac{3}{4}$  for your Dividend, and Multiply crosswise as by the first Rule of Division is directed. and you will find  $\frac{39}{4}$ , and your Division is ended as appears.



But if you will divide 13 by  $\frac{3}{4}$  you set down your Divisor and Dividend in a contrary Order and Multiply as before, and you will find the Product to be  $\frac{39}{4}$ , then divide 39 by 4, and you will find  $9\frac{3}{4}$ , and so often is  $\frac{3}{4}$  in 13 as doth appear.



**3 Rule.**

## 3 Rule.

To divide whole Number by whole Number and Broken, or whole Number and Broken by whole Number.

As if you would divide 20 by  $5\frac{1}{2}$ , reduce  $5\frac{1}{2}$  and you shall have  $3\frac{1}{2}$  for your Divisor, and  $2\frac{0}{1}$  for your Divi-

$$\begin{array}{r} 120 \\ \times 3\frac{1}{2} \\ \hline 35 \\ \times 20 \\ \hline 700 \\ \hline 120 \\ \hline 1400 \end{array}$$

end. Then Multiply crosswise and your Product will be  $\frac{120 \times 20}{35}$ . Then Divide 120 by 35 and you will find your Quotient 3 and  $\frac{15}{35}$ , which being Abbreviated makes  $\frac{3}{7}$ , and so is Fraction produced which makes  $3\frac{3}{7}$  as appears.

But if you will divide  $5\frac{1}{2}$  by 20, change the order of setting down your Divisor and Dividend, and

$$\begin{array}{r} 35 \\ \times 3\frac{1}{2} \\ \hline 105 \\ \hline 175 \\ \hline 105 \\ \hline 122\frac{1}{2} \end{array}$$

Multiply crosswise as before directed and you will find the Product to be  $122\frac{1}{2}$  which you may Abbreviate, and thereof cometh  $3\frac{3}{7}$  for your Quotient as will appear.

## 4 Rule.

4 Rule.

To divide a Broken Number by a whole Number and Broken, or whole Number and Broken by whole Number.

As to divide  $\frac{3}{4}$  by  $13\frac{2}{3}$ , set them down your Divisor and Dividend in order afore-said and Multiply crosswise as before directed, and you will find your Product to be as in the Margent.

$$\begin{array}{r} 9 \\ \times \frac{3}{4} \\ \hline 164 \end{array}$$

But if you will divide  $13\frac{2}{3}$  by  $\frac{3}{4}$  set down, reduce and multiply them in order above directed and you will find the Product  $164\frac{2}{3}$ , then divide 164 by 9, the Quotient will be  $18\frac{2}{3}$  as appeareth.

$$\begin{array}{r} 164 \\ \times \frac{4}{3} \\ \hline 9 \end{array}$$

5 Rule.

## 5 Rule.

To divide whole Number and Broken, by whole Number and Broken.

As to divide  $7\frac{1}{4}$  by  $13\frac{3}{4}$ , reduce the whole Numbers into their broken by the Doctrine of the fourth Reduction and you will find  $3\frac{1}{4}$  for the  $7\frac{1}{4}$ , and  $4\frac{1}{4}$  for the  $13\frac{3}{4}$ , then set them down in order and Multiply crosswise as before, and thereof cometh  $164$  as appeareth.

$$\begin{array}{ccc} & 93 & \\ \frac{3\frac{1}{4}}{\times} & & \frac{4\frac{1}{4}}{\times} \\ & 164 & \end{array}$$

But if you will divide  $13\frac{3}{4}$  by  $7\frac{1}{4}$  change your order in setting them down and Multiply crosswise as before, and you will find the Product to be  $164$ , then divide 164 by 93, and you will find your Quotient to be  $1\frac{7}{93}$ , as will appear by Practice.

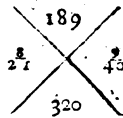
$$\begin{array}{ccc} & 164 & \\ \frac{3\frac{1}{4}}{\times} & & \frac{4\frac{1}{4}}{\times} \\ & 93 & \end{array} \quad \begin{array}{l} 7 \\ 164 \overline{) 164} \left( 1 \frac{7}{93} \\ \underline{93} \end{array}$$

## 6 Rule:

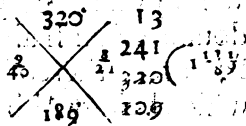
6 Rule

To divide by Broken Numbers of Broken:

You must reduce all your Broken Numbers into two Broken Numbers; one for the Divisor, and the other for the Dividend, and then work as in the foregoing Rules. As if you will divide  $\frac{4}{7}$  of  $\frac{3}{5}$  of  $\frac{2}{3}$  by the  $\frac{2}{3}$  of  $\frac{7}{7}$ , the three first Numbers being reduced into one Fraction will be  $\frac{8}{35}$ , then the two latter reduced will be  $\frac{2}{7}$ , set them down in order for your Divisor and Dividend, and Multiply Crosswise as in the foregoing Rules, and you will find the Product to be  $\frac{112}{245}$  for the Sum of this Division, as by the Operation will appear.



But if you would divide  $\frac{2}{7}$  by  $\frac{4}{5}$ , reduce them as before set them in the contrary Order and Multiply Crosswise as above, and you will find the Product  $\frac{10}{28}$  then



then divide 320 by 189, and thereof cometh in the Quotient  $1\frac{1}{3}$ , as appears.

*Proof of Division.*

Multiply the Quotient by the Divisor, you shall find the Number divided, as if you divide  $\frac{2}{3}$  by  $\frac{1}{3}$  your Quotient will be  $\frac{2}{1}$ , then Multiply  $\frac{2}{1}$  by  $\frac{1}{3}$ , the Product will be  $\frac{2}{3}$ , which being Abbreviated are  $\frac{2}{3}$ , and is the same with your Dividend.

*Duplation, &c. of Fractions.*

If you will double any Fraction or Broken Number, you must divide the same by  $\frac{1}{2}$ . If you will triple it, you must divide it by  $\frac{1}{3}$ , and for the Quadruple any Broken Number, you must divide it by  $\frac{1}{4}$ . As by the Example of Duplation will appear. If you would double  $\frac{3}{8}$  you shall divide  $\frac{3}{8}$  by  $\frac{1}{2}$ , and thereof cometh  $\frac{6}{8}$  which being Abbreviated make  $\frac{3}{4}$  as by Example appears.

$$\begin{array}{r} \frac{3}{8} \\ \times \frac{1}{2} \\ \hline \frac{6}{8} \end{array}$$

Or

Or otherwise if the Denominator be an even Number, you may only take the half of the Denominator, and let the Numerator still remain with the half of the Denominator, and the work is done which here you will find to be  $\frac{1}{2}$  as before, and if your Numerator be an odd Number Multiply it by 2 if you are to double it, or three if you are to triple it, &c. and let your Denominator stand the same and your work is finished.

*The Rule of Fellowship without Time Limited.*

Set down each Mans Sum he layeth into Company directly under one another, then add them together, and the Total Sum is your Divisor, then Multiply either the gain or loss which of them shall happen by the Stock of Money each Man laid in, and divide it by your Divisor and the Quotient sheweth every Mans Profit or Loss. As two Merchants in Company the first laid in 500*l.* the other 300*l.* and with Trading they have gained 64*l.* to know each Man's share of gain you must work by the Rule of Three, and say,



... and thereof  
... as ap-  
...

*Rules of Division*

... the Quotient by the Divisor, which  
... the Number divided as  
... your Quotient will  
... the Product  
... Abbreviate  
... with your D

The R

*Directions for Fractions*

If you will divide any Fraction  
... you must divide  
... you will triple it,  
... and for the Quadru  
... Number, you  
... As by  
... Duplation  
... If you would  
... divide by  
... and thereof cometh  
... which being Abbreviated make  
... Example appears

Let do  
Com  
then  
Sum  
either  
shall  
each Ma  
Divisor  
mans  
ers in  
the other  
have g  
are of  
of Thre



*Arithmetick.*

dit

Or otherwise if the Denominator be an even Number, you may only take the half of the Denominator, and let the Numerator still remain with the half of the Denominator, and the work is done which here you will find to be 4 as before, and if your Numerator be an odd Number Multiply it by 2 if you are to double it, or three if you are to triple it, &c. and let your Denominator stand the same and your work is finished.

*The Rule of Fellowship without Time Limited.*

Set down each Mans Sum he layeth in Company directly under one another, then add them together, and the Sum is your Divisor, then Multiply either the gain or loss which of them shall happen by the Stock of every Man, and divide it by the Divisor, the Quotient sheweth the Mans part or Loss. As two Merchants in Company the first laid in 1000 £ and with Trade they have gained 60 £ know each share of

If 800*l.* gain 64*l.* what 500*l.*? Answer 40 Pounds.

If 800*l.* gain 64*l.* what 300*l.*? Answer 24 Pounds.

As by Multiplying and Dividing by the directions above, and according to the Doctrine of the Rule of Three will appear.

*The Rule of Fellowship with time.*

Multiply the Money each Man layeth in by the time it continueth in Company and what cometh thereof, is the New Stock for each of them. Then Multiply the gains by every of them severally and the Product divide by all their New Stock or Layings in, added together, and you have proportionably each Man's part of the gain according to his Stock or Layings in ; as, Two Merchants have accompanied together, the first hath laid in 450*l.* on the 1<sup>st</sup>. of *January*; the other hath put in 750*l.* on the 2<sup>d</sup>. of *May*; How much shall each of them have of the 100*l.* gained at the years end. Now the 450*l.* continued 12 Months, and the 750*l.* but 8 Months. Multiply the 450 by 12, and the Product is 5400, and Multiply 750 by 8  
and

and the Product is 6000, then add them together they make 11400 for your Divisor, then Multiply 100 *l.* by 5400 and divide the Product by 11400 the Quotient will be  $47\frac{1}{2}$  *l.* for the first Mans part of gain. Then Multiply 100 by 6000 and the Product divide by 11400 and the Quotient is  $52\frac{1}{2}$  for the second Mans part of the Gain, as by the Practice will appear.

If 11400 100 *l.* what 5400? Answer  $47\frac{1}{2}$   
 If 11400 100 *l.* what 6000? Answer  $52\frac{1}{2}$

*The Rule of Factorage.*

This Rule is that the Estimation of the Body or Person of the Factor is in such Proportion to the Stock laid in by the Merchant, as the gain of the Factor to the gain of the Merchant. As if the Merchant deliver the Factor 200 *l.* to employ, and he to have half profit, the Person of the Factor shall be valued 200 *l.* But if  $\frac{1}{3}$  Profit then he hath but half so much as the Merchant, who is to have  $\frac{2}{3}$ , wherefore his Person is esteemed but 100 *l.* And if the Factor take  $\frac{2}{3}$  of the gain, then the Merchant is to have  $\frac{1}{3}$  wherefore to know the value of the

Person of the Factor say, If 3 give me 2 what 200 l? work by the Rule of Tree and you will find  $133\frac{1}{3}$ , as by Example.

If 3 give 2 what 200? Answer  $133\frac{1}{3}$ .

Or otherwise consider that the Factor taketh  $\frac{2}{3}$  of what the Merchant taketh, wherefore take  $\frac{2}{3}$  of 200 l. and you will find  $133\frac{1}{3}$ , as before and so much is the value of the Person of the Factor.

### *The Rule of Barter.*

#### *To Exchange Wares for Wares.*

Two Merchants will change their Wares, the one hath Cloth at 7 s. 1 d. the yard, to sell for ready Mony, but in Barter he will sell it for 8 s. 4 d. The other Cinnamon at 4 s. 7 d. the Pound to sell for ready Mony. To know how he shall sell it in Barter that he be no loser. Say if  $7\frac{1}{2}$  be sold in Barter for 8 what shall  $4\frac{1}{2}$  be sold for in Barter, reduce your whole Numbers and Multiply and Divide by the Rule of Three, and you shall find 5 s. 4 d.  $\frac{1}{2}$ , and so much shall the Pound of Cinnamon be sold for in Barter. As will by Practice appear.

If  $7\frac{1}{2}$  be sold for  $8\frac{1}{3}$ , what  $4\frac{1}{2}$ ? Answer  
 $5\text{ s. } \frac{1}{3} \frac{1}{2}$ .

And thus by changing your Numbers according to the Diversity of the Question you may work all other Propositions in Barter where no Money is paid.

*To Exchange Wares for Wares, paying part ready Money.*

When a Merchant overfelleth his Merchandice, and yet will have part ready Money, as  $\frac{1}{2}$  or  $\frac{1}{3}$  or \* part, subtract the Abatement from the just Price and also from the Over-Price, and the Remainders shall be the 2 first Numbers in the Rule of Three, and the just Price of the second Merchant shall be the third Number; as, if one hath Wool at 5 *l.* the C. Weight and in Barter will sell it for 6 *l.* and yet he will have  $\frac{1}{3}$  ready Money. The other hath Cloth of 13 *s.* and 4 *d.* the Yard to sell for ready Money. To know how he shall sell it in Barter, subtract as above directed then reduce and work by the Rule of Three and you will find 17 *s.* 9 *d.*  $\frac{1}{3}$  for so much shall he sell it in Barter. As by the Operation will appear.

If 3 *l.* bring 4 *l.* what 13 *s.* 4 *d.* Answer 17 *s.* 9 *d.*  $\frac{1}{3}$ .

And this may serve as a Rule for all Questions of like Nature. Changing the Operation as the Circumstances require and discretion will direct.

### Exchange of Money.

#### 1 Rule.

At *Antwerp* they account by Deniers de gros, that is Pence Flemish whereof 12 make 1 *s.* and 20 Flemish do make 1 Li de gros. As if I deliver in *Flanders* 500 *l.* Flemish at 19 *s.* 6 *d.* de gros that is 19 *s.* 6 *d.* Flemish to receive 20 *s.* at *London*. How much am I to receive? say if  $19\frac{1}{2}$  give  $\frac{20}{1}$  what will  $\frac{100}{1}$  give? reduce your Numbers, Multiply and Divide by the Rule of Three, and you will find 512 *l.* 16 *s.* 4 *d.*  $\frac{1}{3}$  of a Penny: As by Example appears.

If  $19\frac{1}{2}$   $\frac{20}{1}$  what  $\frac{100}{1}$ ? Answer 512 *l.* 16 *s.* 4 *d.*  $\frac{1}{3}$ .

## 2 Rule.

If I deliver 375 *l.* in *London* to receive 21 *s.* 8 *d.* de gros for each Pound Sterling. How much in Flemish Money must I receive? I say if  $\frac{20}{1}$  give  $11\frac{1}{2}$  what  $\frac{21\frac{1}{2}}{1}$  Multiply and Divide and you will find 407 *l.* 16 *s.* 3 *d.*

## 3 Rule.

I take up at *Antwerpe* 100 *l.* at 19 *s.* 6 *d.* Flemish to pay at *London* 20 *s.* Sterling. At the day of Payment I am forced to return the Money, and to take up Money in *London* to pay for 20 *s.* here 19 *s.* 9 *d.* at *Antwerp*, whether do I win or lose? Say if  $19\frac{1}{2}$  give  $19\frac{1}{2}$  what  $\frac{100}{1}$ ? Answer  $98\frac{2}{3}$ , which being abated from 100 there remains  $1\frac{2}{3}$ , so much do I lose in the 100 *l.*

## 4 Rule.



## 4 Rule.

The *French* Account by *Crowns* which are worth 50 *Soufe Tournois* the piece, and in *France* they Account by *Deniers Tournois*, whereof 12 make a *Soufe Tournois*, and 20 *Soufe Tournois* make 1 *l. Tournois*, which is a *Livre* or *Franc*. And the *French* *Crown* is current among *Merchants* for 51 *Soufe Tournois*, but by *Exchange* it is otherwise, for they will deliver but 50 *Soufe Tournois*, which is 2 *l.* 10 *Soufe Tournois* for a *Crown*, and at such price the *Crown* as the taker up can agree for. If I deliver 340 *l.* *Sterl.* to have 6 *s.* 4 *d.* *Sterl.* the *Crown* to receive at *Roan* 50 *Soufe Tournois* for every *Crown*, how many *Livres Tournois* must I receive for my 340 *l.*? Say if 6 *s.*  $\frac{1}{4}$  *Sterl.* give me 2 *l.* 2 *Tournois*. what 6800 *s.* (which is 340 *l.* reduced into *Shillings*,) then multiply and divide and you shall find 2684 *Livres*  $\frac{1}{2}$ . And so much shall I receive in *Roan* or *Paris* for my 340 *l.* *Sterling*.

For

*For Exchange of Money to Paris.*

Reduce the Sum Sterling you are to return into the lowest Denomination, and set down that for your Dividend. Then reduce the price or rate of Exchange into the least Denomination if there be a Fraction, making your Dividend and Divisor of equal Denomination and that shall be your Divisor. And the Quotient of the Division will shew how many *French Crowns* you are to receive for the Sum Sterling you returned. And if there be any Remainder of that Division Multiply that by 60 because there are 60 Pence or Soufe in a Crown, and divide by the price of Exchange and the Quotient shews how many Soufe you are to receive, and if there be any thing remaining of that Division, Multiply that Remainder by 12 and divide the Product by the price of Exchange and the Quotient will shew the Deniers to be received for that sum.

*Alligation.*

The Rule of Alligation is so called, because it teacheth in binding several parcels together of sundry prices to know how much you shall take of each Parcel, and is distinct in two parts. The First sheweth how to make a mixture of things of sundry prices and to know the common price of such mixture as, if a Man would mix 5 Bushels of Wheat at 2 s. 8 d. the Bushel with 9 Bushels of Rye at 2 s. the Bushel, what doth that mixture stand him the Bushel? Multiply every thing by its price and add the Products together and divide that Product by the Number of things to be mixed and the Quotient Answers the Question; as, Multiply 5 Bushels by 2 s. 8 d. makes 13 s. 4 d. Multiply 9 by 2 s. makes 18 s. which added together makes 31 s. 4 d. which reduced into pence are 376 pence, which divide by 14, the Quotient is 26  $\frac{4}{7}$  the worth of each Bushel. As will appear.

5 B. at 2 s. 8 d.	13 s. 4 d.	192	( 26 <sup>s</sup> ;
9 B. at 2    0	18    0	376	
14	31    4	244	
		7	

*2 Rule.*

If you would mix several things of several prices but equal Portions together and know the price of the mixture: If there be two things add the prices together and take the half. If three things add the prices together and take  $\frac{1}{3}$ , and if four take a  $\frac{1}{4}$  of the prices added together and so of others. As if there were a portion of Barley to be added or mingled at 20 d. the Bushel with the like quantity of Wheat at 2 s. 8 d. and Rye at 2 s. the Bushel, as suppose a Bushel of each were mingled add 20 d. 2 s. 8 d. and 2 s. together and they make 6 s. and 4 d. the  $\frac{1}{3}$  whereof is 2 s. 1 d.  $\frac{1}{3}$  which is the price of one Bushel of that mixture.

*3 Rule.*

## 3 Rule.

A Merchant hath 27 Pound of large Cloves at 6 s. the Pound. 15 Pound of middle sort at 2 s. 6 d. the Pound, and 20 lb of Fust at 2 s. 2 d. the Pound, when all are mixed together he would know the price. Multiply every Drug by its price and then divide the Total Sum of the Products by the whole weight of the Drugs and you shall find 51 d.  $\frac{2}{3}$ , and so much is a Pound of that mixture worth as by the Operation will appear.

27 at 6 s. 0 d.	162	221 $\frac{1}{2}$	0
15 at 2 0	37 $\frac{1}{2}$	12	152
10 at 2 2	21 $\frac{2}{3}$	442	2654
52	221 $\frac{1}{6}$	221	522
		2652	5
		2	
		2654	)

51  $\frac{2}{3}$

## 4 Rule.

4 Rule.

To mix  $\frac{1}{2}$  large Cloves,  $\frac{1}{3}$  middle sort and  $\frac{1}{6}$  Fuft, take a Number hath thofe parts as fuppose 12, whereof  $\frac{1}{2}$  is 6,  $\frac{1}{3}$  is 4, and  $\frac{1}{6}$  is 2, then Multiply each Drug by its price, and divide the Products, by the whole Sum of the Drugs, and you fhall find 48 *d.*  $\frac{1}{3}$ , and fo much is a Pound of that mixture worth. As by Operation will appear.

6 l. at 6 s. 8 d.	36	52 $\frac{1}{2}$	0
4 at 2 6	10	12	13
3 at 2 2	06 $\frac{1}{2}$	104	226
13		52	630
		624	133
		6	1
		630	

And if you would make 100 l. weight of fuch mixture you fhall work by the Rule of Company and find 46  $\frac{1}{3}$  of large Cloves 30  $\frac{1}{3}$  of middle fort, and 23  $\frac{1}{3}$  of Fuft.

6	13. 100	}	6 Anf. 46 $\frac{1}{3}$
4			4 Anf. 30 $\frac{1}{3}$
3			3 Anf. 23 $\frac{1}{3}$
13			100

A

A Goldsmith hath 3 sorts of Silver Bullion, one 5 *l.* 7 Ounces 10 *d.* weight at 7 Ounces  $\frac{1}{2}$  fine, another 12 *l.* 3 Ounces at 6  $\frac{1}{2}$  Ounces fine, and 4 *l.* at 9 Ounces fine. Of what fineness will the mixture be when molten together. Multiply each Bullion by its fineness and add the Products, and they amount to 155 *l.*  $\frac{17}{32}$ , then add the weights of the Bullion together, and they make 21 *l.*  $\frac{7}{8}$ , then divide 155  $\frac{17}{32}$  by 21  $\frac{7}{8}$  and your Quotient will be 7 Ounces  $\frac{10}{16}$  remaining which being brought into Penny Weights and Grains do make 2 Penny Weight and 10 Grains and  $\frac{3}{4}$  of a Grain, so that you find the fineness of that mixture to be 7 Ounces, 2 *d.* 10 Grains and  $\frac{3}{4}$  of a Grain fine the Pound weight.

Silver Weight is thus.

One Pound of Troy Weight is 12 Ounces.

One Ounce is divided into 20 Penny Weight.

One Penny weight into 24 Grains.

One Grain into 20 smaller parts.

Gold Weight is thus.

One Ounce of fine Gold without Allay is 24 Caracts.

One Caract is 4 Grains.

One Grain is divided into 2 half Grains, 4 Quarters of a Grain, &c. into smaller parts.

But if he would have added 5 *l.* of Copper to those Bullion, then he must have added the 5 *l.* and  $21\frac{7}{8}$  and divided by  $26\frac{7}{8}$ .

*The second part of the Rule of Alligation:*

The second part of this Rule sheweth how to bring a mixture of things of several prices into one common Price certain; as, A Goldsmith hath Gold worth 30 Crowns the Pound, another sort worth 36 Crowns, another 42 Crowns, and another 45 Crowns, of these he is to make a Scepter 6 *l.* weight at 40 Crowns the Pound, how much must he take of each sort. Set down your Sums one under another with the common price 40 before them, and then always link the greater with a lesser Number, because of a greater and lesser may be made the mean or common Number; Then set the difference of the lesser Number from the common Price or Number, against the greater Number with which it is linked, and then set the difference of the greater Number

Q            against



against the lesser Number linked with it, then add the differences together and the Sum shall be your first Number in the Rule of Three, the whole Massy piece which here is 6 *l.* shall be the second Number, each particular difference shall be your third, and your fourth Number found shall shew the Portion must be taken of each particular, as by Example will appear.

The Common	}	30		5	A
Price 40.		36		2	B
		42		4	C
		45		10	D
				21	—

If 21 6 5 Answer 1  $\frac{1}{7}$

If 21 6 2 Answer  $\frac{4}{7}$

If 21 6 4 Answer 1  $\frac{2}{7}$

If 21 6 10 Answer 2  $\frac{6}{7}$

---

6

### 2 Rule.

A Mint-Master hath 4 sorts of Silver Bullion, first of 3 Ounces fine, second of 5 Ounces, third of 8 Ounces, fourth of 10 Ounces fine. Of which he would make a sort but 6 Ounces fine. What Portion must he take of each sort. Set down

down your Sums and work as by the Rule in the last Question is directed:

	The several Prices.	Differences.
The Common Price 6.	3	4
	5	2
	8	1
	10	3

If you would make a mixture of 60 l. of these sorts say,

If 10 l. give 60 l. what 4 l? Ans. 24 l. and so of the rest.

This Form may be varied by combining the particular Values after this manner.

Sometime the value doth change his difference and is linked to divers

to represent the Portion taken of every thing as,

6	}	3	2
		5	4
		8	3
		10	1

3 Rule.

A Minter hath Gold 19 Caracts, 22 Caracts fine, and 24 Caracts fine, that is full fine without corruption, and he would make Coyn of 23 Caracts fine.

How much must he take of each sort?

Ans: Put the difference of 22 from 2

Q 2

and

and 24 right against 16. And likewise the difference of 16 from 22 right against 32 and 24, as here you see.

$$22 \left\{ \begin{array}{l} 32 \text{ --- } 6 \\ 24 \text{ --- } 6 \\ \hline 16 \text{ --- } 10 \end{array} \right. \text{ and } 2, \text{ in all } 12, \text{ and thus have you done.}$$

A Goldsmith hath 3 sorts of Silver, *viz.* of 6 Ounces fine, 7 Ounces fine, 9 Ounces fine, and would make Silver of 5 Ounces fine, he must mix Copper therewith and combining them thus, will shew how much of each sort.

$$5 \left\{ \begin{array}{l} 6 \text{ --- } 5 \\ 7 \text{ --- } 5 \\ 9 \text{ --- } 5 \\ \hline 0 \text{ --- } 1. 2. 4. \text{ in all } 7. \end{array} \right.$$

A Merchant hath given order to his Factor to employ him 83 *l.* 6 *s.* 8 *d.* Sterl. in five sorts of Spices, follo weth

{	Nutmegs	80 <i>d.</i>	the Pound.	}
{	Cloves	76 <i>d.</i>	the Pound.	}
{	Cinamon	52 <i>d.</i>	the Pound.	}
{	Ginger	34 <i>d.</i>	the Pound.	}
{	Pepper	30 <i>d.</i>	the Pound.	}

How much must the Factor have of each sort to buy of each like quantity. Answer,

fwer, add the prices together and divide the Product by the Sum of money laid out to be reduced into Pence, and the Quotient is your desire. As for Example divide 20000 *d.* by 272, and thereof comes 73 *l.* the Quantity he must buy of each fort.

But in case he would not take of each fort alike. Then take a middle value between the particulars, as suppose 50 *d.* then divide the 83 *l.* 6 *s.* (and reduced into Pence, *viz.* 20000 *d.*) by 50 *d.* and the Quotient will be 400, and so many Pounds must he have of all sorts together. Then to know how much or how many Pounds he must have of each fort, set them down, combine them and operate as by this Rule is before directed after this manner.

The Common	}	80		20
		76		16
Price 50.		52		16
		34		26 and 2, in all 28.
		30		30
			110	

If 110 give 400 what	}	20	Answ. 72	$1\frac{2}{11}$
		16	Answ. 58	$1\frac{3}{11}$
		16	Answ. 58	$1\frac{3}{11}$
		28	Answ. 101	$1\frac{2}{11}$
		30	Answ. 109	$1\frac{1}{11}$

*The Rule of False Positions.*

This Rule teacheth by Numbers supposed though never so Erroneous to find out the true Number required. And this of all vulgar Rules is the most excellent, and consists of 2 parts. The first of one false Position alone, the other of two Positions, and the Operation in a manner like to that of the Rule of Three only that hath three Numbers known, and this but one to work by, unto which we must devise 2. other Numbers the one multiplying and the other dividing. As by Examples appears.

*Single False Position.**Question 1.*

I have delivered to a Banker a certain Sum of Money to have 6 *l. per Cent. per Annum*, and at the end of 10 years he paid me 500 *l.* for all. How much was the Sum I delivered? Here are divers Terms, but the chief to work with is 500, which cometh of the other Numbers 10 and 100: now let us suppose a  
 Num-

Number and work therewith, as if it were the principal Sum we seek for; as for Example, suppose I delivered to him 200*l.* the 10 years of it will amount to 120*l.* which added to the 200 makes 320 whereas I should have 500, so that I have erred in this supposition 180, yet however I have hereby three Terms of the Rule of Three found out, whereby I may produce a fourth, which shall be the true Number I seek for, as will appear by the Operation when I state my Question thus and say.

If 320 *l.* come of 200 *l.* of how (much) 500 *l.* Answer 312 *l.*  $\frac{1}{2}$ .

Which 312 *l.*  $\frac{1}{2}$  is the true Sum I delivered at the first, as by the Multiplying and Dividing according to the Rule of Three will appear.

*Question 2.*

A Traveller found so many pieces of Gold that the half third and fourth parts made 50, now what was the Sum found First I suppose the Sum he found which hath those parts to be 12, the half hereof is 6, the third part 4, the fourth part 3 which added together make 13 but I seek 50, and therefore I have erred in

my Conjecture, yet this Error leads me to the Truth when I consider that as 13 the Sum of the parts of my false Conjecture, are to the whole Sum 12 so the parts of the Sum found which being added together make 50, ought to be the Sum found which is yet unknown. Therefore I say,

If 13 12 50 46 $\frac{2}{3}$ .

*Question 3.*

It is required of what Number 5 will be two thirds. I suppose 6, but find 2 thirds of 6 but 4, therefore by the Rule of Three I say, If 4 6 5 7 $\frac{1}{2}$ .

*Question 4.*

Two Numbers are to be sought out in which  $\frac{1}{2}$  and  $\frac{1}{3}$  of the one Number are  $\frac{1}{3}$  and  $\frac{1}{4}$  of the other, I suppose 54 whose  $\frac{1}{2}$  and  $\frac{1}{3}$  part make 45, and then I seek a Number, of which 45 will be  $\frac{1}{3}$  and  $\frac{1}{4}$  and suppose of 60 that being a Number which hath a fourth and a fifth part to be taken in whole Numbers, and find the  $\frac{1}{3}$  and  $\frac{1}{4}$  of 60 to make but 27, but I sought 45, therefore by the Golden Rule I state  
my

my Position thus, and say, if 27 60 45  
100, and thereby I find that 54 and 100  
are the 2 Numbers sought.

Question 5.

If 3 were the half of 7 what part  
would 4 be of 11? This is an ambi-  
guous Question, for if 3 do increase to  
 $3\frac{1}{2}$ , then by the Rule of Three you  
will find 4 to increase to  $4\frac{2}{3}$ , and  
then divide 11 by  $4\frac{2}{3}$  and you will find  
your Quotient to be  $2\frac{3}{4}$ , and that part  
will 4 be of 11. But if you will have  
 $3\frac{1}{2}$  to Decrease to 3, then you will  
find 4 to Decrease to  $3\frac{1}{2}$ , and Divide  
11 by  $3\frac{1}{2}$ , and you will find your Quoti-  
ent  $3\frac{1}{4}$ , and that part would 4 be of 11,  
as by the Operation appears.

If 3       $3\frac{1}{2}$       4       $4\frac{2}{3}$   
If  $3\frac{1}{2}$     3        4       $3\frac{1}{2}$

$\begin{array}{r} 33 \\ \times 1\frac{1}{2} \\ \hline 33 \\ 14 \\ \hline 33 \end{array}$ 
  
 $\begin{array}{r} 33 \\ \times 2\frac{3}{4} \\ \hline 33 \\ 25 \\ 24 \\ \hline 74 \end{array}$

$\begin{array}{r} 77 \\ \times 1\frac{1}{2} \\ \hline 77 \\ 24 \\ \hline 77 \end{array}$ 
  
 $\begin{array}{r} 77 \\ \times 3\frac{1}{4} \\ \hline 77 \\ 25 \\ 24 \\ \hline 24 \end{array}$

Question



## Question 6.

I have a Cistern with 3 unequal Cocks containing 60 Pipes of Water, and if the greatest Cock be opened it will avoid in an hour, at the second in 2 hours, and at the third in 3 hours. Now in what time will it avoid if all the Cocks be open? Suppose in half an hour, then must there avoid at the first Cock 30 Pipes, at the second 15 Pipes, and at the third 10 Pipes, which being added together make but 55 Pipes, whereas it should be 60 Pipes. Therefore by the Golden Rule I say

If 55 30 60 32  $\frac{33}{55}$   $\frac{1}{55}$ .

In which space of 32 Minutes and  $\frac{33}{55}$  or Abbreviated  $\frac{1}{55}$  of a Minute will the Cistern be emptied if all the Cocks were set open.

Double

*Double False Positions.*

The Rule of two false Positions is when a Question is propos'd. First imagine a sum at pleasure which you name your first Position and work with the same instead of the true Number as the Question doth import. And if you have missed the true you seek, observe how much and Note the same with this Mark *P* signifying *Plus* if more, or with this Mark *M* signifying *Minus* if less. Then begin again and suppose another Number which you must call the second Position, and work the same as before, and note the Error how much or how little, and set the same down with its mark on the other side of the Cross, as you see them in the Examples following. Then shall you Multiply Crosswise the first Position by the second Error, and set the Product over the first Position. Then likewise Multiply the second Position by the first Error and set that Product over the second Position. Then if the signs of the Errors be both too much, or both too little, then you must subtract the one lesser from the greater, and keep the Residue for your Dividend, and then subtract the lesser Error from the greater, and keep the

Re-

Remainder for your Divisor, then divide and the Quotient is your true Number sought. But if your signs of your Errors be one greater and the other lesser, then instead of subtracting you must add the Products of your Cross Multiplications together, and keep that Product for your Dividend, and likewise add your two Errors together, and keep the Product for your Divisor, then divide, and your Quotient is the true Number sought for. As by Examples will more plainly appear.

*Question 1.*

A Man at his death gave 100 Ducats to three Friends in this manner. The First to have a certain Portion; the second twice so many as the first abating 8 Ducats, and the third three times as many as the first abating 15 Ducats. Now how many must each of them have? First I suppose the first Man had 30 then by order of the Question the second must have 52 and the third 75, these added together make 157, but I must have but 100, therefore this first Supposition hath erred 57, therefore I set down my Position 30 with his



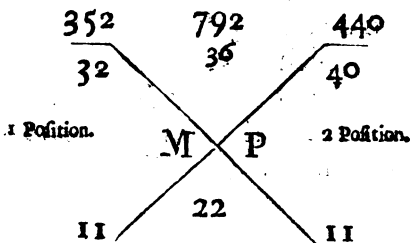


*Question 3.*

Two Travellers found certain pieces of Gold, and one said to the other if you give me two of your pieces I shall have 3 times as many as you. Nay saith the other 'twere more reason, our sums were equal and so will it be if you give me 3 of your pieces. Now how many pieces did each find? I search and find that the one found 7 and the other 13 pieces.

*Question 4.*

A Traveller passing by asked a Soldier how many Men were in their



Com-

Company: He answered if there were so many more, half so many more, and the fourth part of so many more, we together with thy self should make 100. Now 'tis demanded how many were in the Company. I search and find it to be 36.

*Extraction of the Quadrate or Square Root.*

A square Number is the Product of a Number Multiplied by it self, and consequently to extract the square Root of a Number is to find out a Number, which being Multiplied by it self doth produce the Number proposed. As for Example being desirous to draw the square Root of 25, I search for a Number, which being Multiplied by it self makes 25, which is 5. But to find out the Square Root of any Number proposed you must first learn by heart the Squares of the 9 Simple Figures which follow.

Square

Square Roots.	1	2	3	4	5	6	7	8	9
Square Numbers	1	4	9	16	25	36	49	64	81

And now if one is desirous to mark in the Fields a square piece of Ground containing 531441 square yards how long shall every side be. To do this I must find out the square Root in this manner First I set down my Number Marked and Divided as hereafter you see. Then I seek the Square Root of the next square Number I can have in 53 which I find to be 7, for 7 Multiplied in it self makes 49, which is the greatest square Number I can have in 53, therefore I set down 7 in the Quotient betwixt and likewise underneath, and then I Multiply 7 times 7 that makes 49, which I take from 53, being the Figures in the first Division, and which stand over it, and there rests 4 which I set overhead: Then I double my Quotient 7 and that makes 14, the 4 I set down one place forwarder, and then the 1 will come back to stand under. Then I consider how I may have another Digit which Multiplied by it self, and likewise with the double Number 14 I can take from the Figures over, and I find such Digit to

R be



be 2, wherefore I set down 2 betwixt the Lines in the next void space for my Quotient, and likewise underneath, then Multiplying 142 by 2 the Quotient and the Product will be 284, which I Subtract from the Figures directly over it, which are 414, and there will remain 130, which I set over head as you see, then I double my last Quotient 2 which makes 4, and set it down with the other Figures one place forwarder, and seek for another Digit which being Multiplied by it self together with the other Figures might be taken from the Figures over them, and I find the greatest I can take to be 9, therefore I set down 9 in the last void space for the Quotient and likewise underneath, and then the Figures underneath will 1449 which Multiplied by 9 makes 13041 which being the last Division, I set down underneath and subtract from 13041 which are the Figures over it, and nothing remains. Therefore I conclude that 729 which is my Quotient is the square Root or

$$\begin{array}{r}
 | \ 1 \ 00 \ | \ 0 \ | \\
 | \ 04 \ 30 \ | \ 00 \ | \\
 \hline
 | \ 53 \ 14 \ 41 \ | \\
 \hline
 | \ 7 \ | \ 2 \ | \ 9 \ | \\
 \hline
 | \ 7 \ | \ | \ | \\
 | \ 1 \ 42 \ | \ | \\
 | \ | \ 14 \ 49 \ | \\
 \quad 1 \ 30 \ 41 \\
 \quad 53 \ 14 \ 41
 \end{array}$$

fide

side of my square Number 531441, as by the Operation you see.

And now lastly for Proof of my Operation I Multiply 729 by it self, and find the Product to be 531441, the same with my Number first proposed, therefore I set the same down underneath as you see, and am assured that I have done right.

And if I desire to know how many square Perches, Yards or Feet are in 9 Acres of Ground. And likewise to extract the square Root or side of the same in Perches, Yards or Feet. First to know how many square Perches I set down 160 the Number of Perches in an Acre, and Multiply it by 9 the Number of Acres and the Product is 1440 which is the Number of square Perches in 9 Acres of Ground. Now to find out or extract the square Root or side of this Number 1440 I set down that Number and work as in the Example foregoing is directed. And find the nearest square Root to be 37 in this manner,

$$\begin{array}{r}
 | \ 0 \ | \ | \\
 | \ 5 \ 7 \ 1 \ | \\
 \hline
 | \ 1 \ 4 \ 4 \ 0 \ 7 \ 1 \ | \\
 \hline
 | \ 3 \ | \ 7 \ 1 \ 7 \ 4 \ | \\
 \hline
 | \ 3 \ | \ 6 \ 7 \ | \\
 | \ 4 \ | \ 6 \ 9 \ | \\
 | \ 1 \ 4 \ | \ 4 \ 0 \ |
 \end{array}$$

But this not being an even Square Number there being 71 remaining I set it down over the middle Line without and then doubling my last Quotient 7 I set that with the other Figure 6 added which makes 74 underneath that Line which is  $\frac{7}{4}$  of a Perch and thus have I done.

*Extraction of the Cubique Root.*

As the Square Root is a Number which being multiplyed in it self doth make a square superficial Number having only length and breadth, so the Cubique Root is a Number which being first multiplyed in it self, and the Product thereof being again multiplyed by the first Number doth make a Cubique Number having both Length, Breadth and Depth, as 2 times 2 makes 4, and 2 times 4 makes 8, and so of the rest, as by this Table of Square and Cubique Numbers will appear.

Roots.	1	2	3	4	5	6	7	8	9
Square Numbers.	1	4	9	16	25	36	49	64	81
Cubique Number.	1	8	27	64	125	216	343	512	729

Now being to find out the Cubique Root of any Number greater than 1000 (for lesser it cannot be to work upon) First set a prick under your first Figure on your right hand, and so proceed towards your left hand, omitting always 2 Figures, as here you see, 41063625, then so many pricks so many Figures shall you have in the Quotient, then by your Table you are to find out such a Cubique Number as will take away as much as may be of the Number or Figure right over your first prick towards the left hand with the Figure before it (if any be) which in this Example is 41 and the Cubique Number which will take away the greatest part of it, which may be had is 27, the Foot whereof is 3, therefore I set down 3 in the Quotient as here you see,

and take the Cu-	14
bique Number 27	41063625(3
which comes there-	Triple . 9
of out of 41, and	Divisor 27
there remains 14	
R 3	which

which I set overhead, then I triple the Quotient which makes 9, and set that down under 6 next to the second Prick on the left side thereof. Then to find out the Divisor I multiply the triple 9 by the Quotient 3 and the Product 27 is my Divisor, which Divisor I place right under the Triple, one Figure shorter towards the left hand. Then I draw a Line and ask how many times 2, which is the first Figure of the Divisor, is there in 14, and I must take such a Digit as may not take it all away, but leave so much, that the Quotient being afterwards Multiplied divers ways may take away the rest, and I find the fittest Digit for this purpose to be 4 which I put in the Quotient and so make my Quotient 34, then I Multiply this last Quotient which is 4 into the Divisor 27 which produceth 108, which I set down the Divisor beneath the Line as you may see. Then I multiply the 4 Quadrately in it self which makes 16, then I multiply that 16 by the Triple 9, the Product whereof is 144 which I set under the Triple as you see. Then I Multiply the 4 Cubically in it self which makes 64 which I set underneath the next Prick on the right hand, as here is done.

done. So as every of the aforesaid Products extend one further than another towards the right hand. Now these Products being thus placed I draw another Line underneath and bring all the 3 Products betwixt the Lines into one Sum, and I find it to be 12304

$$\begin{array}{r}
 1 \\
 14759 \\
 4106325(34 \\
 \text{Triple } 9 \\
 \text{Divisor } 27 \\
 \hline
 108 \\
 144 \\
 64 \\
 \hline
 12304
 \end{array}$$

which being substracted out of 14063 which is over it, there will remain 1759 which I set down. Then to avoid Confusion I set down my Remainder in a new place, and proceed to find out a new Triple, and a new Divisor which I do thus. Multiply the whole Quotient 34 by 3, the Product is 102 and that is the Triple which is to be placed in the next void place just before the next Prick on the right hand. Then Multiply the whole Quotient into the Triple 102, the Product whereof which will be 3468 shall be my Divisor, which I place under the Triple one Figure shorter towards the left hand with

R 4 two

two Numbers  
thus found, and  
rightly placed I  
draw a Line, then  
I ask how many  
times my first Fi-  
gure of my Divi-  
sor, which is 3, is  
in the Number

$$\begin{array}{r}
 1759625(345 \\
 \text{Triple } 102 \\
 \text{Divisor } 3468 \\
 \hline
 17340 \\
 2550 \\
 125 \\
 \hline
 1759625
 \end{array}$$

over it, which is 17, which I find to be  
5 times, wherefore I set 5 in the Quo-  
tient, and Multiply that 5 unto the Quo-  
tient, and place the Product thereof,  
which is 17340, right under the Divisor  
beneath the Line, as in Example you see,  
Then I square 5, that is I Multiply it in it  
self and it makes 25, which I Multiply  
again into the Triple 102 the Product  
is 2550, which I set down right under  
the Triple beneath the Line, then I  
multiply the said 5 Cubically in it self  
which makes 125 which I place right  
under the first prick on the right hand,  
then I draw a Line and add the 3 Pro-  
ducts together, and find the Total Sum to  
be 1759625, which being Subtracted  
from the upper Number, there remaineth  
nothing, whereby I find that 41063625  
is a perfect Cubique Number, for if I  
Mul-

Multiply the Quotient 345 Cubically in it self, it will make the same Number, as by the Operation will appear.

Now if I have to deal with a few Numbers and the Divisor cannot be had in the Number over it, I must set a Cypher in the Quotient and so I have done. As for Example, being to extract the Cubical Root of 8567, I find 2 to be the Quotient, which being Cubically Multiplied in it self, doth wholly take away the 8, and according to my former Rule of Operation, 12 must be my Divisor, which I cannot take out of 5, and therefore I set down a Cypher which in the Quotient makes my Quotient 20, the Cubical Root of the afore-said Number, for if 20 be Multiplied Cubically in it self and 567 which is the Remainder added thereunto it makes 8567, as by Example appears.

8567	
	6 Triple (20
	12 Divisor
	20
	20
	400
	20
	000
	800
	8000
	567
	8567



*The Virgins Rule.*

A Man bought 20 Fowls, cost 20 *d.* Geese at 4 *d.* a piece, Partridge at  $\frac{1}{2}$  Penny a piece, and Larks at  $\frac{1}{4}$  a piece.

Now how many were of each sort?

First reduce all into Farthings, then observe the difference of the least prized Fowl from the two greater prices as the difference of 1 Farthing from 2 which is 1. Then the difference of one from 16 the price in Farthings of the greatest Fowl, and that is 15, then suppose there were 20 of the least priced Fowl or Larks, the price will be 20 Farthings, which if you take from 80 Farthings, there will remain 60 Farthings which divide into 2 such Numbers that the one may be divided by 15, being the one difference, and the other by 1 the other difference of the prices, and there will remain nothing, and these two Numbers you will find to be 45 and 15, then divide 45 by 15, and the Quotient will be 3 which is the Number of Geese, then I should divide 15 by 1, but because 1 neither Multiplies nor Divides, I find

15 is Partridges, and the rest of the 20 Fowls which is 2 I find to be the Number of Larks.

And now having gone thro' the main Body of Arithmetick I shall proceed to some few

*Arithmetical Questions, both delightful and profitable, all of them performed without Algebra.*

*Question 1.*

A Schollar agreed with a Man, who had 7 Persons at his Table to give him so much as he demanded for his Board for a year, provided he would board him for the same Money, so long time as he could place those 7 Persons daily in a several and distinct order. How many days might the Scholar board there? Answer 5040 Days, that is 14 Years wanting 70 Days.

To effect this you must still Multiply your preceding Product by the Figure following. Thus at the first Day they  
fat

fat in order, 1 2 3 4 5 6 7,  
 the second Day Multiplying  
 1 by 2 makes 2, and so 2  
 Changes may be made of 2  
 Persons 1 2, 2 1, then Mul-  
 tiply this Figure by the next  
 Day or 3, and it makes 6,  
 and 6 Changes may be  
 made of 3 persons, as 1 2 3,  
 1 3 2, 2 1 3, 2 3 1, 3 1 2,  
 3 2 1, then Multiply this  
 Number 6 by the next Fi-  
 gure 4, it makes 24 Changes,  
 that by 5 makes 120, that  
 by 6, 720, that by 7,  
 5040.

$$\begin{array}{r}
 1) \quad \underline{\quad 1} \\
 2) \quad \underline{\quad 2} \\
 3) \quad \underline{\quad 6} \\
 4) \quad \underline{\quad 24} \\
 5) \quad \underline{120} \\
 6) \quad \underline{720} \\
 7) \quad \underline{5040}
 \end{array}$$

Like to this is the Changes on Bells,  
 8 Bells making 40320 Changes, and  
 12 Bells 479001600 Changes. And  
 the 24 Letters may be changed to 24  
 Places, making Millions, of Millions,  
 of Millions and more. And the Ga-  
 mut may be varied to 22 places.

*Question*

*Question 2.*

A Country Farmer had a Vessel of Wheat 4 foot high, and 4 foot broad at top and Bottom, his Neighbour borrows half his Wheat till Harvest, and then makes a Vessel 2 foot every way (as the Farmers was 4 foot every way) and filling that twice, gave it in lieu of what he borrowed, whereby the Farmer lost 12 Bushel.

*Question 3.*

A Greyhound courseth a Hare in such sort that the Hare taketh 5 Leaps for every 4 of the Greyhound, and is 100 Leaps from the Greyhound. Now if 3 of the Greyhounds Leaps, be equal to 4 Leaps of the Hare, the Question is in how many Leaps the Greyhound will obtain his Prey. Answer 1200 Leaps.

If  $3, 4, 4, 5 \frac{1}{3}$  therefore the Greyhound in every 4 Leaps gets  $\frac{1}{3}$ . Then say if  $\frac{1}{3}$   
4 100 1200.

*Question*

*Question 4.*

A Man bought and sold both at a Rate, and yet was a loser, *viz.* he bought 120 Apples at 3 for a Penny, and 120 at 2 for a Penny, and sold them again at 5 for 2 Pence, and thereby lost 4 Pence.

*Question 5.*

Being the Fishermans Question.

*I caught a Fish, (others among)  
Whose Head was full five foot along,  
And his Tail was (truly)  
As long as his Head and half his Body,  
And his Body (without fail)  
Was just as long as his Head and Tail.*

*This is my Question,  
Resolve it who can  
How long was the Body  
And Fishes Tail than?*

Multiply the length of the Fishes Head by 3, by 4, and by 8 the one Pro.

Product shall be the length of the Tail the other the length of the Body, and the third will be the length of the whole Fish. So the Head being 5 Foot, this Multiplied by 3 giveth 15 Foot for the length of the Tail. Again Multiply 5 by 4 it produceth 20 for the length of the Body. And Lastly Multiply 5 by 8 it produceth 40 for the length of the whole Fish, and exactly Answers the Question.

*Question 6.*

The Shadow of a Steeple being 260 Foot from the Bottom, when the Shadow of a Rule 2 Foot long is 3 Foot. How high is the Steeple? Answer by the Rule of Proportion  $86\frac{2}{3}$  Foot.

*Question 7.*

A Draper demands 12 *d.* a yard for Cloth. The Chapman saith I will give 2 *s.* the yard provided every Angel of my Money may go for 20 Shillings. To which the Draper agreeing, he bids him cut off five yards, Then lay-  
ing

ing down an Angel which being to go for 20 s. he requires him to give him the rest again, so that he got his Cloth for nothing.

*Question 8.*

*To find the Number any person thinketh upon without asking any Question.*

Let the Party Multiply the Number thought upon, by what Number he pleaseth, and Divide the Product by what other Number he will. Again let him Multiply this Quotient by what Number he please, and Divide that Quotient by what other Number he thinketh fit, and so Multiply and Divide as many times as he please (only let him tell you by what Number he Multiplies and Divides) and when he hath Multiplied and Divided as often as he listeth, bid him divide his last Number by the Number he thought upon and keep the Quotient to himself. In like manner do you take any Number and privately Multiply and Divide it as often as he doth; and by the same Number he doth, and when you have done it as often as he hath done;

done, and Divided your last Number by the Number that you supposed, your last Quotient will be the same as his. Then to know the Number he thought upon at first, bid him add his last Quotient to his Number he thought upon and give you the Sum from which Subtract your last Quotient and the Number which he thought upon will remain.

*Another.*

Bid him add to the Number thought (as admit 15) half of it, if it may be if not, the greatest half that exceeds the other but by an Unite, which is 8 and it makes 23, unto this 23 add the half of it, if it may be, if not the greatest half, *viz.* 12 makes 35 in the mean time. Note, that if the Number thought upon cannot be halved at the first time, then for it keep 3 in memory, if at the second time reserve 2 in memory, if at both times it could not be equally Halv'd, then may you together reserve 5 in memory, this done, cause him from the last Sum, *viz.* 35, to subtract the double of the Number thought; *viz.* 30 then will rest 5, will him to take the half of that if he can, if not, reject one and then take the half of the rest, which keep in your memory, then will him to

S

take



take the half again if he can, if not, take 1 from it, which reserve in your memory, and so perpetually halving until 1 remain, for then mark how many halves there were first taken for the first half account 2, for the second 4, for the third, 8, &c. and add unto those Numbers the one's, which you reserved in memory. So there being 5 remaining in this Proposition there were 2 halvings, for which last I account 4, but because it could not be exactly halved without rejecting of 1, I add the 1 therefore to this 4 which makes 5, which half or Sum always multiplied by 4 makes 20, from which subtract the first 3 and 2, because the half could not be formerly added, leaves 15, the Number thought upon.

*Question 9.*

A Debtor owing a Sum of Money, his Creditor condescends to his paying 5 s. the first Week, 10 s. the second, 15 s. the third, &c. still advancing 5 s. each Week for one Year. Now to know how much is received at the Years end, (for to add 5 s. 10 s. 15 s. 20 s. till you come to 52 Weeks which makes up a year

year

year would be tedious) Multiply 52 the Number of Weeks in the year by 5 the increase every Week, the Product is 260 which is equal to the 52th. Number if you had added the Sums together. Secondly to this 260, add 5 (the increase for one Week) it makes 265 which Multiply by 26 (half the Number of Weeks in the year) and it produceth 6890 s. which is 344*l.* 10 s. and so much will the Creditor have received of his Debtor at the years end.

For more of these and the like Questions see hereafter in Geometry, in my Book called *The Gentlemans Treasury*, and in *Leybourn's Arithmetical Recreations*, also *Henry Van Ettens Mathematical Recreations*, and many of the Arithmeticians Books.

*A Table for the Ready Casting up of any true Value for any Quantity of Goods or Commodities Bought or Sold by the Pound, Yard, Ell, &c.*

The use of the following Table is very plain, and of great use to all, but especially to such as are not exercised in Casting up Accounts, for the certain Understanding whereof, take this one

*Example.*

At 7 *d.* the Pound, what must I give for 7584 Pound?

It is required to know what 7584 Pound of any Commodity will cost at 7 *d.* the Pound, I look in the Table for the Column of 7 Pence, and because

I cannot find such a Number as 7584 in the Table at once, therefore I look for 7000 first, which I find out in the left side of the Table under the Title Number of Pounds, Yards, &c. and against it

<i>Po. wt.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
7000—	204	03	04
500—	14	11	08
80—	02	06	08
4—	00	02	04
7584—	221	04	00

it in the 7<sup>th</sup>. Column I find 204 03 04, which I set down, and look for 500, and in the 7<sup>th</sup>. Column find 14 11 08, which I also set down, and in like manner I find 02 06 08 to stand against 80, and 02 s. 04 d. against 4, which I set down one under another as you see, and then by Addition find the Total Sum to be 221 l. and 04 s. And so much is 7584 Pound of any Commodity worth at 7 d. the Pound.



Number Of Pounds Yards, &c	1 Farthing.				2 Farthings.				3 Farthings.			
	l.	s.	d.	f.	l.	s.	d.	f.	l.	s.	d.	f.
1				1				2				3
2				2				1 0				1 2
3				3				1 2				2 1
4			1	0				2 0				3 0
5			1	1				2 2				3 3
6			1	2				3 0				4 2
7			1	3				3 2				5 1
8			2	0				4 2				6 0
9			2	1				4 0				6 3
10			2	2				5 2				7 2
20			5	0		10	0	0		1	3	0
30			7	2		1	3	0		1	10	2
40			10	0		1	8	0		2	6	0
50		1	0	2		2	1	0		3	1	2
60		1	3	0		2	6	0		3	9	0
70		1	5	2		3	11	0		4	4	2
80		1	8	0		3	4	0		5	0	0
90		1	10	2		3	9	0		5	7	2
100		2	1	0		4	2	0		6	3	0
200		4	2	0		8	4	0		12	6	0
300		6	3	0		12	6	0		18	9	0
400		8	4	0		16	8	0	1	05	0	0
500		10	5	0	1	00	10	0	1	11	3	0
600		12	6	0	1	05	0	0	1	17	6	0
700		14	7	0	1	09	2	0	2	03	9	0
800		16	8	0	1	13	4	0	2	10	0	0
900		18	9	0	1	17	0	0	2	16	3	0
1000	1	00	10	0	2	01	8	0	3	02	6	0
2000	2	01	8	0	4	03	4	0	6	05	0	0
3000	3	02	6	0	6	05	8	0	9	07	6	0
4000	4	03	4	0	8	06	8	0	12	10	0	0
5000	5	04	2	0	10	08	4	0	15	12	6	0
6000	6	05	0	0	12	10	0	0	18	15	0	0
7000	7	05	10	0	14	11	8	0	21	17	6	0
8000	8	06	8	0	16	13	4	0	25	00	0	0
9000	9	07	6	0	18	15	0	0	28	02	6	0
10000	10	08	4	0	20	16	8	0	31	05	0	0

Number of Pounds, Yards, &c.	1 Penny.			2 Pence.			3 Pence.		
	l.	s.	d.	l.	s.	d.	l.	s.	d.
1			1			2			3
2			2			4			6
3			3			6			9
4			4			8		1	0
5			5			10		1	3
6			6		1	0		1	6
7			7		1	2		1	9
8			8		1	4		2	0
9			9		1	6		2	3
10			10		1	8		2	6
20		1	8		3	4		5	0
30		2	6		5	0		7	6
40		3	4		6	8		10	0
50		4	2		8	4		12	6
60		5	0		10	0		15	0
70		5	10		11	8		17	6
80		6	8		13	4	1	00	0
90		7	6		15	0	1	02	6
100		8	4		16	8	1	05	0
200		16	8	1	13	4	2	10	0
300	1	05	0	2	10	0	3	15	0
400	1	13	4	3	06	8	5	00	0
500	2	01	8	4	03	4	6	05	0
600	2	10	0	5	00	0	7	10	0
700	2	18	4	5	16	8	8	15	0
800	3	06	8	6	13	4	10	00	0
900	3	15	0	7	10	0	11	05	0
1000	4	03	4	8	06	8	12	10	0
2000	8	6	8	16	13	4	25	00	0
3000	12	10	0	25	10	0	37	10	0
4000	16	13	4	33	06	8	50	00	0
5000	20	16	8	41	13	4	62	10	0
6000	25	00	0	50	00	0	75	00	0
7000	29	03	4	58	06	8	85	10	0
8000	33	06	8	66	13	4	100	00	0
9000	37	10	0	75	00	0	112	10	0
10000	41	13	4	83	06	8	115	00	0

Number of Pounds, Yard	of Gr.	4 Pence.			5 Pence.			6 Pence.		
		l.	s.	d.	l.	s.	d.	l.	s.	d.
1				4			5			6
2				8			10		1	0
3			1	0		1	3		1	6
4			1	4		1	8		2	0
5			1	8		2	1		2	6
6			2	0		2	6		3	0
7			2	4		2	11		3	6
8			2	8		3	4		4	0
9			3	0		3	9		4	6
10			3	4		4	2		5	0
20			6	8		8	4		10	0
30			10	0		12	6		15	0
40			13	4		16	8	1	00	0
50			16	8	1	00	10	1	05	0
60	1	00	0		1	05	0	1	10	0
70	1	03	4		1	09	2	1	15	0
80	1	06	8		1	13	4	2	00	0
90	1	10	0		1	17	6	2	05	0
100	1	13	4		2	01	8	2	10	0
200	3	06	8		4	03	4	5	00	0
300	5	00	0		6	05	0	7	10	0
400	6	13	4		8	06	8	10	00	0
500	8	06	8		10	08	4	12	10	0
600	10	00	0		12	10	0	15	00	0
700	11	13	4		14	11	8	17	10	0
800	13	06	8		16	13	4	20	00	0
900	15	00	0		18	15	0	22	10	0
1000	16	13	4		20	16	8	25	00	0
2000	33	06	8		41	13	4	50	00	0
3000	50	00	0		62	10	0	75	00	0
4000	66	13	4		83	06	8	100	00	0
5000	83	06	8		104	03	4	125	00	0
6000	100	00	0		125	00	0	150	00	0
7000	116	13	4		145	16	8	175	00	0
8000	133	06	8		166	13	4	200	00	0
9000	150	00	0		187	10	0	225	00	0
10000	166	13	4		208	06	8	250	00	0



Number of Pounds, Yards, &c.	7 Pence.			8 Pence.			9 Pence.		
	l.	s.	d.	l.	s.	d.	l.	s.	d.
1			7			8			9
2			1 2			1 4			1 6
3			1 9			2 0			2 3
4			2 14			2 8			3 0
5			2 1			3 4			3 9
6			3 6			4 0			4 6
7			4 1			4 8			5 3
8			4 8			5 4			6 0
9			5 3			6 0			6 9
10			5 10			6 8			7 6
20			11 8			13 4			15 0
30			17 6	1	00	0	1	02	6
40	1	03	4	1	06	8	1	10	0
50	1	09	2	1	13	4	1	17	6
60	1	15	0	2	00	0	2	05	0
70	2	00	10	2	06	8	2	12	6
80	2	06	8	2	13	4	3	00	0
90	2	12	6	3	00	0	3	07	6
100	2	18	4	3	06	8	3	15	0
200	5	16	8	6	13	4	7	10	0
300	8	15	0	10	00	0	11	05	0
400	11	13	4	13	06	8	15	00	0
500	14	11	8	16	13	4	18	15	0
600	17	10	0	20	00	0	22	10	0
700	20	08	4	23	06	8	26	05	0
800	23	06	8	26	13	4	30	00	0
900	26	05	0	30	00	0	33	15	0
1000	29	03	4	33	06	8	37	10	0
2000	58	06	8	66	13	4	75	00	0
3000	87	10	0	100	00	0	112	10	0
4000	116	13	4	133	06	8	150	00	0
5000	145	16	8	166	13	4	187	10	0
6000	175	00	0	200	00	0	225	00	0
7000	204	03	4	233	06	8	262	10	0
8000	233	06	8	266	13	4	300	00	0
9000	262	10	0	300	00	0	337	10	0
10000	291	13	4	333	06	8	375	00	0

Number of Pounds, Yards, &c.	10 Pence.			11 Pence.			1 Shilling.		
	l.	s.	d.	l.	s.	d.	l.	s.	d.
1			10			11		1	0
2		1	8		1	10		2	0
3		2	6		2	9		3	0
4		3	4		3	8		4	0
5		4	2		4	7		5	0
6		5	0		5	6		6	0
7		5	10		6	5		7	0
8		6	8		7	4		8	0
9		7	6		8	3		9	0
10		8	4		9	2		10	0
20		16	8		18	4	1	00	0
30	1	05	0	1	07	6	1	10	0
40	1	13	4	1	16	8	2	00	0
50	2	01	8	2	05	10	2	10	0
60	2	10	0	2	15	0	3	00	0
70	2	18	4	3	04	2	3	10	0
80	3	06	8	3	13	4	4	00	0
90	3	15	0	4	02	6	4	10	0
100	4	03	4	4	11	8	5	00	0
200	8	06	8	9	03	4	10	00	0
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400	16	13	4	18	06	8	20	00	0
500	20	16	8	22	18	4	25	00	0
600	25	00	0	27	10	0	30	00	0
700	29	03	4	32	01	8	35	00	0
800	33	06	8	36	13	4	40	00	0
900	37	10	0	41	05	0	45	00	0
1000	41	13	4	45	16	8	50	00	0
2000	83	06	8	91	13	4	100	00	0
3000	125	00	0	137	10	0	150	00	0
4000	166	13	4	183	06	8	200	00	0
5000	208	06	8	229	03	4	250	00	0
6000	250	00	0	275	00	0	300	00	0
7000	291	13	4	320	16	8	350	00	0
8000	333	06	8	366	13	4	400	00	0
9000	375	00	0	412	10	0	450	00	0
10000	416	13	4	458	06	8	500	00	0

Number of Pounds, Yards, &c.	2 Shillings.			3 Shillings.			4 Shillings.		
	l.	s.	d.	l.	s.	d.	l.	s.	d.
1		2	0		3	0		4	0
2		4	0		6	0		8	0
3		6	0		9	0		12	0
4		8	0		12	0		16	0
5		10	0		15	0	1	00	0
6		12	0		18	0	1	04	0
7		14	0	1	01	0	1	08	0
8		16	0	1	04	0	1	12	0
9		18	0	1	07	0	1	16	0
10	1	00	0	1	10	0	2	00	0
20	2	00	0	3	00	0	4	00	0
30	3	00	0	4	10	0	6	00	0
40	4	00	0	6	00	0	8	00	0
50	5	00	0	7	10	0	10	00	0
60	6	00	0	9	00	0	12	00	0
70	7	00	0	10	10	0	14	00	0
80	8	00	0	12	00	0	16	00	0
90	9	00	0	13	10	0	18	00	0
100	10	00	0	15	00	0	20	00	0
200	20	00	0	30	00	0	40	00	0
300	30	00	0	45	00	0	60	00	0
400	40	00	0	60	00	0	80	00	0
500	50	00	0	75	00	0	100	00	0
600	60	00	0	90	00	0	120	00	0
700	70	00	0	105	00	0	140	00	0
800	80	00	0	120	00	0	160	00	0
900	90	00	0	135	00	0	180	00	0
1000	100	00	0	150	00	0	200	00	0
2000	200	00	0	300	00	0	400	00	0
3000	300	00	0	450	00	0	600	00	0
4000	400	00	0	600	00	0	800	00	0
5000	500	00	0	750	00	0	1000	00	0
6000	600	00	0	900	00	0	1200	00	0
7000	700	00	0	1050	00	0	1400	00	0
8000	800	00	0	1200	00	0	1600	00	0
9000	900	00	0	1350	00	0	1800	00	0
10000	1000	00	0	1500	00	0	2000	00	0

Number of Pounds, Yards, &c.	5 Shillings.			6 Shillings.			7 Shillings.		
	l.	s.	d.	l.	s.	d.	l.	s.	d.
1		5	0		6	0		7	0
2		10	0		12	0		14	0
3		15	0		18	0	1	01	0
4	1	00	0	1	04	0	1	08	0
5	1	05	0	1	10	0	1	15	0
6	1	10	0	1	16	0	2	02	0
7	1	15	0	2	02	0	2	09	0
8	2	00	0	2	08	0	2	16	0
9	2	05	0	2	14	0	3	03	0
10	2	10	0	3	00	0	3	10	0
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30	7	10	0	9	00	0	10	10	0
40	10	00	0	12	00	0	14	00	0
50	12	10	0	15	00	0	17	10	0
60	15	00	0	18	00	0	21	00	0
70	17	10	0	21	00	0	24	10	0
80	20	00	0	24	00	0	28	00	0
90	22	10	0	27	00	0	31	10	0
100	25	00	0	30	00	0	35	00	0
200	50	00	0	60	00	0	70	00	0
300	75	00	0	90	00	0	105	00	0
400	100	00	0	120	00	0	140	00	0
500	125	00	0	150	00	0	175	00	0
600	150	00	0	180	00	0	210	00	0
700	175	00	0	210	00	0	245	00	0
800	200	00	0	240	00	0	280	00	0
900	225	00	0	270	00	0	315	00	0
1000	250	00	0	300	00	0	350	00	0
2000	500	00	0	600	00	0	700	00	0
3000	750	00	0	900	00	0	1050	00	0
4000	1000	00	0	1200	00	0	1400	00	0
5000	1250	00	0	1500	00	0	1750	00	0
6000	1500	00	0	1800	00	0	2100	00	0
7000	1750	00	0	2100	00	0	2450	00	0
8000	2000	00	0	2400	00	0	2800	00	0
9000	2250	00	0	2700	00	0	3150	00	0
10000	2500	00	0	3000	00	0	3500	00	0

Number of Pounds, Yards, &c.	8 Shillings.			9 Shillings.			10 Shillings.		
	l.	s.	d.	l.	s.	d.	l.	s.	d.
1		8	0		9	0		10	0
2		16	0		18	0	1	00	0
3	1	04	0	1	07	0	1	10	0
4	1	12	0	1	16	0	2	00	0
5	2	00	0	2	05	0	2	10	0
6	2	08	0	2	14	0	3	00	0
7	2	16	0	3	03	0	3	10	0
8	2	04	0	3	12	0	4	00	0
9	3	12	0	4	01	0	4	10	0
10	4	00	0	4	10	0	5	00	0
20	8	00	0	9	00	0	10	00	0
30	12	00	0	13	10	0	15	00	0
40	16	00	0	18	00	0	20	00	0
50	20	00	0	22	10	0	25	00	0
60	24	00	0	27	00	0	30	00	0
70	28	00	0	31	10	0	35	00	0
80	32	00	0	36	00	0	40	00	0
90	36	00	0	40	10	0	45	00	0
100	40	00	0	45	00	0	50	00	0
200	80	00	0	90	00	0	100	00	0
300	120	00	0	135	00	0	150	00	0
400	160	00	0	180	00	0	200	00	0
500	200	00	0	225	00	0	250	00	0
600	240	00	0	270	00	0	300	00	0
700	280	00	0	315	00	0	350	00	0
800	320	00	0	360	00	0	400	00	0
900	360	00	0	405	00	0	450	00	0
1000	400	00	0	450	00	0	500	00	0
2000	800	00	0	900	00	0	1000	00	0
3000	1200	00	0	1350	00	0	1500	00	0
4000	1600	00	0	1800	00	0	2000	00	0
5000	2000	00	0	2250	00	0	2500	00	0
6000	2400	00	0	2700	00	0	3000	00	0
7000	2800	00	0	3150	00	0	3500	00	0
8000	3200	00	0	3600	00	0	4000	00	0
9000	3600	00	0	4050	00	0	4500	00	0
10000	4000	00	0	4500	00	0	5000	00	0

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# G E O M E T R Y .

**G** *Eometry*, in Latin *Geometria*, from the Greek *Γεωμετρία*, *ex* *γῆ* *seu* *ἡ* *i.* *Terra*, & *μετρίω*, *i.* *Metior*. A Measuring of the Earth and Figures; and as Number and Multitude is the Subject of Arithmetick, so is Magnitude and Greatness the Subject of this Science, which *Philo* the *Jew* calls the Principle and Mother of all the Arts, and hath this Excellency above the rest, that whereas there are manyfold Contentions among the Professors of all other Arts, the Masters of this Science generally agree in their Problems; neither is there any great matter of Debate among them, but only as to Points, Lines, and Superficies, whether they be divisible or

no. To this Science belongs the making of all Mechanick Engines and Instruments appertaining to the Mechanick Arts, all Engines of War, and Architecture, also Painting, Agriculture, Mensuration of Land, Timber, Stone, &c. and all Smiths and Carpenters work; also Souldiers and Commanders should be skilled herein, since they cannot without some privy Rules and the knowledge of some principles in Geometry Fortify, order their Battalia in Square, Triangle, Cross, Crescentwise and many other Forms, *Jovius* sheweth, nor level or plant Ordnance, Undermine, raise Bulwarks, Rampires, Casamates, Ravelines with many other means of offence and defence by Fortification, &c. Likewise all Musical Instruments, Clocks and Rarities done by Hydraulick Art, &c. borrow their experience from this Science for many admirable performances in this Art see my Book called *The Gentlemans Treasury*.

There are three kinds of Principles whereon the Demonstrations (which in this Science are always used thereby to explain their Theorems and Propositions) of all Geometrical Conclusions depend

pend, *viz.* Definitions, Petitions and Maxims, of the first it being of great use and necessity in the attaining to the Knowledge of this Art I shall treat somewhat of, Referring you for the rest to *Euclid* his Elements translated into *Englisch*, as also *Cook's* principles of Geometry, *Blundeville's* Exercises and many other of the Mathematicians Books. In Latin you may have the Learned Jesuit *Clavius*, *Melancthon*, *Frisius*, *Valtarius* his Geometry Military: *Albert Durer* hath writ hereof in *High-Dutch*, and *Forcadelle* in *French* with many others.

#### *Definitions in Geometry.*

A Point in Latine *Punctus* is a thing supposed to be indivisible having neither length, breadth or depth, A  
as the Point A.

A Line in Latine *Linea*, is a supposed length having neither A—B  
breadth nor thickness, as the Line A—B. which is called a right Line.

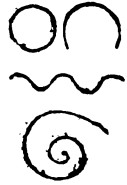
T

A



A Crooked Line goeth and is either a whole Circle, (which Line is sometimes called the Periphery of a Circle) or is only a part or portion of a Circle, or else goeth Serpentine winding in and out as a Serpent, and this Line is called *Linea Tor-*

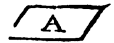
bowing ;



*tuosa*: Or else is a Line which winds about inwards like the Shell of a Snail, called in Latine *Linea Spiralis*, as the Figures do shew.

Superficies, or Upperface, is that which only hath length and breadth without depth, and is two-fold, Plain and Crooked.

A Plain Superficies is that which lyeth strait betwixt his Lines (for the bounds of

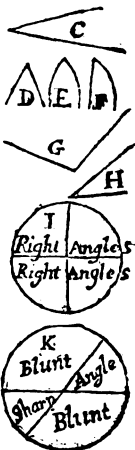


Convex.



Superficies are Lines) as the Figure A. and a Crooked Superficies is that which goeth Arched or Bowing, and lyes not strait betwixt his Lines, as the Figure B. And this Arched Superficies is considered twofold for the upper part is said to be Convex, the inner part Concave.

A Plain Angle is when 2 Lines being drawn upon a plain Superficies not directly one against another, but so as by meeting one another in a point they make an Angle in the manner as you see in the Figure C. Of plain Angles some are called right Line Angles, some crooked Line Angles, and some mixt; the reason whereof may be seen in the Figures D. E. F. A Blunt Angle, called also an obtuse Angle, is that which is greater than a right Angle, as the Angle G, and a Sharp or Acute Angle is lesser than a right Angle, as the Figure H. Spherical or Round Angles consist of two Circular Lines drawn upon a Spherical Superficies, which cross one another in some point either Right or Oblique; if right they make right Angles, as the Figure I. sheweth; if Oblique they make sharp and obtuse Angles as the Figure K. may partly shew, but such Angles cannot be so well described in Plain as upon the Surface of some Spherical Body.



A Term in Latine *Terminus*, is the bound or limit of any thing, as Points are the bounds of Lines, and Lines the bounds of Superficies, and Superficies the bounds of a Body, which is that which hath (imaginatively, but not materially) both length, breadth and depth, and if such Body have many Faces or Sides, then it is bounded with many Superficies as the Figure L. (which is a Cube like a Dye) doth shew; but if such Body be round as a Globe, Bowl, &c. then is it bounded or covered with but one Superficies as the Figure M.



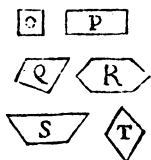
A Circle is a plain Figure bounded with a Circular Line which is called a Circumference, the middle point whereof is called the Center, and a right Line passing thro' the Center is called the Diameter.



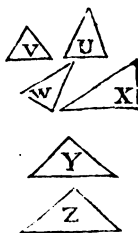
A Semi-circle is a Figure contained within the Diameter and half the Circumference of a Circle, as the Figure N.



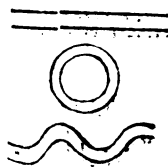
Four Square Figures are bounded with 4 right Lines as the Figure O. Another is called a Parallelogram or Long Square as the Figure P. Another Romboides as the Figure Q. Another fort is bounded with more right Lines than four as the Figure R. All other forts are called Trapezia as S. and the like, except one called Rombus, in Heraldry named a Lozenge and shaped like a Diamond as the Figure T.



Triangles or three Corner'd Figures are of six kinds, 1 Isopleurus having 3 equal sides and 3 equal Angles as V. 2 Ifofceles having two equal sides and Angles as U. 3. Scalenos having no side equal one to another as W. 4 Orthogonius having one right Angle as X. 5 Ampligonius having one Blunt Angle as Y. 6 Oxygonius having three sharp Angles, but not equal sides as Z.



Parallels are two Lines equally distant, which being drawn forth infinitely, would never meet or touch one another in any part. As may be seen by the Examples in the Margent of Right Line Parallels, Circular Parallels, and Serpentine Parallels.



Parallels of Latitude see hereafter in Astronomical Definitions.

And now tho I mean not to run o're all the common Elements in Geometry of which you may find enough in *Euclid* and others, yet for the satisfaction of the more Ingenious disposed in this Art I will here insert some

### *Curious Problems in Geometry.*

*How with one and the same Compasses, and at one and the same Extent or Opening, to describe many Circles Concentrical, that is greater or lesser than one another.*

Tho many may admire how this Proposition is to be resolved, and may seem Impossible, yet the Industry of an Ingenious Geometrician makes it possible and that most facil, sundry ways. For  
in

in the first place if you make a Circle upon a fine Plain, and upon the Center of that Circle a small Peg of Wood be placed, to be raised up and put down at pleasure by help of a small hole made in the Center, then with the same opening of the Compasses you may describe Circles Concentrical for the higher the Center is lifted up, the lesser the Circle will be Secondly, the Compass being at that extent upon a gibbous Body, a Circle may be Described which will be less than the former upon a Plain and more Artificially upon a Globe or round Bowl: And this again is obvious upon a round Pyramid placing the Compasses upon the Top of it which will be far less than any of the former and this is Demonstrated by the Twentieth Proposition of the first of *Euclid*.

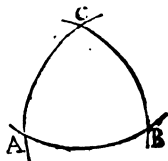
*To make or describe an Oval Form, or that which near resembles unto it, at one turning with a pair of Common Compasses.*

There are many ways in Geometrical Practises to make an Oval Figure, or one near unto it, by several Centers, but that it may be done promptly upon

one Center only, appears when one describeth Circles with the points of a common Compass somewhat deep upon a Skin stretched forth hard: which contracting it self in some parts of the Skin maketh an Oval form. But it will more evidently appear upon a Column or Cylinder: if Paper be placed upon it, and then with a pair of Compasses describe as it were a Circle upon it, which Paper afterwards being extended will not be Circular but Ovalwise. But *Henry Van Etten's* Mathematical Recreations tells of a pair of Compasses having one foot lower than the other, and made to go with a Spring betwixt his Legs, by which guiding a Thread an Oval may be described upon a plain.

*To make a Triangle that shall have three Right Angles.*

Open the Compasses at pleasure and upon A. describe an Ark B C, then at the same opening place one of the feet in B and describe the Ark A C. Lastly place one of the feet of the Compasses in C and describe

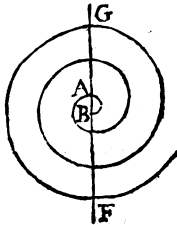


the

the Ark A B so shall you have the Spherical *A*equilateral Triangle *A B C* right Angled at *A*, at *B* and at *C*, that is each Angle comprehends 90 Degrees which can never be in any plain Triangle.

*How to draw a Parallel Spherical Line with great ease.*

First draw an obscure Line *G F* in the middle of it make two Points *A B* (which serve for Centers) then place one foot of the Compass in *B*, and extend the other foot to *A*, and describe a Semi-circle, then place one foot of the Compasses in *A* and extend the other foot to the end of the Semicircle already drawn, and describe another Semicircle; Then place the Compasses in *B* and extend the other foot to the end of the Circular Line drawn, and describe thereto another Semi-circle and so *ad infinitum*, which being neatly done that there be no Right Line seen nor where the Compasses were placed, will seem very strange how it could possibly be drawn with such

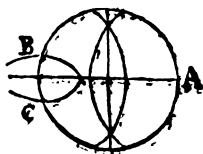




such exactness, to those who are Ignorant of the way whereby it is done.

*How to describe a Circle that shall touch three Points placed howsoever upon a Plain, if they be not in a Right Line.*

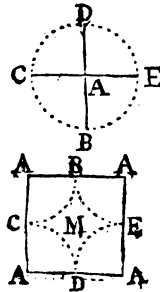
Suppose the three points be A B C, put one foot of the Compass upon A, and describe an Arch of a Circle at pleasure, and placed at B cross that Arch in the two points E and F, and placed in C cross the Arch in G and H, then lay a Ruler upon G H, and draw a Line, and place a Ruler upon E and F, cut the other Line in K, so K is the Center of the Circumference of a Circle which will pass by the said three points A B C. Or it may be inverted, having a Circle drawn to find the Centre of that Circle; make three points in the Circumference, and then use the same way, so shall you have the Center.



*How*

How to change a Circle into an exact square form.

Make a Circle, as the Circle **A B C D** **E**, of which **A** is the Center, then cut it into four Quarters, and dispose them so, that **A** at the Center of the Circle may always be at the Angle of the square and so the four Quarters of the Circle being placed so, it will make a perfect square, whose side **A** is equal to the Diameter **B D**. Here is to be noted that the square is greater than the vacuity in the Middle, *viz.* **M**.



And now I shall proceed to the more necessary and beneficial part of this Science, inserting a Collection of the most practical and useful Propositions I can find both of advantage and pleasure, And first of

The

*The Mensuration of Land.*

A Pole or Perch is 16 Foot and a half, and four Poles in Breadth and fourty in Length make an Acre, so that an Acre is 160 Poles.

*Squares.*

To Measure a Square piece of Land Multiply one of the sides by the other side joyning to it, and Divide the Sum by 160. As for Example, A piece of Land being 40 Poles one way, and 20 Poles another way, these Multiplied make 800 Poles, which divided by 160 shews five Acres for the Contents, or else as 160 to the one side 40 Poles, so the other side 20 Poles to the Content in Acres, 5 Acres.

*Triangles.*

Measure the longest side of the Triangle, and the Perpendicular from the Angle opposed to that long side, and then Multiply the half of the one by the whole of other and divide by 160, as  
Let

Let the side be 60, the Perpendicular 40, 60 Multiplied by 20, or 40 by 30 makes 1200, which divided by 160 yield 7 Acres and an half for the Contents.

*Trapezia or Double Triangle.*

Multiply both the Perpendiculars by half the Diagonal Line which is the Common Base of both the Triangles and Divide by 160. As let the Diagonal Line be 40, one of the Perpendiculars 15 the other 8, these two added together make 23, which Multiplied by half the Diagonal Line 20 makes 460, which divided by 160 makes 2 Acres, 3 Roods 20 Poles. Or else,

As 320 to the Sum of the two Perpendiculars 23, so the length of the Diagonal Line 40 to the Content.

*Circles.*

Multiply half the Diameter by half the Circumference and Divide the Product by 160. So the Diameter of the Circle being 140 Poles, and the Circumference 440 Poles, the half of these two being

Being 220, and 70 multiplied together produce 15400 Poles, which divided by 160, yield 96 Acres and a Quarter.

### *Ovals.*

Let the Oval be 30 Poles one way and 40 Poles the other, what is the Content? Multiply the length 40 by the breadth 30 it makes 1200, which Divide by 203  $\frac{1}{2}$ , it yields 5 Acres, 3 Roods, 23 Perches.

### *Irregular Figures.*

If the Figure which you are to measure consists of many unequal Sides and Angles, you must first reduce the same Figure into several Triangles, by Drawing of Diagonal Lines from Angle to Angle, and then by letting Perpendiculars fall from the Angles opposite to those Diagonal Lines you may Measure them as so many particular Triangles: the Contents of all which being added together, will be the Content of the whole Figure. And in the reducing of the Irregular Figures into Triangles this Note will be worth observing. The Number of Triangles into which any Irregular Plat or Figure

Figure may be reduced will be less by two than the Number of the sides of the Irregular Figure.

*The Mensuration of Timber.*

*Square.*

The usual way is to have a Line upon their Ruler to shew how many Inches make a foot for any square. But it is as good a way or better (especially if you cast it up with your Pen) to know how much one Foot length of any square will yield in proportion to a Foot of Timber which is to contain 1728 Cubick Inches, which you may do by this Rule.

If the square of 12 Inches which is 144 for every foot length yield one Foot of Timber or parts  $\frac{144}{1728} = \frac{1}{12}$  1, 000

What shall any other square, as the square of 6, which is  $\frac{36}{1728} = \frac{1}{48}$  36

The Answer will be  $\frac{144}{36} = 4$  0, 250

Now Multiply this by the Number of Feet in length, and it yields the Content of the piece of Timber in Feet and parts. As if this piece of Timber

6 Inches square were 10 Foot long, it would contain 2 Foot 500 paces or an half.

*Round.*

Because there is so much abuse in the Measuring of Round Timber, observe this more plain and ready way for Measuring thereof which is thus. Take the Compass thereof with a String, and then measuring the String by your Ruler, see how many Inches the Tree is in Compass, and then find those Inches in the following Table, and there you shall see how many Inches and parts of that Tree will make a Foot of Timber which take out with your Compasses and turn them over from one end to the other of the Tree, and the several spaces will shew how many Feet of Timber is in that Tree, thus,

Let the Compass of a Tree be sixty Inches you shall find in the following Table against sixty Inches Compass, that six Inches  $\frac{3}{4}$  parts of an Inch divided into one hundred parts make a foot of Timber ; so that if the piece of Timber be twelve foot long, there is very near twenty four foot of Timber  
in

in it, for twelve foot and one Inch is somewhat more than twenty four foot.

If the Tree exceed the Compass of one hundred Inches (which is the greatest Number in the Table) then take half the Compass and find the Number in the Table belonging thereunto, and divide it by 5 that is take a Quarter of that Number, and so many Inches and parts will make a foot of Timber of a Tree of that Compass.

U

A



## A Table for Measuring Round Timber.

Compals			Inch. Par.			Compals			Inch Par.			Compals			Inch Par.											
The Compals of the Tree in Inches.						10	217	15	The Compals of the Tree in Inches.						41	12	92	The Compals of the Tree in Inches.						71	4	31
						11	179	46							42	12	31							72	4	20
						12	150	80							43	11	74							73	4	08
						13	128	49							44	11	31							74	3	97
						14	110	79							45	10	72							75	3	86
						15	94	31							46	10	26							76	3	76
						16	84	82							47	9	83							77	3	66
						17	75	14							48	9	42							78	3	57
						18	67	02							49	9	04							79	3	48
						19	60	15							50	8	69							80	3	39
						20	54	29							51	8	35							81	3	31
						21	49	23							52	8	03							82	3	23
						22	44	86							53	7	73							83	3	15
						23	40	90							54	7	42							84	3	08
						24	37	69							55	7	18							85	3	01
						25	34	74							56	6	92							86	2	94
						26	32	12							57	6	68							87	2	87
						27	29	79							58	6	45							88	2	80
						28	27	70							59	6	24							89	2	74
						29	25	82							60	6	03							90	2	68
						30	24	13							61	5	84							91	2	62
						31	22	60							62	5	65							92	2	57
						32	21	21							63	5	47							93	2	51
						33	19	92							64	5	30							94	2	46
						34	18	78							65	5	14							95	2	41
						35	17	74							66	4	98							96	2	36
						36	16	76							67	4	84							97	2	31
						37	15	86							68	4	70							98	2	26
						38	15	04							69	4	56							99	2	22
						39	14	28							70	4	43							100	2	17
						40	13	57																		

*Of any form if strait and equal.*

Cast up the Superficial Content at the end thereof and find how many Inches it contains by the Geometrical Propositions before for the finding out the Content of the Triangle, Long Square, Many Square, Round Circle, and then say; as 144 the Inches of the Superficial Content of the end or side of a Cubique foot to a Cubick foot containing 1000 parts, so the Superficial Content of the end of any piece of Timber let it be 100, 200, 300, Inches, to the solid Content of one foot length thereof.

*Tapering Timber Cones or Pyramids.*

Many times Timber is less at one end than the other and most Trees or Round Timber is so. Now the common way to measure such a piece of Timber is to Measure it by the Square or Compass taken in the middle thereof, but that gives the Quantity a good deal too little, and the more Tapering it is so much the worse.

These pieces of Tapering Timber are either parts of Cones or Pyramids, now the way to measure a whole Cone or Pyramid is to Multiply the Superficial Content of the Base by a third part of the length. And the best and plainest way to measure these Sections will be first to find the length of the Pyramid or Cone, and so to find the Content thereof, then by the Superficial Content at the lesser end, and the length which belongs to that part, find the Content thereof as if it were a Cone or Pyramid it self. Lastly Subtract the Content of this lesser top-part from the Content of the whole, the Remainder must needs be the Content of the bigger bottom part which you were to Measure.

Now to find the length of the top part of the Cone or Pyramid which is cut off, Measure the Sides or Diameters of the 2 ends, and observe how much they differ from each other in Breadth. Then, as the difference of the breadth of the two ends, To the length between them: So the breadth of the Greater end to the whole length of the Cone or Pyramid.

Or

Or if this may seem difficult and tedious, you may part your piece of Timber into several parts 10 or 5 foot long, and so measure each part according to his Square or Compass in the middle, and then add them all together. This will come very near, and you will find much difference between this, and measuring the whole piece at once by the middle.

*The Mensuration of Superficies,*

*As Boards, Glass, Pavements,*

May be Effected Arithmetically or Instrumentally, but the Arithmetical being most certain, I shall only make use of that as best, and in order thereunto first shew how cross Multiplication, or Multiplication of Feet and Inches by Feet and Inches is to be performed; which is thus.

If it be required to Multiply 9 Foot 3 Inches by 7 foot 6 Inches, set down the Numbers to be Multiplied one under another with a cross between them, as you see in the Margent; and drawing a Line under them begin your Multiplication in this manner. First Multiply Feet by Feet, saying 7 times 9 is 63 Feet, set 63 under the Line in the place of Feet. Secondly Multiply as the Cross directs you, saying, 9 times 6 is 54 Inches which is 4 Feet and 6 Inches, set the 4 Feet under Feet, and the six Inches under Inches. Thirdly Multiply cross again, saying 7 times 3 is 21 Inches, that is 1 Foot 9 Inches, set the one Foot under Feet, and the 9 Inches under Inches. Fourthly, Multiply Inches by Inches, saying 3 times 6 is 18, that is  $\frac{1}{2}$  of an Inch, which is 1 Inch and a  $\frac{1}{2}$  or  $1\frac{1}{2}$ , which set under Inches, Lastly draw a Line and add all together; and you shall find the Sum to be 69 Feet 4  $\frac{1}{2}$  Inches.

$$\begin{array}{r}
 9 \quad \times \quad 3 \\
 7 \quad \times \quad 6 \\
 \hline
 63 \quad 6 \\
 4 \quad 9 \\
 \hline
 69 \quad 4\frac{1}{2}
 \end{array}$$

But



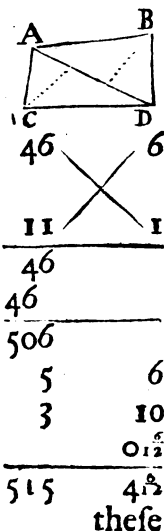
by 12, it will be 864, and so many are the superficial Feet.

### Triangle.

All right Lined Triangles (of what kind soever) may be measured thus. Multiply half the length of the Base by the length of the Perpendicular. Or half the length of the Perpendicular Multiplied by the whole length of the Base, the Product of either shall give the Superficial Content of the Triangle.

### A Trapezia,

Or Figure whose Angles are not right nor sides equal, as the Figure in the Margent. Draw a Diagonal Line from A to D, and from the Angles B C draw Perpendicular Lines to the Diagonal Line A D. Then Measure the Diagonal Line A D, and here suppose it to be 46 Foot 6 Inches, and one of the Perpendiculars 9 Foot 10 Inches, and the other 12 Foot 4 Inches,



these two added together make 22 Foot 2 Inches, the half whereof is 11 Foot 1 Inch, which being Multiplied by 46 Foot 6 Inches, the length of the Diagonal Line A D, the Product will be 515 Foot 4 Inches and  $\frac{1}{2}$  of an Inch for the Content of the Figure A B C D.

*Circle.*

The Diameter of every Circle hath such Proportion to the Circumference of the same Circle as 7 hath to 22, from whence may be performed the following necessary and useful Conclusions.

1. *The Diameter* of a Circle being given to find the Circumference. Let the Diameter of the given Circle be 14, Multiply the Diameter 14 by 22, the Product will be 308, which divided by 7, the Quotient is 44, and so much is the Circumference of that Circle whose Diameter is 14.

2. *The Circumference* of a Circle given, to find the Diameter.

Let the Circumference of a Circle be 44, Multiply 44 by 7, the Product will be 308 which Divide by 22 and the Quotient will be 14, and so much will

the



the Diameter of a Circle be whose Circumference is 44.

3. *The Diameter* of a Circle being given, to find the Area or Superficial Content of that Circle.

Let the Diameter of the given Circle be 14, Multiply 14 by 14, the Product will be 196, this 196 Multiplied by 11 produceth 2156 and this Number divided by 14 giveth in the Quotient 154 for the Area or Superficial Content of the Circle.

#### *A Semicircle.*

Multiply half the Diameter which is 7 by a quarter of the Circle.

#### *A Quadrant.*

Or quarter of a Circle. Multiply half the Diameter which is 7 by the eighth part of the Circle.

#### *The Mensuration of Solids.*

As Plain or Superficial Measure consisteth of two Dimensions, namely Length and Breadth, so solid measure consists

consists of three Dimensions, viz. Length, Breadth and Thickness.

*A Cube*

Is a solid Body consisting of 6 square Plains whose sides and Angles are all equal as a Dye. Suppose a piece of Stone or Timber to be in such a form, that every side thereof were two foot 9 Inches long, how many solid Feet of Stone or Timber is there in such a Cube.

Feet.	Inches.
2	9
2	9
4	
1	6
1	6
	6 <sup>2</sup> / <sub>12</sub>
7	6 <sup>2</sup> / <sub>12</sub>

First Multiply 2 Foot 9 Inches the side in it self (which is 2 Feet 9 Inches) by 2 Foot 9 Inches and the Product will be 7 Foot 6 Inches and <sup>2</sup>/<sub>12</sub> of an Inch, and is the Area or Superficial Content of one of the Flat sides.

And this Product Multiplied again by the side 2 Foot 9 Inches produceth 20 Foot 9 Inches <sup>2</sup>/<sub>12</sub> of an Inch, and so much solid Stone or Timber is contained in that Cubical piece.

7	6 <sup>2</sup> / <sub>12</sub>
2	9
14	
1	0
5	3
	6 <sup>2</sup> / <sub>12</sub>
20	9 <sup>2</sup> / <sub>12</sub>

A

*A Parallelopipedon or long Cube.*

If there be a long squared piece of Stone or Timber (or other solid matter) whose length is 142 Inches, its breadth 18 Inches and depth 13 Inches, how many solid Feet is contained therein?

First Multiply the breadth 18 by the depth 13, the Product is 234 for the Superficial Inches at the end of the piece.

Secondly, Multiply this 234 by 142 the length of the piece and the Product will be 33228 Inches for the solid Content.

Thirdly Divide 33228 by 1728, the Quotient will be 19 solid Feet and 396 Inches remaining, which is one quarter of a foot wanting 36 Inches. And so much is the solid Content of that piece.

$$\begin{array}{r}
 18 \\
 13 \\
 \hline
 54 \\
 18 \\
 \hline
 234 \\
 142 \\
 \hline
 468 \\
 936 \\
 234 \\
 \hline
 33228
 \end{array}$$

$$\begin{array}{r}
 (3 \\
 66 (9 \\
 1596 \\
 2604 (6 \\
 3320 (19 \\
 17288 \\
 172
 \end{array}$$

*A Prism or long Triangle.*

If the Base of the Triangle at the end of the piece be 32 Inches, the Perpendicular 21 Inches, and the length 108 Inches, and let the solid Content thereof be required.

$$\begin{array}{r}
 21 \\
 16 \\
 \hline
 126 \\
 21 \\
 \hline
 336 \\
 108 \\
 \hline
 2688 \\
 3360 \\
 \hline
 36288
 \end{array}$$

First Multiply 16 the half of the Base by 21 the Perpendicular and the Product will be 336 for the Area of the Triangle.

Secondly, Multiply 336 by 108 the length of the piece and the Product will be 36288 for the solid Inches in the whole piece.

Thirdly Divide 36288 by 1728 the Quotient will be 21 and nothing remaining so that there is just 21 Feet in this solid piece.

$$\begin{array}{r}
 27 \\
 1282 \\
 36288 \quad (21 \\
 \hline
 27288 \\
 272
 \end{array}$$

*Irregular Solids.*

Prepare a hollow Cube into which put your Irregular Body which being placed therein, pour therein Water till it no more than cover the Cube, then make a Mark in the inside of the Cube where

where the Superficies of the Water toucheth, this done take out the Irregular Body, and mark again directly under the former where the brim of the Water now toucheth, for the distance of these two marks multiplyed by the square of the Cubes side produceth the Crafftitude of that Irregular Body.

And now referring to the Authors at large for the Mensuration of other Figures Superficial and Solid, I shall for the greater ease in Measuring add some Tables of Board and Timber Measure ready Calculated.

*A Table*

A Table shewing the length of a Foot Square in Board, Glas, Pavement, &c.

The Breadth of the Board, &c.				The Breadth of the Board, &c.			
Inches.		Feet.Inch. Parts.		Inches.		Feet.Inch. Par.	
1	12	0	0	19	0	7	6
2	6	0	0	20	0	7	2
3	4	0	0	21	0	6	8
4	3	0	0	22	0	6	5
5	2	4	8	23	0	6	2
6	2	0	0	24	0	6	0
7	1	8	6	25	0	5	8
8	1	6	0	26	0	5	5
9	1	4	0	27	0	5	3
10	1	2	4	28	0	5	1
11	1	1	1	29	0	5	0
12	1	0	0	30	0	4	8
13	0	11	9	31	0	4	7
14	0	10	3	32	0	4	5
15	0	9	6	33	0	4	4
16	0	9	0	34	0	4	2
17	0	8	5	35	0	4	1
18	0	8	0	36	0	4	0

A Table for Measuring square Timber or Stone.

Square Inches.	The length of a solid Foot in Feet.Inch. Parts.			Square Inches	The length of a solid Foot in Feet.Inch.Par.		
6	4	0	0	22	0	3	5
7	2	11	2	23	0	3	3
8	2	3	0	24	0	3	0
9	1	9	3	25	0	2	8
10	1	5	3	26	0	2	6
11	1	2	3	27	0	2	3
12	1	0	0	28	0	2	2
13	0	10	2	29	0	2	1
14	0	8	8	30	0	1	9
15	0	7	6	31	0	1	8
16	0	6	7	32	0	1	7
17	0	5	9	33	0	1	6
18	0	5	3	34	0	1	5
19	0	4	8	35	0	1	4
20	0	4	3	36	0	1	3
21	0	3	9				

And

And now I shall set down some Rules for

*The Mensuration of Artificers Work.*

*Carpenters* for the most part Measure their Work by the square which is 10 Foot every way, and 100 in all, they agree so for their Flooring, Partitioning Raftering, and have several prices for every sort of Work. For Stair Cases they either agree by the whole, or by the Step, for their Windows they agree for so much a Light.

*Bricklayers* for the most part agree and measure by the Rod, which is sixteen Foot and a half square every way, and 272 Foot in all. They generally, that is to say many of them demand about 7*l.* a Rod, and to find all Materials, or forty Shillings a Rod and the Builder to find them. Note, they reduce all their work to one Brick and a half, and so measure the same, and 4500 Bricks will make a Rod of Brickwork.

If a Wall be 192 Foot long and 12 Foot high, Multiply 192 the length by 12 the height, the Product will be 2204, which divided by 272 (the Number of square Feet upon the superficies of a Rod) the Product in the Quotient is 8 Rod and 26 Foot. But because

X

there



there is a difference, all Brickworks being not of equal thickness, the Standard for Brickwork being the thickness of one Brick and half; if the Wall be thicker or not so thick, it may be reduced to that Standard by this General Rule. *Multiply* the Number of Superficial Feet contained in the Wall by the Number of half Bricks, which that Wall is in Thickness. One third part of that Product shall be the Content of the Brickwork reduced to the Standard of one Brick and half.

For Tiling they commonly measure it by the square of 10 Foot as the Carpenters do, so that in a Roof, the Carpenters work in measure will be very little, but the Bricklayers will be most; besides, the Bricklayers sometimes will desire to have running measure for Hyps and Valleys, which in some cases may be allowed, but in most not. They demand very largely for this sort of Work, some demanding 40 Shillings a square, and a square of Tiling takes up about 700 Tyles, which are sold at about five and twenty Shillings a Thousand. For Chimney work and other work of these Artificers I refer to Authors at large.

*Plasterers* Work is principally of two kinds, namely, 1. Work Lathed and  
Plaste-

Plastered which they call Cieling. 2.  
 Work rendered which is of two kinds,  
*viz.* either upon Brickwork, or in Par-  
 titioning between the Quarters. All  
 which they measure by the Yard square,  
 or the square of 3 Foot, which is 9 Foot.  
 Every hundred of Laths (which costs  
 about 20 pence) will cover 6 Yards of  
 Cieling or Plastering. For Lathing  
 and Plastering against Cielings and  
 Partitions they ask about ten pence a  
 Yard, and for Partition Walls one  
 Shilling.

If a Cieling be 58 Foot 9 Inches long,  
 and 23 Foot 7 Inches broad, how many  
 Yards is contained therein? Multiply  
 58 Foot 9 Inches by 23 Foot 7 Inches,  
 the Product will be 1385 Foot 6  $\frac{1}{2}$  Inches:  
 the 6 Inches and  $\frac{1}{2}$  reject, and divide 1385  
 by 9, the Quotient is 153 Yards, and 8  
 remaining, which is 8 Foot, so that that  
 Cieling contains 153 Yards 8 Foot, or  
 or 154 Yards wanting 1 Foot.

If a Partition or Partitions between  
 Rooms be 132 Foot about and 12 Foot  
 high, how many Yards is contained  
 therein? Multiply 132 by 12 the Pro-  
 duct is 1584 which divided by 9 giveth  
 in the Quotient 176, and so many Yards  
 is contained in that Partitioning. Note,

1. If there be any Doors or Windows in your Partitioning, you must make Deduction for them. 2. When you measure rendering upon Brickwork, you must account of all you measure, without Deducting ; but when you measure rendring between quarters, you may deduct one fifth part for the quarters, braces and entertoifes.

Whiting and Colouring are measured as Cieling and Partitioning are.

*Joiners* Measure all their Work by the Yard or Square of 3 Foot, which is 9 Foot, as the Plaisterers do, but in taking of their Dimensions they differ; for *Joiners* say, *We ought to be paid where our Plain goes*, wherefore in taking of the height of any Room, where is a Cornice above, and swelling Pannels and Mouldings downwards, you must with a Line girt over every Member of the Cornice, and swellings of the Mouldings which in lusty work will make the Room much higher than it is. For Measuring about the Room, some *Joiners* are so unreasonable that they desire a Girt that way also; but that makes an unreasonable Augmentation which ought not to be. In Window Shuts, Cupboard doors  
and

and such things as are wrought on both sides, they account to be paid for work and half work, for indeed the work is half more though the stuff be the same.

If a Room of Wainscot being girt, do contain in heighth 15 Foot 7 Inches and be in Compass about 286 Foot, how many yards doth that Room contain? Multiply 286 by 15 Foot 7 Inches, the Product will be 4456 Foot 8 Inches, which divided by 9 (the 8 Inches omitted) and the Quotient will be 495 Yards and 1 Foot, and so many Yards is contained in that Room.

Let the Window Shutters about a Room (all of them together) be 78 Foot 4 Inches, and let the height of them be 6 Foot 6 Inches, how many yards is contained in these Shutters at work and half? Multiply 78 Foot 4 Inches by 6 Foot 6 Inches, the Product will be 509 Foot 2 Inches, the half whereof is 254 Foot 7 Inches, which added together make 763 Foot 9 Inches, or 764, Foot which being divided by 9 the Quotient will be 84 Yards and 8 Foot. And so many Yards are contained in those Shutters, counting work and half work.

Note that you Deduct for all Window lights, and measure the Window Boards, Cheeks and Sphetaes by themselves.

*Painters* take the Dimensions of their work the same way as the *Joiners* by girting of the Moldings, and the Dimensions being taken, the casting up and reducing Feet into Yards is the same with *Plastering* or *Joinery*, but the *Painter* never accounts work and half, but once, twice, or thrice done over.

*Glaziers* Measure by the Foot square, so that the length and breadth being Multiplied together produceth the Content of any pain of Glafs. When Windows have half rounds at the top, they measure them at the full height as if they were Square, Oval or Round Windows they measure at the full Lengths and Breadths of their Diameters. Crooked Windows in Stone Work are all measured by their full squares, there being more trouble and more wast of Glafs.

If a Pane of Glafs be Foot 49 Inches long, and 3 Foot 2 Inches broad, to know how many Foot is contained therein, Multiply 4 Foot 9 Inches by 3 Foot

2 Inches, the Product will be 15 Foot and half an Inch, and so many Feet are contained therein.

*Masons* Measure their work by the Foot either Superficial or Solid, wherefore the Rules delivered in the Mensuration of Superficials and Solids before, will perform any thing required in Masonry.

*Smiths, Plummers and Carvers* work being at so much a Pound or so much a piece, their prices alter as times change and occasions differ. And here it may not be amiss to set down the

*Proportion of Metals.*

A Cube or Bullet of a certain bigness of Metals or other heavy Bodies weigh thus.

A Cubical Foot of	Pounds.	A Cubical Foot of	Pounds.
Gold	1368	Marble	252
Silver	744	<i>Irish</i> Slate	156
Lead	828	Salt	117 $\frac{1}{2}$
Copper	648	Honey	104 $\frac{2}{3}$
Quicksilver	977 $\frac{1}{2}$	Wax	68 $\frac{1}{10}$
Iron	576	Oyl	66
Tin	532 $\frac{2}{3}$	Wine	70 $\frac{2}{3}$
Earth	95 $\frac{1}{2}$	Water	72
Sand	132	Air weighs of an Ounce	$\frac{2}{3}$
Stone	140	Bricks	130

*Navigation*

Having a great dependance upon Geometry as well as Aitronomy, and being a Mathematical Art, although professed by rude and unskilful Men, yet most perfect and Ingenious Seamen have good skill in the Liberal Arts, and therefore shall we speak somewhat thereof here and then proceed to the Gauging of Ships and Vessels.

Navigation is commonly distinguished into three sorts, Plain Sailing, Mercators way, and Circular Sailing or Sailing by the Arch of a great Circle.

Plain Sailing or Sailing by the Plain Chart, is the plainest and Foundation of all the rest; and near the *Æquinoctial* there is need of no other to be used, because there the Degrees of Longitude, as well as of Latitude are all equal, each Degree being divided into 60 Minutes or Miles, though they are somewhat more than English Miles, each Minute or Mile containing about 6000 Feet, in this Art the Seaman hath these helps. First he hath his Compass to direct him which way he goes, which is divided first into four Cardinal Points or Quarters, East, West,

West, North, South, and each of these Quarters are divided into eight equal parts, commonly called Rhombs making in all 32 Points. So that steering by the Compass well made and duly rectified, the Seaman always knows which way he sails to a very small matter. The second help the Seaman hath in keeping his Account, is, a careful observation (by the Log line or some other good way) how many Miles or Leagues he sails every hour, and so every Watch and so every Day. The third help is the knowledge and observation of the Latitude both of the Place from whence he sails, and where he is arrived, or whither he is to sail. And out of these three things the Doctrine of plain Triangles he comes to know all that is necessary for the keeping of his Account: So that he may know at any time where he is, how far he hath sailed and how far he is yet to sail, and which way, or upon what point of the Compass he is to steer, and all this by the plain Rules of Rectangular Triangles. For which having no present occasion I refer to the Authors who treat thereof at large.



Sailing by Mercator's Chart requiring Tables of Meridional Parts or Miles and other things, I shall refer you to *Phillips's Mathematical Manual*, *Blundevill's Exercises* and many others.

Circular Sailing or Sailing by the Arch of a great Circle is difficult, and of little use altho' in some sence it is the most exact way of Sailing. For Seamen do seldom keep their course near this Arch, but are either drawn aside from it, by some conveniencies of Winds and Streams, or else are forced away by crosswinds or Interposition of some head Lands or Islands. See Mr. *Phillips's Geometrical Seaman*.

### *Gauging of Ships.*

#### *Proposition 1.*

To Gauge a Ship and cast up how many Tuns her Burthen is, Measure the length of her Keel, the breadth at the Midship Beam, and the depth of the Hold, and Multiply these three one by the other, and divide the Product thereof by 100 so you shall find how many Tuns her Burthen is. But for Merchants Ships who give no allowance for Ordnance, Mafts,

Masts, Sails, Cables, Anchors, which are all a Burthen but no Tunnage you must divide your Product by 95, so the aforesaid Ship will be found to be 105 Tuns  $\frac{3}{4}$  parts. But this way of reckoning the Tunnage of Ships, though it may come near in some Ships, yet it may miss much in others, for all Ships are not built of the same Fashion: Therefore it is the best and truest way to cast up the Content of the Ship more exactly according to the Rules of Art, with respect had to the Mold and Shape of the Ship, and so to find how many Cubick Feet the Ship doth contain, and every Cubick Foot of Water according to some weighs 55 Pound Averdupois. But Dr. *Wybard* found every Cubick foot of Water to weigh 62 Pounds 588 parts. Now every Tun being 20 Hundred weight, and every 100 weight 112 Pound which makes 2240 Pound, divide this by 62 Pound 588 parts, it makes 35 Foot 79 parts. So that about 36 Cubick Feet make a Tun weight.

But here take notice, if you thus measure a Ship within, you shall find the Content or Burthen the Ship will hold

or

or take in. If you measure the Ship on the outside to her Light Mark, as she swims being unladen, you shall have the weight or Content of the Empty Ship, and if you measure from this light mark to her full Draught of Water being laden, that will be the true Burthen or Tunnage of the Ship.

*Propof. 2.*

To make a Ship Double or Treble or in any Proportion to another Ship. Multiply the Measures of the length, breadth or depth of a Ship Cubically, and then double or treble the Cube and extract the Cube Root of each and it will be the Cubical Root of Breadth, Length and Depth respectively.

*Gauging of Vessels.*

There are two things necessary herein. First to reduce Vessels to a Regular Proportion. Secondly to find the true quantity of the Gallon in Cubick Inches or parts of a Foot, both which are much controverted.

For

For the first of these one of the best ways is that of Mr. *Oughtred*. Measure the Diameter of the Cask, both at the Bung and at the Head, and by their Diameters find out the Area of their Circles. Then take two thirds of the Area at the Bung, and one third of the Area at the Head and add them together, this will be the mean Area of the Vessel. Lastly if you Multiply this mean Area by the length of the Vessel, it will shew how many solid Inches the Vessel contains, which if you divide by the Number of solid Inches in one Gallon, it will shew you how many Gallons the Cask will hold.

Suppose a Wine Cask, having the Diameter at the Head 18 Inches, and the Diameter at the Bung 32 Inches, and the length 40 Inches, what is the Content?

$\frac{2}{3}$ of the Area at the Head is	84, 823
$\frac{1}{3}$ of the Area at the Bung is	536, 166
The Sum of these two	620, 989
Multiplied by the length	<u>40</u>
Makes Solid Inches	24839, 560

Which divided by the solid Inches in one Gallon of Wine, which are 231 Inches, yields

yields for the Content 107 Gallons 530<sup>3</sup> that is somewhat above half a Gallon.

But now here is the second difficulty, to resolve how many solid Inches are in a Gallon.

As for the Wine Gallon it hath been and still is commonly received, that a Wine Gallon contains 231 Cubick Inches yet Dr. *Wybard* says it is somewhat less, viz. 224 or 225 at most. But this difference is not so much as others make it in the Ale Gallon, for tho' most old Gaugers and the Coopers make the Ale Gallon to the Wine Gallon, as 4 to 5, so that the Wine Gallon being 231 Inc. the Ale Gallon is 288 Inches  $\frac{4}{5}$ , yet since the Excise it is accounted by them but 282 Cubick Inches.

To Gauge a Cask which is not full. First Measure the Diameters of the Cask at the Head and Bung and so find the Content of the whole Cask. Then Measure many how Inches deep the Liquor is which is in the Cask, and then work by the Rule of Proportion.

Let the Cask be as before 32 Inches at the Bung and the Liquor 24 Inches deep.

As the Diameter at the Bung in Inches	32
To the Depth of the Liquor in Inches	24
So the Radius of the Table	10000
To the part proportional	7500

Find this Number 7500 in the Table following, and it answers very near to 50 Gallons 3 Quarters.

**A Table**

A Table for Gauging Wine Casks not full.

	G.	Parts.	G.	Parts.	J.	Parts.	G.	Parts.	G.	Parts.	G.	Parts.
$\frac{1}{2}$	295	11	2328		3777	32	5057		6353	53	7829	
1	470		2405	22	5842		5115	43	6418		7909	
	602	12	2481		3906	33	5174		6483	54	7990	
2	720		2556	23	3960		5234	44	6548		8072	
	830	13	2630		4024	34	5294		6613	55	8154	
3	935		2703	24	4087		5354	45	6679		8236	
	1038	14	2775		4150	35	5415		6745	56	8319	
4	1138		2847	25	4213		5476	46	6811		8404	
	1235	15	2918		4276	36	5535		6877	57	8491	
5	1339		2986	26	4338		5600	47	6944		8580	
	1420	16	3056		4400	37	5662		7012	58	8661	
6	1502		3123	27	4462		5724	48	7082		8765	
	1596	17	3189		4542	38	5787		7153	59	8862	
7	1681		3255	28	4585		5850	49	7225		8962	
	1764	18	3321		4646	39	5913		7297	60	9065	
8	1846		3387	29	4706		5976	50	7370		9170	
	1928	19	3452		4766	40	6040		7444	61	9280	
9	2010		3517	30	4826		6094	51	7519		9398	
	2091	20	3582		4885	41	6158		7595	62	9530	
10	2171		3647	31	4943		6223	52	7672		9705	
	2242	21	3712		5000	42	6288		7758	63	10000	

And now work again thus, omitting the smaller Fractions which are of little Concernment.

As the Gallon of the Radius'	Gal.	Par.
To the Proportional Gallons found	63	00
So the Content of the whole Cask	50	75
To the Content of the Liquor being 24 Inches	107	50
	86	61

That





Substance or whole Mass of Metal, the Body ; the Hollownes or Concave Cylinder, the Bore or Soul ; so much of her Bore as containeth the Pouder and Shot, is the Chamber or Charged Cylinder ; the Remainder her vacant Cylinder ; the Spindals or Ears are called the Trunnions ; the Pummel at her Coyl, the Cafacabell Deck ; the little Hole the touch Hole ; all the Metal behind the touch Hole her Breech or Coyl ; the greatest ring at her touch Hole, her base ring, the next ring above her touch Hole her Reinforc'd Ring ; the next to that her Trunnion Ring, the ring next her mouth the Muzzle ring ; the ring between the Muzzle ring and Trunnion ring her Cornish ring ; all the rings and circles about the Muzzle, the Frieze, the whole length, the Chace.

**A Table**

A Table of Gunnery.

The Names of the several Pieces of Ordnance.	Guns		Guns		Bullets.		Ladles		Powder		Shoot	
	length	wei.	Bore	Diamet.	weight.	length	Bread	weight	Level	Urmott		
	Feet	Inches.	8 parts.	Inches.	Pounds.	Inches.	8 parts.	Pounds.	Paces	Paces.	Level	Rand.
<i>A Bals.</i>	4	6	200	1	2	1	0	5	1	0	8	600
<i>A Rabinet.</i>	5	6	300	1	4	1	3	0	8	4	0	700
<i>A Falconet.</i>	6	0	400	2	2	2	1	5	7	4	0	900
<i>A Falcon.</i>	7	0	750	2	6	2	5	2	8	8	4	1300
<i>Minton ordinary.</i>	7	0	800	3	0	2	7	3	4	8	4	1200
<i>Minton large ft.</i>	8	0	1000	3	0	3	12	9	0	5	0	1250
<i>Saker leaf.</i>	8	0	1400	3	4	2	4	12	9	6	4	1500
<i>Saker ordinary.</i>	9	0	1500	3	6	3	4	6	10	4	6	1600
<i>Saker old fort.</i>	10	0	1800	4	0	3	6	7	5	11	0	1630
<i>Demiculver leaf.</i>	10	0	2000	4	2	4	0	9	0	12	0	1740
<i>Demiculver ord.</i>	11	0	2700	4	4	4	2	10	11	12	6	1740
<i>Demiculver old f.</i>	11	0	3000	4	6	1	4	12	11	13	4	1750
<i>Culvering leaf.</i>	11	0	4000	5	0	4	6	15	0	14	2	1780
<i>Culvering ordin.</i>	12	0	4500	5	2	5	0	17	5	16	0	1800
<i>Culvering large ft.</i>	12	0	4800	5	4	5	2	20	0	16	0	1810
<i>Demican, leaf.</i>	12	0	5400	6	2	6	0	30	0	20	0	1830
<i>Demican, ordin.</i>	12	0	5600	6	4	6	1	32	0	22	0	1560
<i>Demican, large.</i>	12	0	5000	6	6	6	3	36	0	22	6	1620
<i>Cannon Royal</i>	12	0	3000	8	0	7	4	58	0	24	0	1800
												1850

Y 2

There

There are three Degrees in used Fortifying each sort of Ordnance both Cannons and Culverings. First such as are ordinarily Fortified which are called Legitimate Pieces; secondly, such whose Fortification is lessened, which are called Bastard Pieces; thirdly, double Fortified Pieces or extraordinary Pieces. This Fortification is reckoned by the thickness of the Metal at the touch hole, at the Trunnions at the Muzzle in proportion to the Diameter of the Bore, for more particulars of which I refer you to the Authors that treat of Gunnery at large.

Of Powder for Cannons  $\frac{2}{3}$  of the weight of the Iron Bullet for Proof, but for service half the weight of the Bullet is enough, especially for Iron Ordnance, which will not endure so much Powder as Brass Guns by one Quarter. For Culverings the whole weight of their Shot for Proof, and for Action  $\frac{2}{3}$ . For the Saker and Falcon  $\frac{2}{3}$  of the weight of their Shot, and for lesser pieces the whole weight may be used in service till they grow hot, but then you may abate with discretion. For proof of the lesser Pieces of all you may take once and  $\frac{1}{3}$  of the weight of their Bullet.

Bullets

Bullets must be somewhat less than the Bore of the Gun, that it may not stick and break the piece in the discharge. The most just and certain Proportion is to divide the Bore of the Gun into 20 equal parts, and let the Diameter of the Ball be 19 of these parts.

Ladles ought to be so proportioned for every Gun, that two Ladle fulls of Pouders may charge the piece.

To know how far any piece of Ordnance will shoot there is much difference, in Authors, but all agree in this. First that the Bullet is carried from the mouth of the piece more violently, and for a good space in a streight Line or Range, but afterwards as it proceeds further, as the violent force of the Motion abateth, so the Bullet sinketh down by Degrees till it graze upon the Ground. Now these two Motions are considered apart, or else joyned together, but they are both of them somewhat the longer according as the piece is Mounted higher from the Level to the Angle of 45 Degrees, which is the utmost Random, and if you mount any Piece higher the Random of the Bullet will be shorter and shorter, so that if you could shoot exact-

ly upright, the Bullet would fall down into the mouth of the piece again.

The right Range of every Piece being discharged in a Level or Parallel to the Horizon is set down in the forgoing Table, in which the Cannon exceeds not 185 Paces, that is 5 Foot to each Pace. Some reckon much more, but then they count ordinary Steps or Paces of 2 Foot and a half.

Batteries made with such Pieces are usually made at 100 or 120 such Paces, at which distance they do the best Execution.

The utmost Random likewise of any piece, that is from the Platform to the first Graze of the Bullet, is found for the most part to be about ten times the distance of the right Range, and so is it set down in the Table.

#### *Of Mortar-pieces.*

As Cannons and other pieces of Ordnance are used for the most part to shoot forward near a Level, so Mortar-pieces are used for the most part to shoot upward, and at Random into Towns, &c. and therefore the Random of these pieces is very necessary to be known. And most

most of the Tables found thereof agree in their Randoms tho' they are in a several Dress, so that one would think this were fully and certainly known, but yet there are several manifest Errors in the Tables of Randoms for which reason I shall omit some I have by me, and only place here one Table according to Mr. *Norton's* observations, not lyable to so much Absurdity, which Table I find thus stated in Mr. *Philips's* Mathematical Manual.

Y 4

A Table

A Table of Randoms for Mortar-pieces according to Mr. Norton.

Deg.	Yards.	Diff.	Deg.	Yards.	Diff.	Deg.	Yards.	Diff.
45	750	6	61	603	12	76	362	21
46	744	7	62	59	12	77	341	21
47	737	7	63	578	13	78	330	21
48	730	7	64	564	14	79	298	22
49	723	8	65	550	14	80	275	23
50	715	8	66	536	15	81	251	24
51	707	8	67	521	15	82	227	24
52	699	9	68	506	16	83	202	25
53	690	10	69	490	16	84	176	26
54	680	10	70	474	17	85	149	27
55	670	10	71	457	18	86	121	28
56	660	11	72	439	18	87	92	29
57	649	11	73	421	19	88	62	30
58	638	11	74	402	20	89	31	31
59	627	12	75	382	20	90	00	31
60	615							

For Dyaling see hereafter in *Astronomy*.  
 And now for that infinite Causes may arise from Geometrical Figures which may deceive a Judge or Magistrate not skilled in Mathematical Demonstrations, I shall add these following

*Experiments in Geometry.*

## Problem I.

*Concerning two Neighbours changing of their Lands.*

One Neighbour had a piece of Land four-square, each side 120 Perches, being round about 480 Perches, another would give him a square Field in Exchange, the sides whereof were longer than the others field, *viz.* 140 Perches, but the ends shorter, *viz.* 100 Perches apiece, which made a field of 480 Perches round also. Yet is the latter Field less by 400 Perches, *viz.* 2 Acres and an half, For Multiply 120 by 120 (the sides of the first Field,) and the Product is 14400, and so many square Perches doth that piece of Land contain. But Multiply 140 (the length of one of the longer sides of the latter Field) by 100 Perches (one of the shorter sides) and the Product will be but 14000, which discovers the loss.

Pro-



*Problem 2.*

*Caius* lent *Sempronius* a heap of Corn 20 Foot every way. *Sempronius* next year offers him 4 Heaps 12 Foot every way, or 7 Heaps 10 Foot every way, which seems extraordinary fair, yet would *Caius* thereby lose near 1000 Foot.

*Problem 3.*

*Caius* had a Field 24 Measures in Circuit being equally square, for which *Sempronius* gave him a Field of the same Circuit but a long square, *viz.* 9 Measures on two sides and 3 on the other, whereby he lost a fourth part. *Caius* brought his Suit at Law, whereupon *Sempronius* argued, that Figures that have equal Perimeter or Circuit (which equal Figures in Compass Geometricians call Isoperimeter) are equal amongst themselves which might have deceived a Judge ignorant in Geometrical proportions.

*Problem 4.*

A Man having a Pipe of Water 1 Inch Diameter, for to make it more useful hath leave to make it so as to convey as much more Water, and therefore he goes and makes it 2 Inches Diameter, by this the Grantor is injured, for it will convey four times as much Water.

*Problem 5.*

A piece of Silver 20 Inches every way was borrowed, the Party the next year having pieces of 12 Inches and 10 Inches every way, offers 4 of the greatest or 7 of the lesser, for that which he had of 20 Inches every way, which seems to be with advantage to the Lender, yet would he lose near 1000 Inches.

*Problem 6.*

*Aristotle* in his Mechanick Questions, saith the Merchants of his time used a deceitful balance, which had one Arm longer than another. As if the Beam were 23 Inches long, 12 should be on  
one

one side and 11 on the other, yet the short end was made as heavy as the longer, whereby it would hang in *Æquilibrium*, and putting in 12 Pound weight in the Balance hung upon the shorter part of the Beam, and 11 in the other, they would still hang even and seem just, tho' abominable false, cheating the Buyer of 1 Pound in 12.

*Problem 7.*

A Country Fellow offers to serve a Farmer 8 years for one Grain of Corn and one quarter of an Inch of Land to sow it in the first year, and Land enough to sow that one Corn and the encrease of it for his whole 8 years, to which the Farmer agreeing, gave him above 420000 Acres of Land for his 8 years service.

## Problem 8.

*Gold and Silver or Lead of equal weight  
put in light Boxes to know in which is  
the Gold.*

An Emperor to reward his Servant prepared two Boxes of like weight, Form and Magnitude, one containing Gold the other Lead. Now if a Mathematician weigh these Chests first in the Air, and then in the Water it is clear by the Proportion of Metals, and according to the Principles of *Archimedes*, that the Gold should be less in his weight by his 18th part and the Lead by his 11th part, whereby it may be known in which the Gold is, but a more certain invention to discover this the Geometricians have and is thus, Take a broad pair of Compasses and clip one of the Chests somewhat from the middle, then fix a small piece of Iron in the Chest between the feet of the passers, at the end of which hang a Weight, so that the other end may be counterpoised and hang in *Æquilibrium*.

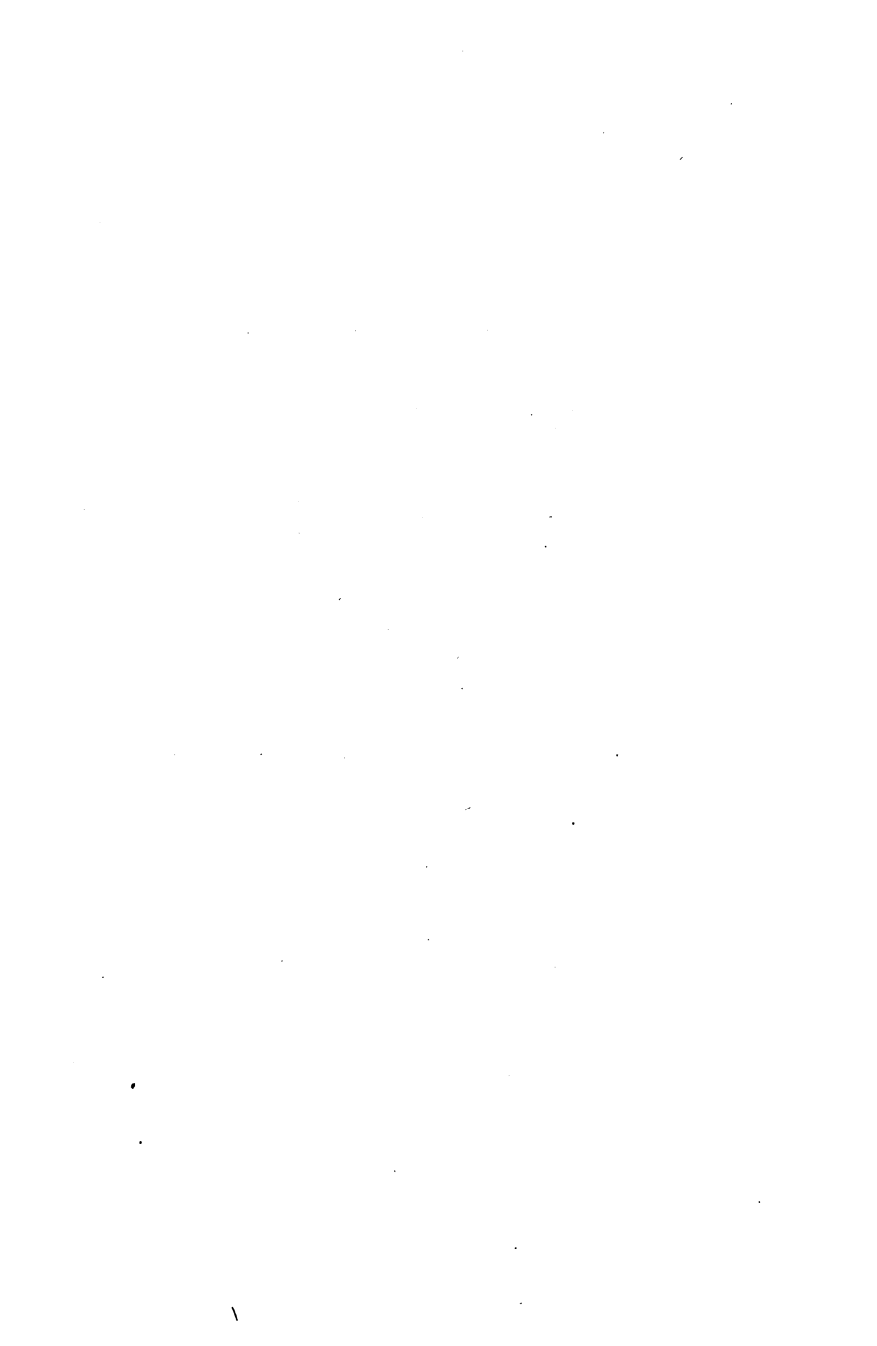
brio. Now if the other Chest being clipped in like distance from the end, and hanging at the other end the same Weight there be found no difference, then clip them nearer the middle that so the points of the Compass may be against some of the Metal inclosed or just against the extremity of the Gold, and suppose it hang thus in *Æquilibrium* it is certain that in the other Chest is the Lead for the points of the Compasses being advanced as much as before which takes up a part of the Lead (because it occupies a greater place than the Gold) therefore that shall help the other weight and so will not hang in *Æquilibrium*.

*Problem 9.*

How many Weights will serve to weigh all things from 1 to 40 Pounds, and so unto 121 and 364. Answer 4 Weights or Numbers in Triple Proportion so as they be equal, or somewhat greater than 40, as 1, 3, 9, 27. As admit to weigh 21 Pound, put unto what is to be weighed the 9 Pound weight, and in the other Balance put the 27 Pound and 3 Pound, and so of others. To these 4 weights

weights add an 81 Pound weight, and you may weigh with them between 1 and 121 Pound. How to make a Pound of Water weigh as much as 10, 20, 30, or 100 nay 1000 pound of Lead, see in *Henry Van Ettens* Mathematical Recreations, where you may read many such like performances in Geometry.

**ASTRO-**



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# ASTRONOMY.

**A** *Stronomia*, εκ αστρον & νομῶν *Astrorum*  
*Lex.* The Science of the Magnitude and Motions of the Heavens and Stars, being comprehended under the Science of Cosmography which describeth the whole world, that is to say both the Heavens and the Earth, and since we cannot describe the one without mentioning the other, I shall divide the world into two Essential parts.

The *Terrestrial* or Elementary part containeth the Element of Fire, next to the Sphære of the Moon, and next below that is the Air, and next to that the Water, and the lowest is the Earth, of which see more in the beginning of the Treatise of Geography in my *Gentlemen's Treasury*.

The *Celestial* containeth Eleven Heavens or Sphæres, which in Ascending are 1. *The Sphere of the Moon*, 2. *Mercury*, 3. *Venus*, 4. *Sol*, 5. *Mars*, 6. *Jupiter*

Z



piter, 7. Saturn, 8. The Sphere of fixed Stars, commonly called the Firmament, 9. The Chrystalline Heaven, 10. called *Primum Mobile*, 11. called *Cælum Em-pyreum*, the Imperial Heaven, where God and his Angels are said to dwell.

The Magnitude of these Heavens is known by their Courses which those great Bodies within them make round the Poles of the Zodiack. The Moon runs thro' the Heavens by her natural course from West to East in 27 days 8 hours, *Mercury* in 88 days, *Venus* in 225 days, *Sol* in 365 days and 6 hours, *Mars* in about 2 years, *Jupiter* in 12, and *Saturn* in 30; the eighth Heaven perfects its course according to the affirmation of *Tycho Brahe* in 25400 years. These Heavens are turned round about upon the Axis of the World by the tenth Heaven which is the *Primum Mobile* or first mover, by which Motion is caused Day and Night and the daily rising and setting of the Heavenly light, but before I proceed any farther it will be necessary to speak of the *Ptolemaick*, *Copernican* and *Tychonick* Systems of the World.

The *Ptolemaick* System is the most ancient, and by some thought more consonant to the Letter of Scripture than the rest.

rest. It was first invented by one *Claudius Ptolemaeus* a Native of *Peleusium*, who lived *A.C.* 135, and wrote several Books on this subject, placing the Globe of Earth and Water in the Centre of the World and supposed it destitute of all Motion. Next to the Earth he placed the Air with Vapours and Exhalations, which raising it self only a few Miles above the Earth is called the Atmosphere. Next to that he placed the Element of Fire, and in the spaces above, he ranked the Planets in the same order before rehearsed.

The *Copernican System* is the most generally received by the Astronomers and was contrived by one *Nicholaus Copernicus* a Physician of *Thorne* in *Prussia*, and Canon of *Frassenburg*, the Cathedral of *Wamerlandt*, who lived *A. C.* 1536, and framed a System or Hypothesis in imitation of the *Pythagoreans* who attributed a Motion to the Earth and placed the Sun as the soul in the Center of the World, and assigns the same place to the Earth, which *Ptolemy* allows the Sun, making the Earth a Planet having annual motion about the Sun which was fixed, and this opinion are all our Ablest Astronomers content with.

The *Tychonean* System partakes of both the foregoing Systems, and was invented by one *Tycho Brahe* a Nobleman of *Denmark* Lord of *Knudsborp* in the *Isle Schonen*. In his Hypothesis he supposeth that *Mercury*, *Venus*, and all the Planets, except the Moon, in their Motion respect the Sun as their Center, so that *Saturn* in opposition to the Sun, is nearer to the Earth than *Venus* in *Apo-gæo*, and that *Mars* in opposition to the Sun is nearer to the Earth than the Sun it self. For the better understanding of these Systems, &c. I shall here give

*A Description of the Material Sphere:*

By the word *Sphere* we understand that common Instrument of a round Figure consisting of several Circles, invented to explain and represent the Heavenly Motions and the Fabrick of the whole World, which like a little Ball is in the Center of the Sphere having an Axis thro it, the extremities whereof are called Poles, about which the whole Body of the Heavens is supposed to turn round in the space of 24 Hours. But for more Explanation,

The

The *Poles* of the World are two fixed Points in the Heavens Diametrically opposite to one another, the one visible in our Hemisphere, called the Artick Pole, the other not seen of us, being in the lower Hemisphere, called the South or Antartick Pole.

The *Axis* of the World is an imaginary Line drawn from Pole to Pole, about which the Diurnal Motion is performed from East to West.

The *Meridians* are great Circles concurring and intersecting one another in the Poles of the World.

The *Equinoctial* is a great Circle 90 degrees distant from the Poles of the World, cutting the Meridians at right Angles and dividing the World into two equal parts called the North and South Hemisphere.

The *Zodiack* is a Zone having eight degrees on either side of the Ecliptick, in which space the Planets make their Revolutions, divided into 12 Signs, having 30 Degrees to each sign, as *Aries* ♈, *Taurus* ♉, *Gemini* ♊, *Cancer* ♋, *Leo* ♌, *Virgo* ♍, which are called Northern Signs. *Libra* ♎, *Scorpio* ♏, *Sagittarius* ♐, *Capricornus* ♑, *Aquarius* ♒, and *Pisces* ♓, called the Southern Signs.

The *Ecliptick* is a Circle in the midst of the Zodiack touching the Equinoctial in two opposite points of *Aries* and *Libra*.

The *Colures* are two Meridians dividing the Equinoctial and *Ecliptick* into two equal parts, one of these passes the Equinoctial points of *Aries* and *Libra* and is called the Equinoctial Colure; the other by *Cancer* and *Capricorn*, called the Solstitial Colure.

The *Poles of the Ecliptick* are two points 23 Deg. 30 Min. distant from the Poles of the World.

The *Tropicks* are two small Circles parallel to the Equinoctial, and distant therefrom 23 Deg. 30 Min. limiting the Sun's greatest Declination.

The Northern Tropick is called the Tropick of *Cancer*, the Southern the Tropick of *Capricorn*.

The *Polar Circles* are two small Circles, parallel to the Equinoctial, and are distant from the Pole of the World 23 Deg. 30 Min. that which is adjacent is called the Artick Circle and the Antartick Circle.

The

The *Zenith* and *Nadir* are two points diametrically opposite. The *Zenith* is the Vertical point, or point right over our heads, and the *Nadir* directly opposite thereto.

The *Horizon* is a great Circle, 90 Degrees distant from the *Zenith* and *Nadir*, dividing the World into two equal parts, the upper and visible Hemisphere, and the lower and Invisible.

### *Astronomical Definitions.*

The Meridian of a place, is that which passeth by the *Zenith* and *Nadir* of the place.

*Azimuths* or Vertical Circles are great Circles of the Sphære, concurring and intersecting each other in the *Zenith* and *Nadir*.

*Almicanters* or Parallels of Latitude, are small Circles parallel to the Horizon imagined to pass thro' every Degree and Minute of the Meridian between the *Zenith* and *Horizon*.

Parallels of Latitude or Declination are small Circles parallel to the Equinoctial, they are called Parallels of Declination, in respect of the Sun or Stars in the Hea-

vens, and parallels of Latitude, in respect of any place upon the Earth.

The Latitude of a place is the height of the Pole above the Horizon, or the distance between the Zenith and Equinoctial.

The Latitude of a Star is the Arch of a Circle contained between the Center of a Star and the Ecliptick Line making right Angles with the Ecliptick, and is counted either Northward or Southward according to the Situation of the Star.

Longitude on the Earth is measured by an Arch of the Equinoctial, contained between the Primary Meridian (or Meridian of that place where the Longitude is assigned to begin) and the Meridian of any other place, counted always Easterly.

The Longitude of a Star is that part of the Ecliptick, which is contained between the Stars place in the Ecliptick and the beginning of Aries, counting them according to the succession of the Signs.

Altitude of the Sun or Stars is the Arch of an Azimuth contained betwixt the Horizon and Center of the Sun or Star.

Ascen-

Ascension is the rising of any Star, or any part of the Equinoctial above the Horizon.

Descension is the setting thereof.

Right Ascension is the Number of Degrees and Minutes of the Equinoctial (counted from the beginning of *Aries*) which cometh to the Meridian with the Sun or Stars, or with any portion of the Ecliptick.

Oblique Ascension is an Arch of the Equinoctial between the beginning of *Aries* and that part of the Equinoctial that riseth with the Center of a Star, or with any Portion of the Ecliptick in an Oblique Sphære.

Oblique Descension, is that part of the Equinoctial which setteth therewith.

Ascensional difference is an Arch of the Equinoctial being the difference between the Right and Oblique Ascension.

The Amplitude of the Sun or Star is an Arch of the Horizon, intercepted between the rising or setting of the Sun or Star, and the East to West point of the Horizon.



The Parallax is the difference between the true and apparent place of the Sun or Star.

Refraction is caused by the Atmosphere or vaporous thickness of the Air, near the Earths superficies whereby the Sun and Stars seem always to rise sooner, and set later, than in reality they do.

*Of the two Hemispheres of the Heavens.*

The one of these shews the Constellations of the Northern, and the other of the Southern Hemispheres of the Heavens: whereby may be seen the right Ascension and Declination of any of the Stars in either Hemisphere, by which any Star may be easily found, and the way or course of a New Star or Comet may be trac'd in its Way or Orbit with several other uses, &c.

Altho' (as *David* saith) the Number of the Stars is known only to God, yet Astronomers by diligent observation have attained to the knowledge of many of them, as first they know the seven Planets otherwise called the Wandring Stars and have made manifest Demonstrations

strations of their Motions, and by continual observations have found out the manifold vertues.

*Properties and Influences of the Planets.*

♄ Denotes in general Lands, Houses, Country Men, Ancient People, &c.

♃ Signifies, Judges, Divines, Senators, Riches, Law, Religion, &c.

♂ Signifies Souldiers, Physicians, War, Strife and Debate, Theft and all Cruelty, &c.

♁ Signifies Honour, Greatness, Noble Persons of all Degrees.

♀ Denotes Women, Pleasure, Pastime, all kinds of delight, Mirth, Perfumes, &c.

♁ Denotes all kinds of Scribes, Secretaries, Mathematicians, Servants, &c.

♁ Signifies Women in General, and all common and vulgar Persons, &c.

Of the fixed Stars so called (because they always keep the same invariable distance from one another, and from the Ecliptick) the Astronomers could never find more than 1022, which they have discovered by the help of their Tele-

Telescopes as being nearer to us and more in view, and because the Stars are not equal in greatness or bigness, they make six differences, appointing to

The first Magnitude 15 Stars, whereof every one containeth the Earth 207 times.

The second Magnitude 45 Stars, whereof every one containeth the Earth 90 times.

The third Magnitude 208 Stars, whereof every one containeth the Earth 72 times.

The fourth Magnitude 474 Stars, whereof every one containeth the Earth 54 times.

The fifth Magnitude 217 Stars, whereof every one containeth the Earth 50 times.

The sixth Magnitude 49 small Stars which containeth the Earth 18 or 20 times.

Besides these are 14 others, whereof 5 are called Cloudy, and the other Misty or Dark, because hardly to be perceived. But *Galileus* by Telescope-observations found 62500 Stars, where but 63 appeared to the Bare Eye.

As

As to their *Substance* the Modern Philosophers and Astronomers suppose their Bodies Compound and not Simple, made up of Elementary matter, formed into Fiery Globes, and consisting of matter Solid and Liquid as this Terraqueous Globe below. Their Light some consider to be innate, others think it borrowed of the Sun. Their Colour various according to the difference of their Light, tempered by the divers constitutions of their matter or Substance, some appearing ruddy, others bright, &c. whence some have made an estimate of their Natures, and rang'd them under the several Planets. Their Scintillation distinguisheth them from the Planets which have no such Twinkling or Glimmering Light. Of their Number and Magnitude we have spoke; and their Figures tho seemingly round are not Mathematically so, for their Superficies is found to be uneven and to consist of many Angles and Sides.

The Astronomers divide all the fixed Stars to them known into 48 Images or Constellations, whereof 12 are in the Zodiack and named before. The others are 21 placed in the Northern, and 15 in the Southern Hemisphere.

In *Aries* 3 Stars are most conspicuous, 2 in the left horn, and 1 between the horns.

In *Taurus* are Aldebaran in his Eye, 7 Stars called Pleiades in his Neck, and 5 called the Hyades near the great Star called the Bulls Eye or Aldebaran.

In *Gemini* are 4 Stars, 1 of which is on the North Head of the Twins called Castor, another in the South Pollux, 1 on the right foot of Castor, t'other on the left of Pollux.

In *Cancer* scarce any Stars appear, besides one near to the right Claw.

In *Leo* are divers bright Stars, two whereof are of the first Magnitude, that on the Breast called *Cor Leonis*, and that in his Tail called the Lyons Tail.

In *Virgo* are several bright Stars, one of the first Magnitude being called *Spi-ca Virginis* standing in the Ear of Corn in her left hand.

In *Libra* are two very bright Stars called the Scales.

In *Scorpio* are several great Stars, one of'em called the Scorpions Heart.

In *Sagittarius* are 4 chief Stars on his Shoulder making a Trapezium or Table, and 3 or 4 resembling a Bow, with one imitating an Arrow.

In

In *Capricornus* are 4, 2 in his Tail, and 2 other in his Horns.

In *Aquarius* are several Stars of the third, first and fourth Magnitude.

In *Pisces* are several small Stars, but bound with a Ribband adorned with Stars of the first Magnitude.

The Constellations without the Zodiac are Northern which appear in our Hemisphere and are these following, beginning with the Constellation next the Pole.

*Ursa Minor* hath 7 Stars, 4 whereof are in a square Figure, the other 3 in the Tail, the hindermost and brightest being called the North Star because nearer to the Pole than any other.

*Ursa Major* hath also 7 Stars in Position as the former. This Constellation was anciently called *Plaustrum Majus* or the greater Wain.

*Bootes* the Herdsman, hath many bright Stars the chiefest of which betwixt his Thighs on the Rim or edge of his Coat is called *Arcturus*.

The *Dragon* hath many Stars none greater than of the third Magnitude.

The *Crown* of *Ariane* represents a half Circle composed of five Stars.

*Engonasi* or *Hercules* kneeling hath several great Stars therein.

*Lyra* the Harp hath the most eminent Star next to the Dog-Star, and some others.

The *Swan* is an illustrious Constellation within the Milky Way.

*Cepheus* hath but few bright Stars, his right foot stands on the Tail of *Ursa Minor*.

*Cassiopea* the Lady in her Chair, hath 5 Stars of the third Magnitude.

*Perseus* placed between the feet of *Cassiopea* and the Bull, hath a bright Star on the Back, and another called *Medusa's* head in his left hand, and 4 more called *Gorgons*.

*Andromeda* hath 3 Stars of the second Magnitude, the last in the Head common to her and *Pegasus*.

*Delta-ton* or the Triangle, consists of 3 bright Stars of the fourth Magnitude.

*Auriga* the Waggoner, hath 3 Stars, the chief called *Capra* the Goat on the Shoulder.

*Pegasus* the flying Horse hath 7 great Stars, one called the Mouth of *Pegasus*.

The *Dolphin* between the *Colt* and the *Eagle* hath 10 Stars.

The *Arrow* hath 5 Stars, that at the *Points* end of the fourth Magnitude.

The *Colt* is as it were, but the shadow of the Head of *Pegasus*, and hath 4 Stars.

The *Eagle* hath several bright Stars, and one called the bright Star of the *Eagle*.

*Serpentarius*, *Ophiuchus*, or the *Serpent Bearer* is a large Aferism or Constellation, but hath no Stars greater than of the third Magnitude.

The *Serpent* or *Ophiuchus* hath several Stars of the third and fourth Magnitude.

The Southern signs are 15 in Number being these following Constellations.

The *Whale* situate under the *Fishes* and the *Ram*, having a vast wide Mouth hath therein a Star of the first Magnitude called the bright Star of the *Jawbone* of the *Whale*; and another as big in the midst of the point of his *Tail*, and other large Stars.

*Eridanus* is a long and winding Aferism betwixt *Orion* and the *Whale*.



The *Hare* hath 4 Stars of the first Magnitude, and among others 4 smaller in his Ears.

*Orion* hath many bright Stars, 2 in his Shoulder, 3 in his Girdle called 3 Kings, one in his right Knee, and another in his left foot called *Regel*.

*Canis Major* hath not his equal for a bright Star, called *Syrius*.

*Canis Minor* riseth before the great Dog, and hath a bright Star in his Neck, and another on his Thigh, called *Procyon*.

The *Ship Argo* hath but a few Stars to be seen, except one at the Helm, called *Canopus*.

*Hydra* the Water Serpent hath a bright Star in the Breast, called *Cor Hydrae*.

The *Bowl* or Cup on the midst of *Hydra* hath a C or half round of Stars.

The *Crow* hath a Table in it consisting of 4 pretty large Stars.

The *Centaur* besides 14 visible Stars, hath 4 called the Crofters, by which Mariners sail in the Southern Hemisphere, as here by the Pole Star.

The *Wolf* whose head reacheth the middle of the *Scorpion*, hath no very great Stars.

The *Altar* or *Censer* is for the most part hid under the bending of the Scorpions Tail.

The *South Crown* hath one notable Star among others called *Uraniscus* or the petty Heaven.

The *South Fish* hath many pretty large Stars, and one called *Tomabant* very large in its Mouth.

The *unformed Stars* are so called as being comprehended under no Figure or Image.

The *Galaxy* or *Milky way* is nothing else but a vast Multitude of thick set Stars.

*Note*, When the Sun or any Planet is said to be in a sign, the meaning is that it is placed under it, or Intervenes between our Eye and that sign.

Concerning the Nature, Original and Affections of the Planets, as also concerning the Principle of the Planets Motion and of their Direction, Station and Retrogradation, it being too large a discourse abundantly to treat of here, I shall refer you to the Astronomers and Astrologers who have wrote thereof at large, and to the following compendious Treatise of Astrology for a brief account thereof.

By the Ascensional difference and Motions of the Planets and Stars is known the Increase and Decrease of the Artificial Day in every Latitude, and the distinction of Times and Seasons, and the several kinds of Days and Weeks, Months and Years. But this Volume only admitting a compendious Abstract of what may be instructive and constantly useful, I shall therefore insert from Mr. *Seller's Atlas Cælestis*.

A Perpetual Almanack.

<u>Fanu.</u>	<u>Febr.</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>
<u>At</u>	<u>Dover</u>	<u>Dwells</u>	<u>George</u>	<u>Brown</u>	<u>Esquire</u>
<u>Good</u>	<u>Christ</u>	<u>Finch</u>	<u>And</u>	<u>David</u>	<u>Fryer.</u>
<u>July</u>	<u>August</u>	<u>Sept.</u>	<u>October</u>	<u>Nov.</u>	<u>Decem.</u>

To find the Dominical Letter for ever.

<u>C 1</u>	<u>E 1</u>	<u>G 1</u>	<u>B 1</u>	<u>D 1</u>	<u>F 1</u>	<u>A 1</u>
<u>B 2</u>	<u>D 2</u>	<u>F 2</u>	<u>A 2</u>	<u>C 2</u>	<u>E 2</u>	<u>G 2</u>
<u>A 3</u>	<u>C 3</u>	<u>E 3</u>	<u>G 3</u>	<u>B 3</u>	<u>D 3</u>	<u>F 3</u>
<u>G F</u>	<u>B A</u>	<u>D C</u>	<u>F E</u>	<u>A G</u>	<u>C B</u>	<u>E D</u>
<u>1000</u>	<u>1200</u>	<u>1400</u>	<u>1600</u>	<u>1100</u>	<u>1300</u>	<u>1500</u>
<u>1616</u>	<u>20</u>	<u>24</u>	<u>28</u>	<u>32</u>	<u>36</u>	<u>40</u>
<u>44</u>	<u>48</u>	<u>52</u>	<u>56</u>	<u>60</u>	<u>64</u>	<u>68</u>
<u>72</u>	<u>76</u>	<u>80</u>	<u>84</u>	<u>88</u>	<u>92</u>	<u>96</u>
<u>1700</u>	<u>4</u>	<u>8</u>	<u>12</u>	<u>16</u>	<u>20</u>	<u>24</u>
<u>28</u>	<u>32</u>	<u>36</u>	<u>40</u>	<u>44</u>	<u>48</u>	<u>52</u>
<u>2400</u>	<u>1900</u>	<u>2100</u>	<u>2300</u>	<u>1800</u>	<u>2000</u>	<u>2200</u>

To find the Day of the Month.

1	8	15	22	29	5	12	19	26
2	9	16	23	30	6	13	20	27
3	10	17	24	31	7	14	21	28
4	11	18	25	0	c	o	c	o

All those Years expressed in the Tables are all Leap-Years, as 1000, 1200, &c. and have each of them two Dominical Letters, as may be seen in their respective Columns over their heads. The other Figures as 20, 24, 28, 32, &c. are all Leap years also, the use of which are thus explained, 1. Suppose the Dominical Letter is required for 1716, look for 1700 in one Column, and in another for 16 you will find it is Leap year and the Dominical Letters A G. 2. Suppose you would know the Dominical Letter for the year 1709, look for 9 which you cannot find, therefore look for the year before which is 8, and that is Leap year and the Dominical Letters D C. Now C being the Dominical Letter for the latter part of the year 1708. The next Letter before it in the Alphabetical Order is B, which you will find on the top of the next Column with a 1 by it, which tells you it is the first after Leap year, and that the Dominical Letter is B, and so for 1710 the Dominical Letter is A, and the second after Leap year, the same is understood of all the rest.

For

For the finding the day of the Month by the short Verse, take notice, the first Letter in each word is the same Week day Letter that always begins the Month, as A always begins *January*, and so of the rest according to the Order in the Distich. Therefore would I know what day of the Month the first *Sunday* in *June* will be on, *Anno 1709*, finding as before B is the Dominical Letter; I find by the Distich E begins the Month, therefore counting in the Natural order of the Alphabet on to B thus, E 1, F 2, G 3, A 4, B 5, I find the first *Sunday* in *June* is the 5<sup>th</sup>. day of the Month. If I would know what day of the Month the first *Thursday* of *July* is in 1709 the Dominical Letter being B I find by the Verse the Month of *July* begins with G, therefore I say G 1, A 2, B 3, (which is *Sunday*) C therefore is *Monday*, D *Tuesday*, E *Wednesday*, and F *Thursday* which is 7 from G, and therefore the first *Thursday* falls on the 7<sup>th</sup> day of the Month. The Month begins with a *Fryday*, so cast your Eye down to a small Table on the bottom of the said Almanack, and there you find in the first row of Figures, 1, 8, 15, 22, 29, which you may reckon to be always the same days

of the Week, the Month begins with, and so of the rest.

Because I intend to set down here, some of Mr. *Seller's* short Rules to find the Golden Number, Cycle of the Sun, Indiction, &c. which are of good use to all. I shall in the first place declare the natural Reason and Definition of them.

The *Prime* or *Golden Number*, so called because marked by *Julius Caesar* in the Calendar with Letters of Gold, is a Circle of 19 years in which it was supposed all the Lunations and Aspects between the Sun and Moon did return to the same place: Its chief use being to find the Age and Change of the Moon.

The *Cycle of the Sun*, is a Revolutionary Number of 28 years in which space is a change of all the Sunday Letters for every year, whereby is known the true order of the Sunday Letter. A. being placed against the first day of *January* and the rest in order to the years end.

The *Epaēt*, is a Number not exceeding 30, because the Moon between her changes never exceeds 30 days, and thereby the Lunar year consisting of 12 Months is less than the solar by 11 days, for to every  
very

very Lunar Month is reckoned but 29 days and half, so a Lunar year contains 354 days and the Solar 365 days. The difference is 11 days, and this is called the Epact.

*The Indiction*, Is a Number of 5, 10, or 15 years used by the ancient *Romans* in Numbring of years, and set down by the Bishops of *Rome* in their Charters. The ancient *Romans* used also a Division of the Solar Month into *Kalends*, *Nones*, and *Ides*, and therefore will I declare what they be.

*The Kalends* were the first day of every Month from which they counted backwards. As the first of *April* they named the *Kalends* of *April*, and the last of *March*, *Pridie Kalendas Aprilis*, the day before that, the third *Kalends* of *April*, the next day before that; the fourth *Kalends* of *April*, and so on till they came to the *Ides*. This word *Kalends* came from the Greek Verb *Calo*, viz. to call, for the first day of every Month the Cryer standing on a high place, made 4 or more calls to signify to the People how many days in that Month the Fairs or Markets called *Nundinae* should endure, from which word *Nundinae* sprang.



*None* or *Nones*, that is to say, the days of the Fairs, during which time the *Romans* never worshipped any God. Every Month had 4 *Nones*, except *March*, *May*, *July*, and *October* which had 6.

*Ides* were those days by which the *Nones* were divided from the rest, and were 8 in every Month, dividing in a manner the whole Month into two equal parts, for the first *Ides* commonly fell on the 13, 14 or 15<sup>th</sup>. day of the Month.

To find the Golden Number, Cycle of the Sun and Indiction.

When 1, 9, 3, to the year hath added been  
Divide by 19, 28, 15.

Example.

To 1702 add 1 which makes 1703, Divide that by 19, and there remains 12, which is the Golden Number for that year. Again to 1702 add 9 and the Sum is 1711, which divide by 28, the residue is 3, the Cycle of the Sun for that year. Lastly to 1702 add 3, the Sum is 1705, which being divided by

by 15 the Remainder is 10, the Indiction for that year.

*The Golden Number given to find the Epact.*

*Divide by 3, for each one left add 10, 30 reject, the Prime makes Epact then.*

In 1702 the Golden Number is 12, which divide by 3, and there remains 0, therefore 10 times 0 is but 0, which added to 12 makes nothing more, therefore 12 is the Epact for that year.

*To find if it be Leap year or past.*

*Divide the year by 4, what's left shall be For Leap year 0, for past 1, 2 or 3.*

Anno 1702 divided by 4, there remains 2, which shews it to be the second after Leap year.

*To name the Planets right in order.*

*If you would count the Planets soon,  
Remember S I M S V M and the Moon.*

Beginning at the highest Planet S stands for Saturne, J for Jupiter, M for Mars,  
S

S for *Sol*, V for *Venus*, M for *Mercury*,  
beneath which is *Luna* the lowest Pla-  
net from the Heavens, and nearest to  
the Earth.

*The Number of Days in each Month.*

*Thirty Days hath September,  
April, June and November,  
February hath twenty eight alone,  
All the rest have thirty and one.*

And now because many Astronomical  
Elements, Definitions and Problems  
are used therein, I hope it cannot be  
thought improper or offensive to speak  
somewhat briefly and recreatively, for  
the Readers small insight into the Art  
of,

*Dyalling.*

This Art may be performed three fe-  
veral ways, *viz.* Geometrically, Arithme-  
tically, and Instrumentally of all which  
I'll give a touch in their Order.

*Geometrically*, by projecting the Cir-  
cles of the Sphere upon the Plain it self  
with Scale and Compass. A *Dyal* may  
be

be made upon any plain superficies, and all plain superficies are posited in one or other of these three Positions, *viz.* either Parallel, Perpendicular, or Oblique to the Horizon of the place wherein the Plain is seated, and all the Hour Lines drawn upon any plain are great Circles of the Sphære which being projected upon a plain superficies become strait Lines.

Now the Art of Dyaling consisteth chiefly in the finding out of these Lines, and their true distances each from the other which continually vary, according as the Plains upon which they are described or projected are situated in respect of the Horizon of the place.

Of these Plains there are 3 varieties, *viz.* 1 Parallel to the Horizon as is the Horizontal (otherwise Vertical) Plain only. 2 Perpendicular to the Horizon, and such are all Erect Plains which be either Direct, as North and South, East and West or Declining. 3 Reclining from the Zenith, or inclining to the Horizon, and these are either Direct Reclining and Inclining North and South, or East and West. Declining or Reclining and Inclining.

Particular Dyals are in Number 25 which may be reduced to 17 by supplying the inclining Plains from their opposite Recliners which are indeed the same.

These Plains some Denominate from the sight or Positions of their Axis in the Heavens, others denominate them from the Circles of the Sphære in which they lye. Of all which Plains and how to draw the Hour Lines thereupon with other their Mechanick operations in that Art, you may read in Authors at large; but it is not my meaning to describe them here.

*Arithmetically*, by the Cannons or Tables of Artificial Sines and Tangents being a more accurate performance of this Art, by which the severall Requisites in all Plains may be Arithmetically attained. But the Tables being vulgarly known, and the use of them no less common, as also the Rules whereby to find the before mentioned Requisites, to be seen in several Books which treat of this Science, I purpose no more thereof in this place.

*Instrumentally*, by a plain and portable Instrument accommodated with Lines for that purpose and called an Horological Trigon,

Trigon whereby Dyals may be delineated upon all sorts of Plain Superficies, the description of which Instrument and its use you may see at large in Mr. *Leybourn's Art of Dyaling*, see also the description and use of the double Horizontal Dial in *Math. Recrea.*

Before I proceed to Astrology I will here give some necessary Problems upon the Terrestrial Globe, and some Astronomical Observations,

*Cosmographical and Astronomical Problems and Observations.*

I.

*To find the Longitude of a Country.*

If it be upon the Globe bring the Country to the Brazen Meridian and whatsoever Degree that Brazen Meridian cuts in the *Æquinoctial* that Degree is in the Longitude of that place. If it be in a Map then mark what Meridian passeth over it, so have you the Longitude thereof, if no Meridian pass over it, then take a pair of Compasses and measure the distance betwixt the Place and the next Meridian, and apply it to the

the divided Parallel or *Æquator* so have you the Longitude required.

## II.

*To find the Latitude of a Country.*

The Latitude of a Country is the difference of a Country from the *Æquinoctial*, or it is an Arch of the Meridian contained between the Zenith of the place and the *Æquator*, which is two-fold, *viz.* either North Latitude or South Latitude, either of which extended from the *Æquinoctial* to either Pole, so the greatest Latitude that can be is but 90 Degrees. If any Northern Country have the Artick Circle Vertical which is the Latitude of 66 Deg. 30 Min. the Sun will touch the Horizon in the North part thereof, and the longest day will be there then 24 hours. If the Country have less Lat. than 66 Deg. 30 Min. the Sun will rise and set, but if it have more Latitude than 66 Deg. 30 Min. it will be visible for many days. And if the Country be under the Pole, the Sun will make a circular motion above the Earth and be visible for half a year, so under

der the Pole there is but one day and night in the whole year.

If it be upon a Globe, bring the place to the Brazen Meridian, and the Number of Degrees which meeteth therewith, is the Latitude of the place : or with a pair of Compasses take the distance between the Country and the Equinoctial, which applyed unto the Equinoctial, will shew the Latitude of that Country, which is equal to the Poles height. If it be upon a Map, then mark what Parallel passeth over the Country, and where it crosseth the Meridian, that shall be the Latitude. But if no Parallel passeth over it, then take the distance between the place and the next Parallel, which applyed to the divided Meridian from that Parallel, will shew the Latitude of that place.

### III.

#### *The Climates.*

Climates as they are taken Geographically, signify nothing else, but when the length of the longest day of any place is half an hour longer or shorter than it is in another place (and so of the shortest day ;) and this account to begin from the



Æquinoctial Circle, seeing all Countries under it have the shortest and longest day that can be but 12 hours. But all other Countries that are from the Æquinoctial Circle either towards the North or South of it unto the Poles themselves, are said to be in some one Climate or other; from the Æquinoctial to either of the Polar Circles (which are in the Lat. of 66 Deg. 30 Min.) between each of which Polar Circles and the Equinoctial Circle there is accounted 24 Climates, which differ one from another by half an hours time: then from each Polar Circle to each Pole there are reckoned 6 other Climates which differ one from another by a Monthstime: So that the whole Earth is divided into 60 Climates, 30 being allotted to the Northern Hemisphere, and 30 to the Southern. And here note that tho' these Climates which are between the Æquinoctial and the Polar Circles are equal one unto the other in respect of time, to wit, by half an hour; yet the Latitude, Breadth or Interval contained between Climate and Climate is not equal, and by how much any Climate is further from the Æquinoctial than another Climate, by so much the lesser is the Interval between that

that Climate and the next : so those that are nearest the *Æquinoctial* are largest, and those which are farthest off most contracted. And to find what Climate any Country is under,

Subtract the length of an *Æquinoctial* day, to wit 12 hours, from the length of the longest day of that Country, the Remainder being doubled shews the Climate. So at *London* the longest day is near 16 hours and a half, 12 taken from it, there remains 4 hours and half, which doubled makes 9 half hours, that is 9 Climates, so *London* is in the 9th. Climate.

## IV.

*To find the distances of Places.*

If it be upon a Globe, then with a pair of Compasses take the distance between the 2 places, and apply it to the divided Meridian or Equator; and the Number of Degrees shall shew the distance, each Degree being 60 Miles. If it be on a Map (according to *Wright's* projection) take the distance with a pair of Compasses between the 2 places, and apply this distance to the divided

Meridian on the Map, right against the two places; so as many Degrees as is contained between the feet of the Compasses, so much is the distance between the two places. If the distance of two places be required in a particular Map then with the Compasses take the distance between the two places and apply it to the scale of Miles, so have you the distance : If the scale be too short take the scale between the Compasses, and apply that to the two places as often as you can, so have you the distance required.

## V.

Imagine there were a hole thro' the Earth, and that a Millstone should be let fall down this hole, and to move a Mile in each Minute of time, it would be more than two days and a half, before it would come to the Center, and being there it would hang in the Air.

## VI.

If a Man were let down to the Center of the Earth, there would he hang having both his head and his heels up towards Heaven.

## VII.

## VII.

The Moon runs a greater Compass each hour, than if in the same time she should run twice the Circumference of the whole Earth.

## VIII.

The Sun in his proper Sphere according to the *Ptolemaick* System must move more than 7570 miles in one Minute of Time.

## IX.

It is of a far higher nature to consider the exceeding quickness of the Starry Firmament, for a Star being in the *Æ*-quator (which is just between the Poles of the World) makes 12598666 miles in one Hour, which is 209974 miles in one Minute of time, and if a Horseman should ride every day 40 Miles, he could not ride such a Compass in 1000 years, as the Starry Firmament moves in one Hour, which is more than if one should move about the Earth a 1000 times in an hour, which is quicker than possibly thought can be imagined: and if a Star

should fly in the Air with such a prodigious swiftness, it would burn and consume all the World here below. Behold therefore how time passeth and death posteth on. This made *Copernicus* not unadvisedly to attribute this Motion of *Primum Mobile* to the Earth and not to the Starry Firmament, for it is beyond humane Sense to apprehend or conceive the Rapture and Violence of that Motion must be quicker than thought, and the word of God telleth us that the Lord made all things in Number, Measure, Weight and Time.

## X.

Under the *Æquinoctial* the Needle hangs in *Æquilibrio*, but in these parts it inclines under the Horizon, and being under the Pole it is thought it will hang Vertical.

## XI.

In the Countrys which are without the Tropical Circles, the Sun comes East and West every day for half a year, but being under the *Equinoctial* the Sun is  
never

never East nor West but twice in the year, to wit, the 10<sup>th</sup> of *March* and 13<sup>th</sup> of *September*.

## XII.

If a Ship be in the Latitude of 23 deg. 30 min. that is, if it hath either of the Tropicks Vertical, then at what time the Suns Altitude is equal to his distance from any of the *Æquinoctial* points, then the Sun is due East or West.

## XIII.

If a Ship be between the *Æquinoctial* and either of the Tropicks, the Sun will cometwice to one point of the Compass in the Forenoon, that is in one and the same Position.

## XIV.

Under the *Æquinoctial* near *Guinea*, there is but 2 sorts of Winds all the year, 6 Months a Northerly Wind, and 6 Months a Southerly wind, and the Flux of the Sea is accordingly.

## XV.

If two Ships under the *Æquinoctial* be 100 Leagues asunder, and should sail Northerly untill they were come under the *Artick Circle*, they should then be but 50 Leagues asunder.

## XVI.

Those which have the *Artick Circles* Vertical, when the Sun is in the *Tropic* of *Cancer*, the Sun setteth not, but toucheth the Western part of the *Horizon*.

## XVII.

If the Compliment of the Suns height at Noon be found equal to the Suns Declination for that day, then the *Æquinoctial* is Vertical; or a Ship making such an Observation, the *Æquinoctial* is in the Zenith, by which Navigators know when they cross the Line in the Travels to the *Indies* or other parts.

## XVIII.

## XVIII.

The Sun being in the *Æquinoctial* the extremity of the *Style* in any Sun Dyal upon a Plain maketh a right Line, otherwise it is *Ecliptical*, *Hyperbolic*, &c.

## XIX.

When the shadow of a Man or other thing upon a *Horizontal Plain* is equal unto its length, then is the Sun in the middle point between the *Horizon* and the *Zenith*, that is 45 Degrees high.

## XX.

The difference of the *Apogæon* or farthest distance of the Sun and the *Perigæon* is 315244 *Italian Miles*.

*Astrology* being founded upon the Science of Astronomy I shall proceed to give some small account of the *Rudiments* thereof.



## Astrology.

*Astrologia*, derived from the Greek *ἄστρον*, i. *Astrum* & *λόγος*, i. e. *Ratio*, *Sermo*, est enim *Scientia de Astrorum motibus*, or a Science which by considering the Motions, Aspects and Influences of the Stars doth Prognosticate or Judge of things to come.

The Number, Nature and Character of the Planets I have spoke somewhat of before, and therefore shall add here only the two Nodes or certain points of the Heavens Named and Charactered thus, *the Dragons Head*, & *the Dragons Tail*.

The Planets have allowed them every one, except *Sol* and *Luna*, two of these Signs for their Houses, as to *Saturn* belongs *Capricorn* and *Aquarius*; to *Jupiter* *Sagittarij* and *Pisces*; to *Mars* *Aries* and *Scorpio*; to *Sol*, *Leo*; to *Venus*, *Taurus* and *Libra*; to *Mercury*, *Gemini* and *Virgo*, and to *Luna*, *Cancer*. The Planets by their continual motion thro' the 12 Signs make several Angles or Aspects the most forcible of which are these five.

♄ *Conjunction*, \* *Sextile*, □ *Quadrante*,  
 △ *Trine*, ♂ *Opposition*.

A *Conjunction* is when two Planets are in one and the same Degree and Minute of a Sign; and this is either good or bad as the Planets are either Friends or Enemies.

A *Sextile Aspect* is when two Planets are two Signs or 60 Degrees distant, as ♃ in 15 degrees of ♈ and ♄ in 15 degrees of ♀, here *Jupiter* is in a *Sextile Aspect* to *Saturn*; this is an *Aspect* of Friendship.

A *Quadrante Aspect* is when two Planets are 3 Signs or 90 degrees distant, as ♄ in 10 degrees of ♉, and ♀ in 10 degrees of ♌, this particular *Quadrante Aspect* is of imperfect enmity, and Artists say that the Persons signified thereby may have jars at some times, but such as may be reconciled again.

A *Trine Aspect* is when any two Planets are 4 Signs or 120 degrees distant as ♄ in 12 degrees of ♈, and ♀ in 12 degrees of ♌. Here *Sol* and *Mars* are said to be in *Trine Aspect*, and this is an *Aspect* of perfect Love and Friendship.

An

An *Opposition* is when two Planets are diametrically opposite; which is when they are 6 Signs or 180 degrees (which is one half of the Circle asunder) and this is an Aspect of perfect hatred.

A *Partile Aspect* is when two Planets are in a perfect Aspect to the very same degree and minute.

*Dexter Aspects* are those which are contrary to the succession of Signs, as a Planet in *Aries* casts his Sextile Dexter to *Aquarius*.

*Sinister Aspect* is with the succession of Signs, as a Planet in *Aries* casts his Sextile Sinister in *Gemini*.

The Division and Signification of the Twelve Signs of the Zodiack with the Nature and signification of each Planet in each and every of the Houses. Also the Essential and Accidental Dignities of the Planets, and the Kingdoms and Cities under the Signs and Planets, being subjects too large and burthenome for this place by much, I refer you to the Books of Practical Astrology, and invite the young Student of this Science to understand well these following Astrological

*Terms*

## Terms of Art.

*Application* of the Planets is performed three ways, 1 When a light Planet being direct and swift in Motion, applies to a Planet more ponderous and slow in Motion, as *Mercury* in 8 degrees of *Aries*; and *Jupiter* in 12 degrees of *Gemini*, and both direct, here *Mercury* applies to a Sextile of *Jupiter* by direct Application. 2 When they are both Retrograde, as *Mercury* in 20 deg. of *Aries*, and *Jupiter* in 15 degrees of *Gemini*; here *Mercury*, the lighter Planet applies to the Sextile Aspect of *Jupiter* and this is by Retrogradation. 3 When one of the Planets are direct, and the other Retrograde, as suppose *Mercury* were Retrograde in 18 degrees of *Aries*, and *Jupiter*, direct in 14 degrees of *Gemini*; here *Mercury* applies to a Sextile of *Jupiter* by his Retrograde motion.

*Prohibition* is when two Planets are applying either by Body or Aspect and before they come to their Partile Aspect another Planet meets with the Aspect of the former and so prohibits it. As *Mars* in 10 degrees of *Aries*, and *Venus* in 6 degrees of *Aries*, and *Mercury* in 5 degrees of *Aries*: here *Venus* is applying

plying to a Conjunction of *Mars* ; but before they come to their Partile Conjunction *Mercury* being more swift in motion comes to a Conjunction of *Mars* before *Venus*, and so prohibits *Venus*.

*Separation* is when two Planets have been lately in Conjunction or Aspect, and are separated from it : As *Saturn* in 10 degrees of *Libra*, and *Mercury* in 12 degrees of *Libra* ; here *Mercury* is separating from a Conjunction of *Saturn*, but they are still in Platick Conjunction so long as they remain within their Orbs.

*Translation* of Light and Virtue, is when a lighter Planet separates from the Body or Aspect of a more weighty one, and immediately applies to another superior Planet, and so translates the light and vertue of the first Planet to that which he applies to : As *Mercury* in 8 degrees of *Cancer*, *Saturn* in 6, and *Jupiter* in 13, here *Mercury* is separated from a Conjunction of *Saturn*, and applies to a Conjunction of *Jupiter*, and so translates the vertue of *Saturn* to *Jupiter*.

*Refrenation* is when a Planet is applying to the Body or Aspect of another, and before he comes to it he falls Retrograde, and so refrains by his Retrograde motion : As *Saturn* in 10 degrees of *Taurus* and *Mars* in 7 degrees of *Cancer*, here *Mars* applies to a Sextile of *Saturn* ; but before he comes to it, he becomes Retrograde.

*Combustion*, a Planet is said to be Combust of *Sol* when he is within 8 degrees 30 minutes of his Body, either before or after their Conjunction : but a Planet is more afflicted when he is applying to his Body, than when he is separating from Combustion.

*Reception* is when two Planets are in each others Dignities, and it may be either by House, Exaltation, Triplicity or Term : As *Sol* in *Cancer*, and *Luna* in *Leo* ; here they are in Reception by House, or *Sol* in *Taurus* and *Luna* in *Aries* ; here they are in reception by Exaltation.

*Retrograde* is when a Planet moves backwards from 10 degrees to 9, 8, 7, and so contrary to the succession of signs out of *Taurus* into *Aries*, and is noted in the *Ephemeris* thus B.

*Frustration* is when a swift Planet applies to the Body or Aspect of a superiour Planet, and before he comes to it the superior Planet meets with the Body or Aspect of some other Planet, as *Jupiter* in 15 degrees of *Cancer*, and *Venus* in 10 degrees of the same sign, and *Mars* in 14 degrees of *Taurus*, here *Venus* applies to a Conjunction of *Jupiter*; but before they come to their partile Conjunction, *Mars* comes to a Sextile of *Jupiter*, and so frustrates *Venus*.

*Peregrine* is when a Planet is posited in a sign wherein he hath no Essential Dignities.

*Under the Sun Beams*, a Planet is said to be under the Sun Beams untill he be removed 17 degrees from his Body.

*Void of Course*, a Planet is said to be void of course when he is separated from the Body or Aspect of another Planet, and doth not apply to the Body or Aspect of another Planet while he remaineth in that sign.

*Swift of Course*, is when a Planet moves more in 24 Hours than his mean motion, and he is said to be *Slow of Course* when he moves less in 24 Hours than his mean motion.

*Cazimi*;

*Cazimi.* A Planet is said to be in *Cazimi* or the Heart of the Sun, when he is within 16 minutes of his Body in respect of Longitude and Latitude.

*Besieging.* A Planet is said to be besieged when he is between the Bodies of *Saturn* and *Mars*, as *Saturn* in 15 degrees, of *Cancer*, and *Jupiter* in 18 degrees, and *Mars* in 20; here *Jupiter* is besieged of *Saturn* and *Mars*.

*Oriental* is when a Planet riseth before the Sun, and may be seen before Sun rising.

*Occidental* is when a Planet sets after the Sun, and may be seen after Sun set.

*Direct.* A Planet is direct when he moves according to the succession of signs and out of 5 degrees to 6, 7, and so forward.

*Stationary* is when a Planet moves not at all; which they do before and after Retrogradation.

*Increasing in Light* is departed from *Sol* or *Sol* from him.

Longitude and Latitude of a Planet, also Declination, Right and Oblique Ascension, &c. may be seen before in Astronomical Definitions.

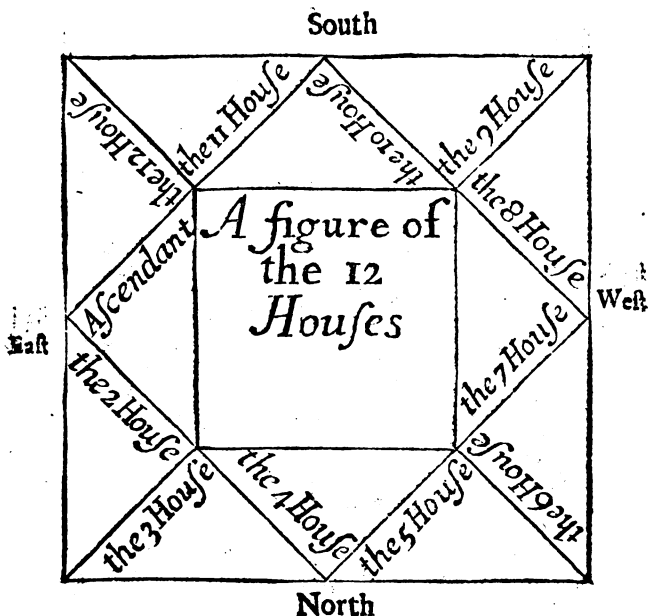


For more of the Theorique part of this Science I refer to Mr. *Middleton's* Practical Astrology and others, and now here will shew you how

*To erect a Figure of Heaven, for any Hour, Day or Night.*

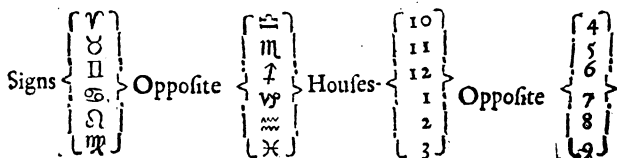
The whole Sphere or Globe of Heaven is divided into 4 equal parts by the great Circles of the Meridian and Horizon, and each of these is divided again into 3 other parts by the Circles of Position which intersect the *Æquator* equally, and do likewise meet in the points of the Grand Meridian, and with the Horizon; which are in all 12, called by Astronomers the 12 Houses, of which there are four principal Angles; two of which fall equally upon the Horizon, the other upon the Meridian, that is to say the First, the Fourth, the Seventh, the Tenth. The following Houses are called Succedent Houses, the other Cadent Houses, which Astrologers commonly draw in this manner.

South



The Lines in the Figure do shew the Cusps or entering into the Houses. But for the erecting of an Astrological Figure: First in your Ephemeris you are to get the true place of the Sun; and if the Minutes exceed 30 you are to add one degree more to the Suns place, then with those whole degrees enter the Table of Houses in that sign which you find *Sol* in, and in the Columa of the

10 House find the degree of the sign, and right against it on the left hand under the Title Time from Noon, you will find certain Hours, Minutes and seconds, which you are to add to the Hour in which you erect your Figure, and if the Sum amount to more than 24 Hours cast away 24 and with the Remainder seek in the great Column entituled Time from Noon, and right against it you shall find the Signs, Degrees and Minutes to be placed upon the Cusps of the 10, 11, 12, 1, 2 and 3 Houses, then you are to place the opposite Signs and Degrees upon the Cusps of the other 6 Houses. The Signs are opposite in this manner.



Here you see that *Aries* is opposite to *Libra*, and *Taurus* to *Scorpio*, *Gemini* to *Sagittarius*, &c. and so in like manner the 10<sup>th</sup> House is opposite to the 4<sup>th</sup> the 11<sup>th</sup> to the 5<sup>th</sup>, the 12<sup>th</sup> to the 6<sup>th</sup>, &c.

In the next place you are to take the places of the rest of your Planets in your . Ephem-

Ephemeris and place them in the signs of your Figure; always remembring if the degrees of the Planets places be less than the degrees of the Cusp of your House you must place him before the Cusp thereof, but if the degrees be more than the Cusp of your House you must place him behind the Cusp thereof.

But if you erect a Figure for 8 or 9 hours afternoon, the Planets will require a Reduction to the hour of the Day; for all Ephemerides and Astronomical Tables are calculated from Noon to Noon, and so you are to reckon the time, as if you would erect a Figure for 2 a Clock in the Morning, you must account it at 14 hours after Noon the day preceding: but if it be only for a Horary Question a mental Reduction of the Planets places will be sufficient; only the Moon by the swiftness of her Motion will require a Reduction, and by adding 30 Minutes to her place for every hour afternoon, and subtracting in the Forenoon 30 Minutes for each hour, you may gain her place truly enough for all ordinary Questions but for more exactness I refer you such Tables as reduce the Planets places to any Hour of the Day or Night, and proceed to give you an Example of, E-

recting the Figure of Heaven just as I find one in *Middleton's Practical Astrology*.

Suppose it were required to erect a Figure the 6 day of *January* 1677 at 3 Hours afternoon. In the Ephemeris you will find the Sun's place to be 27 degrees 6 minutes of *Capricorn*, then look in the Table of Houses for *Sol* in *Capricorn*, then guiding your Eye down the second Column (marked at the top, *Dom. \**) which is the Column of the 10th House) and near the bottom of the Table you'll find 27 degrees, and against that in the great Column on the left hand intituled Time from Noon, 19 Hours, 56 Minutes, 12 Seconds, which add to the 3 Hours the time of erecting the Figure, and it makes 22 Hours, 56 Minutes, 12 Seconds, which Number seek in the Column intituled time from Noon, and the nearest Number to it is 22 Hours, 57 Minutes, 24 Seconds. Then look in the Column of the 10th House, and you find 13 degrees and  $\times$  at the top, for the Cusp of the 10th House, and in the Column for the 11th House you find 21 degrees, 16 minutes of  $\nu$ , and in the Column of the 12th House you find 12 degrees, 31 Mi-

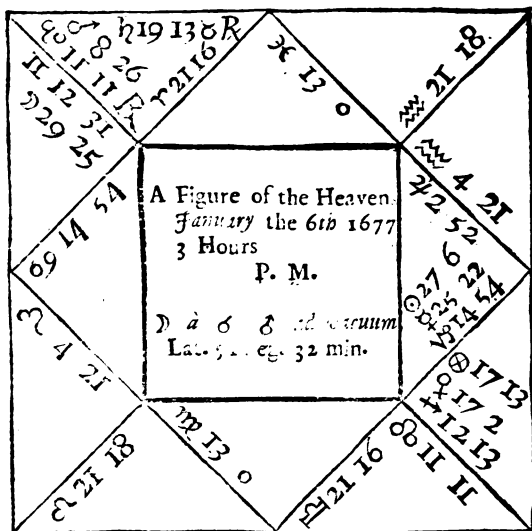
Minutes of  $\Pi$ , and for the Ascendant 14 degrees 54 minutes of  $\mathfrak{S}$ , for the second House you find 4 Degrees 21 minutes of  $\Omega$ , for the third House 21 degrees 18 minutes of  $\Omega$ , and so you have the Cusps of the six Oriental Houses, and upon the other six Houses you are to place the Opposite signs. Then seek in the Ephemeris for the places of the Planets, and against the 6th of January 1677 you find them thus.

*The places of the Planets.*

	deg.	min.			deg.	min.	
$\Upsilon$	19	13	$\mathfrak{S}$	$\mathfrak{Q}$	17	2	$\mathfrak{I}$
$\Upsilon$	2	52	$\mathfrak{M}$	$\mathfrak{Q}$	25	22	$\mathfrak{V}$
$\mathfrak{M}$	8	26	$\Pi$	$\mathfrak{D}$	29	25	$\Pi$
$\odot$	27	6	$\mathfrak{V}$	$\mathfrak{Q}$	12	11	$\mathfrak{I}$

The  $\mathfrak{S}$  is always opposite to the  $\mathfrak{Q}$ .

Having thus found the Cusps of the Houses and places of the Planets you place them as you see in the following Figure.



Here you see the Signs and Degrees placed upon the Cusps of the 6 Oriental Houses which were formerly found in the Table of Houses, and the opposite signs upon the opposite Houses; and for the placing the Planets therein, first you found *Saturn* as aforesaid in *Taurus*, which is not the Cusp of any House, but intercepted between the Cusps of the 11 and 12th Houses; therefore he was placed in the 11th House as you may see in the Figure. Next you found *Jupiter* in 2 degrees, 52 minutes of *Aquarius*, you find

find *Aquarius* both upon the 9<sup>th</sup> and 8<sup>th</sup> Houses, but finding the degrees of *Jupiter* nearest the degrees of the 8<sup>th</sup> therefore was *Jupiter* placed before the Cusp of the 8<sup>th</sup>. Also finding *Mars* posited in 8 degrees, 26 minutes of *Gemini* which you find upon the Cusp of the 12<sup>th</sup>, but finding the degrees of the House more than the degrees of *Mars* therefore was *Mars* placed before the Cusp thereof, but still he shall be accounted in the 12<sup>th</sup> because he is within 5 degrees of the Cusp thereof. The rest of the places may be found posited in the Figure as was before directed.

I should now proceed to the Judicial part of Astrology, teaching the resolution of all manner of Horary Questions. But the Subject being abundantly too large for this little Volume I would have you to have recourse for further knowledge therein (if you desire it) to the Astrologers Books, and desire you will accept of



A Table shewing what Planet rules every Hour of the Day and Night.

Day.												
	1	2	3	4	5	6	7	8	9	10	11	12
Sunday	☉	♀	♁	♃	♅	♁	♁	☉	♀	♁	♃	♅
Munday	♃	♅	♁	♁	☉	♀	♁	♃	♅	♁	♁	☉
Tuesday	♁	☉	♀	♁	♃	♅	♁	♁	☉	♀	♁	♃
Wednesday	♀	♃	♅	♁	☉	♀	♁	♃	♅	♁	♁	♁
Thursday	♁	♁	☉	♀	♁	♃	♅	♁	♁	☉	♀	♁
Friday	♀	♁	♃	♅	♁	♁	☉	♀	♁	♃	♅	♁
Saturday	♃	♅	♁	☉	♀	♁	♃	♅	♁	♁	☉	♀

Night.												
Sunday	♁	♁	☉	♀	♁	♃	♅	♁	♁	☉	♀	♁
Munday	♀	♁	♃	♅	♁	♁	☉	♀	♁	♃	♅	♁
Tuesday	♃	♅	♁	☉	♀	♁	♃	♅	♁	♁	☉	♀
Wednesday	☉	♀	♁	♃	♅	♁	♁	☉	♀	♁	♃	♅
Thursday	♃	♅	♁	☉	♀	♁	♃	♅	♁	♁	☉	♀
Friday	♁	☉	♀	♁	♃	♅	♁	♁	☉	♀	♁	♃
Saturday	♀	♃	♅	♁	☉	♀	♁	♃	♅	♁	♁	♁

This Table is easily to be understood, for know to every day in the Week is appropriated a several Planet, as ☉ to *Sunday*, ♃ to *Monday*, ♀ to *Tuesday*, &c. and therefore each Planet governs the first Hour. As you may perceive by the Table that the Sun governs the first hour after Sun-rising on *Sunday*, ♀ the second, ♃ the third, ♃ the fourth, and so on; ♃ Governs the first Planetary Hour of the Night that is after Sun set, ♀ the second, ☉ the third, &c. And so of all the rest.

See the Treatise of Astrology in my *Gentlemans Treasury*, where you will find the Astrological Predictions of several Men, the Mutability of Fortune in several great Men, and Men born of low degree that attained to great Honours, also fatal contrarieties in one and the same Name, and Days observed by several Persons as lucky and unlucky, with several other things not here mentioned or described.

*Des Cartes* and *Agrippa* as they inveigh much against some other Sciences especially *Agrippa*, so doth the latter of them not spare or favour Astronomy, but particularly Astrology, which he saith is an Art altogether fallacious, and that all the vanities of superstition flows out of the Bosom of Astrology, their whole Foundation being upon Conjectures, and comparing future Occurrences by past Events, which they have no pretence for, since they allow that the Heavens never have nor will be in one exact Position since the World commenced, and yet they borrow the effect, and influences of the from the most remote Ages in the World beyond the memory of things, pretending themselves able to display the hidden Natures, Qualities, &c. of all sorts of Animals, Stones, Metals and Plants, and to shew how the same does depend on the Skies, and flow from the Stars, yet doth *Eudoxus*, *Archelaus*, *Cassandrus*, *Halicarnassus* and others confess 'tis impossible that any thing of certainty should be found out by the Art of Judicial Astrology, by reason of  
the

the innumerable co-operating causes that attend the Heavenly influences ; and so *Ptolemy* is also of opinion. Furthermore they who have prescribed the Rules of Judgments, set down their maxims so various and contradictory, that it is impossible for a Prognosticator out of so many various and disagreeing opinions, to be able to pronounce any thing certain, unless he be inwardly inspired with some secret and hidden instinct and sense of future things, or unless by some occult and latent communication with the Devil. And Antiquity witnesseth that *Zoroastres*, *Pharoah*, *Nebucchadnezer*, *Cesar*, *Crassus*, *Pompey*, *Diatharus*, *Nero*, *Julian* the Apostate and several others most addicted to Astrologers Predictions perished unfortunately, tho' they were promised all things favourable and auspicious. And who can believe that any person happily placed under *Mars* being in the Ninth, shall be able to cast out Devils with his presence only ; or he who hath *Saturn* happily constituted with *Leo* at his Nativity, shall when he departs this Life immediately return to Heaven, yet are these Heresies

lies maintained by *Petrus Aponensis*, *Roger Bacon*, *Guido Bonatus*, *Arnoldus de Villa nova* Philosophers; *Aliacensis* Cardinal and Divine, and many other famous Christian Doctors. Against which Astrologers the most learned *Picus Mirandula* wrote twelve Books so fully as scarce one Argument is omitted against it, and gave the killing blow to Astrology. Amongst the ancient Romans it was prohibited, and most of the Holy Fathers Condemn'd, and utterly banished it out of the Territories of Christianity, and in the Synod of *Martinus* it was Anathematized. As to the Prediction of *Thales* who is said to have foretold a scarcity of Olives and dearth of Oyl, so commonly avouched by Astrologers to maintain the Glory of their Science, *Des Cartes*, answers with an easy reason, and most probable truth, that *Thales* being a great Natural Philosopher, and thereby well acquainted with the vertue of Water (which he maintained the principle of all things) he could not be Ignorant what Fruits stood in most need of Moisture, and how much they were beholding to Rain for their growth, which then being wanting, he might easily know there would be

be a scarcity without the precepts of Astrology; but if they will have it that *Thales* foreknew it only by that Art; why are not others who pretend to be so well skilled therein as able to have the same opportunities of enriching themselves. As for the foretelling the deaths of Emperors and others, it was but Conjectures knowing most of 'em to be Tyrants, and hated, and thereupon also would they pretend to promise others the Empire and Dignities which sometimes spurring up ambitious Minds, they neglected no attempts to gain the Crown, the Astrologers thereby occasioning Murders, and advancements by secret Instructions rather than any Rules of Art, which they publickly pretended to, to gloss their Actions and advance the Honour of their Conjecturing Science: By the same manner might *Asclepiades* foreknow the death of *Domitian*, and as for himself being torn to pieces by dogs 'twas but a meer guess, for Astrologers do not extend their predictions beyond death, and therefore he did not suppose his Body should be torn to pieces after his death, as it proved, but alive as a punishment for his boldness in foretelling the Emperors death, which being a common

mon punishment had it proved so, it had been by probability from Custom, but not of the Rules of Astrology.

For 6 several reasons that prove Judicial Astrology to be vain and false, see in *Blomes Body of Philosophy, Part 3. Chap. 14.* in the History of Nature.

**F I N I S.**

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