Cocker's Arithmetick: being a plain and familiar method suitable to the meanest capacity, for the full understanding of that incomparable art, as it is now taught by the ablest school-masters in city and country ... / By Edward Cocker, late practicioner [!] in the arts of writing, artihmetick, and engraving. Being that so long since promised to the world. Perused and published by John Hawkins, writing-master near St. George's church in Southwark, by the author's correct copy, and recommended to the world by many eminent mathematicians and writing-masters in and near London.

Cocker's

ARITHMETICK:

BEING

A plain and familiar Method, suitable to the meaneſt Capacity for the full underſtanding of that Incomparable Art, as it is now taught by the ableſt School-Maſters in City and Country.

COMPOSED

By *Edward Cocker*, late Practitioner in the Arts of VVriting, Arithmetick, and Engraving. Being that ſo long ſince promiſed to the World.

PERUSED and PUBLISHED

By *John Hawkins* Writing-Maſter near St. *Georges* Church in *Southwark*, by the Authors correct Coppy, and commended to the World by many eminent Mathematicians and Writing-Maſters in and near *London*.

This Impreſſion is corrected and amended, with many Additions throughout the Whole.

Licenſed *Sept.* 3. 1677. *Roger L'Eſtrange.*

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39 | 31

19 | 24

351 | 124

39 | 62

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360 | 128

40 | 64

760 | 768

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TO his much Honoured Friends, *Manwaring Davies* of the *Inner Temple*, Esquire; and Mr. *Humphry Davies* of St. *Mary Newington-Buts*' in the County of *Surry*.

John Hawkins, As an Acknowledgment of unmerited Favours, humbly Dedicateth this *Manael of Arithmetick*.

For

To the READER.

Courteous Reader.

I Having the Happineſs of an Intimate Ac-
quaintance with Mr. *Cocker* in his Life-
time often ſolicited him to remember his
Promiſe to the World, of Publiſhing his Ar-
rithmetick, but (for Reaſons beſt known to
himſelf) he refuſed it; and (after his Death)
the Copy falling accidentally into my hands,
I thought it not convenient to ſmoother a work
of ſo conſiderable a moment, not queſtioning
but it might be as kindly accepted, as if it
had been preſented by his own hand. The
Method is familiar and eaſie, diſcovering
well the Theorick as the Practick of the
Neceſſary Art of Vulgar *Arithmetick*: And in
this new Edition there are many remarkable
Alterations for the benefit of the Teacher and
Learner, which I hope will be very acceptable
ble to the World: I have alſo performed
my promiſe in Publiſhing the *Decimal Arith-*
metick, which finds encouragement to my Ex-
pectation, and the Bookſellers too, I am

This

kind

Mr. *Edward Cocker's*

PROEME or PREFACE.

BY the ſacred Influence of Divine Providence, I have been Inſtrumental to the benefit of many; by vertue of thoſe uſefull Arts, Writing *and* Engraving : *And do now with the ſame wonted alacrity caſt this my Arithmetical Mite into the Publick Treaſury, beſeeching the Almighty to grant the like bleſſing to theſe as to my former Labours.*

Seven Sciences ſupremely excellent,
Are the chief Stars in Wiſdoms Firmament :
Whereof Arithmetick is one. whoſe worth,
The Beams of Profit and Delight ſhines forth ;
This crowns the reſt ; this makes man's mind complete ;
This treats of Numbers, and of this we treat.

I have been often deſired by my intimate Friends to publiſh ſomething on this ſubject ; who in a pleaſing Freedom have ſignified to me that they expected it would be extraordinary. How far I have anſwered their Expectation, I know not ; but this I know, that I have deſigned this Work not extraordinary abſtruſe or profound,

profound, but have by all means possible within the Circumference of my Capacity, endeavoured to render it extraordinary aseful to all those whose Occasions shall induce them to make use of Numbers. If it be objected that the Books already published, treating of Numbers are innumerable, I answer that's but a small wonder, since the Art is infinite. But that there should be so many excellent Tracts of Practical Arithmetick extant, and so little practised, is to me a greater wonder; knowing that as Merchandise is the Life of the Weal-Publick; so Practical Arithmetick is the Soul of Marchandise. Therefore I do ingenuously profess, that in the beginning of this undertaking, the unmerous Concerns of the honoured Merchants first possessed my Consideration: And how far I have accommodated this Composure for his most worthy Service, let his own profitable experience be judge.

Secondly, For your Service, most excellent Professors, whose understandings soar to the sublimity of the Theory and Practice of this Noble Science, was this Arithmetical Tractate composed; which you may please to imploy as a Monitor to instruct your young Tyores, and thereby take occasion to reserve your precious moments, which might be exhausted that way, for your more important Affairs.

Thirdly,

Thirdly, for you, the ingenious off spring of happy Parents, who will willingly pay the full Price of Industry and Evercise for those Arts and choice Accomplishments which may contribute to the Felicity of your future State. For you, I say, (ingenious Practitioners) was this Work composed, which may prove the Pleasure of your Youth, and the Glory of your Age.

Lastly, For you the pretended Numerists of this vapouring Age, who are more disingeniously witty to propound unnecessary Questions, than ingeniously judicious to resolve such as are necessary. For you was this Book composed and published, if you will deny your selves so much as to invert the streams of your ingenuity, and by studiously conferring with the Notes, Names, Orders, Progress, Species, Properties, Proprieties, Proportions, Powers, Affections and Applications of Numbers delivered herein, become such Artists indeed, as you now only seem to be. This Arithmetick ingeniously observed, and diligently practised, will turn to good account to all that shall be concerned in Accompts. All whose Rules are grounded on verity and delivered with Sincerity. The Examples are built up gradually from the smallest consideration to the greatest. All the Problems or Propositions are well weighed, pertinent, and clear, and not one of them

them throughout the Tract taken upon truſt therefore now,

Zoilus and *Momus* lie you down and dye,
For theſe Inventions your whole force defyes

Edward Cocker

Edward Cocker

Courteous

Courteous Reader.

BEing well Acquainted with the deceased Author, and finding him knowing and studious in the Mysteries of Numbers and Algebra, of which he had some choice Manuscripts, and a great Collection of Printed Authors in several Languages. I doubt not but he hath writ his Arithmetick suitable to his own Preface, and worthy acceptation, which I thought to certifie on a request to that purpose made to him that wisheth thy Welfare, and the Progress of Arts.

November 27th. 1694. John Collens.

This Manual of Arithmetick is recommended to the World by Us whose Names are subscribed, viz.

Mr. *John Collens*	Matth.	Mr. *William Mason*
Mr. *James Atkinson*		Mr. *Steph. Thomas*
Mr. *Peter Perkins*		Mr. *Peter Storey*
		Mr. *Benj. Tichbourn*
Mr. *Rich. Laurence*, Senior		Mr. *Joseph Symmonds*
Mr. *Eleazer Wigan*		Mr. *Jerem. Milles*
Mr. *Rich. Noble* of *Guilford*		Mr. *Josiah Cuffley*
Mr. *William Norgate*		Mr. *John Hawkins*

And generally Approved by all Ingenious Artists.

A Table

A Table of the Contents of this BOOK.

CHAP.

CHAP. I.

Notation of Numbers.

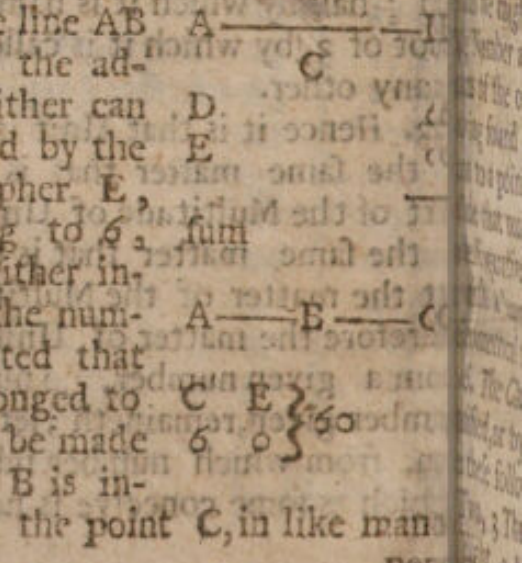
1. *Arithmetick* is an Art of Numbring or Knowledge, which teacheth to number well, (*viz.*) the Doctrine of Accounting by Numbers. And there are divers Species and kinds of Arithmetick and Geometry, the which we do intend to treat of in order; applying the Principles of the one to the Definitions of the other: For as Magnitude or Greatness is the subject of Geometry, so Multitude or Number is the subject of Arithmetick; and if so, then their first Principles and chief Fundamentals, must have like Definitions; or at least, a Semblable Congruency.

2. Number, is that by which the Quantity of any thing is Expressed or Numbred; as the Unit is the number by which the quantity of one thing is expressed or said to be one, and two by which it is named two, and $\frac{1}{2}$ half by which it is named or called half, and the Root of 3, by which it is called the Root of 3, the like of any other.

3. Hence it is that Unit is Number, for the part is of the same matter that is his whole, the Unite is part of the Multitude of Units, therefore the Unit is of the same matter that is the Multitude of Units; but the matter of the Multitude of Units is number, therefore the matter of Unit is number; for else if from a given number, no number, be substracted, the number given, remaineth; let three be the number given, from which number substract or take away one (which as some conceive is no number) therefore the

number given remaineth, that is to say, there remaineth three, which is absurd.

4. Hence it will be convenient to examine from whence Number hath its Rise or Beginning: Most Authors maintain that Unit is the Beginning of Number and it self no number; but looking upon the Principles and Definitions in the first rudiments of Geometry, we shall find, that the definition of a Point is in no way congruous with the Definition of an Unit in Arithmetick; and therefore one, or Unit must be in the bounds or limits of Number, and consequently the beginning of Number is not to be found in the number one; wherefore to make number and magnitude congruent in Principles, and like in Definitions, we make and constitute a Cypher to be the beginning of number, or rather the medium between encreasing and decreasing numbers, commonly called absolute or whole Numbers, and negative or fractional numbers between which nothing can be imagined more agreeable to the definition of a point in Geometry; for as a point is an adjunct of number and it self no line, so (o) Cypher an adjunct of number and it self no number: And as a point in Geometry cannot be divided or increased into parts; so likewise (o) cannot be divided or increased into parts; for as many points though in number infinite do make no line, so many (o) Cyphers, though in number infinite do make no number. For the line AB cannot be increased by the addition of the point C, neither can the number D be increased by the addition of the (o) Cypher E, for if you add nothing to 6, the Sum will be 6, (o) neither increasing nor diminishing the number 6, but if it be granted that A B be extended or prolonged to the point C, so that A C be made a continued line, then A B is increased by the addition of the point C, in like manner



er if we grant D 6 be prolonged to E (0) ſo that D E 60) be a continued number making 60, then 6 is augmented by the aid of (0) as to the conſtituting the number (60) ſixty; and furthermore that one or unit is material and a number, and that (0) is the beginning of umber is proved by all Authors altho' indirectly, for ie Tables of Sines and Tangents prove one degree to e a number, becauſe the Sine of 1 degree is 174524 the Radius being 10000000) and the beginning of hat Table is (0) and to it anſwereth 00000, *&c.*

5. Hence it is that number is not quantity diſcontinued, for all that which is but one quantity, is not uantity disjunct; (60) ſixty as it is a number, is one uantity, *viz.* one number (60) ſixty; therefore as it number, it is not quantity disjunct; for number, is me ſuch thing in Magnitude, as humidity in Water; r as humidity extend it ſelf through all and every rt of Water, ſo number related to Mgnitude, doth xtends it ſelf through all and every part of Magnitude. lſo as to continued Water doth anſwer continued umidity, ſo to a continued Magnitude doth anſwer a ntinued number. As the continued Humidity of y intire Water, ſuffereth the ſame Diviſion and ſtinction that his Water doth; ſo the continued umber ſuffereth the ſame Diviſion and Diſtinction t his Magnitude doth. From all which Conſiderans we might enlarge a further Digreſſion concerng Number and Magnitude, by comparing the Definns of the one with the Principles of the other, for ving found a (0) Cypher to be anſwerable in Definn to a point in Magnitude, we may very well conde that number may be congruent to a line; as alſo Figurative Number to be conſonant in Definition th a Superficies, and Solid, *&c.* in the order of ometrical Magnitudes.

6. The Characters or Notes by which Numbers are nified, or by which a Number is ordinarily expreſſed theſe following, (*viz.*) 0 Cypher or nothing, 1 One Two, 3 Three, 4 Four, 5 Five, 6 Six, 7 Seven, Eight, 9 Nine: The Cypher, which though of it

ſelf ſignifieth nothing (*viz.*) expreſſeth not any certa
or known quantity, but is the beginning, Radix, or Ro
of Number, and the other nine Figures or Characte
are called ſignificant Figures or Digits.

7. In numbers of any ſort, two things are to
conſidered, (*viz.*) Notation and Numeration.

8. Notation teacheth how to deſcribe any Numb
by certain Notes and Characters, and to declare th
value thereof being ſo deſcribed, and that is by D
grees and Periods.

9. A degree conſiſts of three figures, *viz.* of thre
places comprehending Units, Tens and Hundreds,
365 is a degree, and the firſt figure (5) on the righ
hand, ſtands ſimply for its own value, being Units c
ſo many ones (*viz.*) five; the ſecond in order fro
the right, ſignifies as many times ten, as there a
unites contained in it, (*viz.*) ſixty; the third in th
ſame order ſignifies ſo many hundreds as it contai
Units, ſo will the expreſſion of the Number be, thre
hundred ſixty five; alſo 789, is ſeven hundred eight
nine, *&c.*

10. A Period is when a Number conſiſts of mor
than three figures, or places, and whoſe proper orde
is to prick or diſtinguiſh every third Place beginning a
the right hand, and ſo on to the left; ſo the Numbe
63452 being given, it will be diſtinguiſhed thu
63.451, and expreſſed thus, ſixty three thouſand fou
hundred fifty two, likewiſe 4. 578.236.782, being di
ſtinguiſhed, as you ſee will be expreſſed thus, fou
thouſand five hundred ſeven eight Millions, tw
hundred thirty five thouſand, ſeven hundred eight
two.

11. Number is either Abſolute or Negative.

12. An Abſolute, or intire, whole, increaſing Num
ber, is that which by annexing of another Figure o
Cypher it becomes ten times as much as it ſtood fo
before; and if two Figures or Cyphers be annexed, i
makes it a hundred times more than it ſtood for be
fore, *&c.* as if you annex to the Figure 6 a Cypher
then it will become (60) ſixty: So if two Cyphers are
annexe

annexed, then it will be (600) six hundred, and if you do annex to it a (4) four, then it will be (64) sixty four; and if you annex (78) seventy eight, it will be then (678) six hundred seventy eight, and so on: By annexing more Figures or Cyphers, it will encrease in a decuple proportion *ad Infinitum.*

13. A Negative, or Broken, Fractional, Decreasing Number, is that which by prefixing a Point or Prick towards the left hand its value is decreased from so many Units, to so many tenth parts of any thing, and if a point and (0) cypher, or a digit be prefixed, it will be then so many hundred parts, and if a Point and two Cyphers or digits be prefixed, its Value is decreased to be so many thousand parts; as if you would prefix before the Figure 3 a point (.) or prick thus (.3) it is then decreased from 3 Units or Integers, to (3) three tenth parts of an Unit or Integer; and if you prefix a point and Cypher thus (.03) it is decreased from 3 Integers to 3 hundred parts of an Integer, and by this means 5 *l.* Absolute by prefixing of a point will be decreased to 5 *l.* Negative which is five tenth parts of a Pound, equal in value to ten shillings, and so by prefixing of more Cyphers or Digits, its value is decreased in a decuple proportion *ad infinitum.* As in the following Scheme, or rather order of numbers, we have placed (0) Cypher in its due place and order, as it is both the beginning and medium of number; for going from (0) towards the left hand you deal with Intire, Absolute, Whole increasing numbers.

Increasing Numbers. | *Decreasing Numbers.*

29	876	543	256	2 1 0 1 2	345	678	976	3	
mm	mmm	mmm	mmm	CXUXC	mmm	mmm	mmm	m	
mm	mmm	mmm	CX		XC	mmm	mmm	m	
mm	mmm	CX				XC	mmm		
mm	CX						XC		
X									

But going from (0) the place of Units towards the right hand, you meet with broken *Negative*, Fractional and decreasing *Numbers.* And hence it follows that

Multiplication encreaseth product in Absolute Numbers, but decreaseth the product in Negative Numbers. Also Division decreaseth the Quotient in whole Numbers, and increaseth it in Negative or Fraction Numbers.

14. An Absolute, Intire, Whole, Increasing *number*, hath always a point annexed towards the right hand and therefore.

15. A Negative, Broken, Decimal, Decreasing *number*, hath always a point prefixed before it towards the left hand. When we express Integers or whole *numbers*, as 5 *pounds*, 5 *feet*, 26 *men*, we usually annex a point or prick after the number thus, 5. 5. 26. 34. But when we express Decimals, or Numbers that are denyed to be intire, as decreasing *Numbers*, we do commonly prefix a point or prick before the said Decimal or decreasing *number*, thus (.3) that is 3 tenths, or 3 primes. 03, that is 3 hundredths, or 3 seconds.

16. A whole or absolute *number* is an Unit or a composed Multitude of Units, and it is either a prime or else a compounded *number*.

17. Prime *numbers* amongst themselves are those which have no multitude of Units for a common measurer as 8 and 7 or 10 and 13, because not any multitude of Units can equally measure or divide them without a Remainder.

18. Compound *numbers* amongst themselves are those which have a multitude of Units for a common measurer, as 9 and 12, because 3 measures them exactly, and abbreviates them to 3 and.

19 A Broken *number* commonly called a Fraction, a part or parts of a whole *number*, *viz.* a part of an Integer, as $\frac{1}{3}$ one third is one third part of an Unit

20. A Broken *number* or Fraction, consists of 2 parts *viz.* the Numerator and the Denominator.

21. The Numerator and Denominator of a Fraction are set one over the other, with a line between them and the Numerator is set above the line, and expresseth the parts therein contained.

22. The

22. The Denominator of a Fraction is the inferior *number* placed below the line, and expresseth the number of parts into which the Unit or Integer is divided; as let $\frac{3}{4}$ be the Fraction given, so shall 3 be the numerator, and doth expres or *number* the multitude of parts contained in this Fraction, for $\frac{3}{4}$ is a Fraction composed of Fourths or Quarters; and the Figure 3 in *numbring* shews us that in that Fraction there are 3 of those fourth parts or quarters; also in the same Fraction $\frac{3}{4}$ 4 is the *denominator* and doth expres the Quality of the Fraction, *viz.* that the whole, or integer, is here divided into 4 equal parts.

23. A broken *number* is either Proper or Improper; *viz.* Proper, when the *numerator* is lesser than the *denominator*; so $\frac{3}{4}$ is a perfect proper Fraction, but an improper Fraction hath its *numerator* greater or at least equal to the *denominator*; thus $\frac{4}{3}$ is an improper Fraction, the Reason is given in the definition.

24. A proper broken *number* is either *Simple* or *Compound*, *viz. Simple*, when it hath one *Denomination*, and *Compound* when it consisteth of diverse *Denominations*. If $\frac{3}{4}$ *l.* $\frac{6}{7}$ *s.* $\frac{3}{5}$ *d.* were given, we say they are either of them single or *simple* Fractions because they consist but of one *numerator* and one *denominator*; but if $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{2}{5}$ of a pound sterling were given, we say that it is a *compound broken number*, or *fraction*, because the expression and representation consisteth of more *denominations* than one; and such by some are called *Fractions of Fractions*, and they have always this Particle (of) between them.

25. When a single *broken number* or *Fraction*, hath for his *denominator* a *number* consisting of a Unit in the first place towards the left hand, and nothing but Cyphers from the Unit towards the right hand, it is then the more aptly and rightly called a decimal Fraction; under this head are all our decreasing *numbers* placed, and in our 13th. *definition* called Negative, and by that order there prescribed, we order them to be *Decimals* by signing a point or prick before them, or the *numerator* rejecting the *denominator*: Therefore according

cording to our last Rule, $\frac{1}{10}$, $\frac{5}{100}$, $\frac{25}{1000}$, $\frac{25}{10000}$ are sa[id] to be *Decimals*; and a *Decimal Fraction* may be expre[ssed] sed without its *denominator* (as before) by prefixing [a] point or prick before the *numerator* of the said *Fracti[on]* and then shall the former *Fraction* $\frac{5}{10}$ and $\frac{25}{100}$ sta[nd] thus .5 and .25.

But oftentimes as in the second and fourth fractio[n] $\frac{5}{100}$ and $\frac{25}{10000}$, a prick or point will not do witho[ut] the help of a Cypher or Cyphers prefixed before th[e] significant figures of the *numerator*, and therefore whe[n] the *numerator* of a *decimal fraction*, consisteth not [in] so many places as the *Denominator*, hath Cyphers, fi[ll] up the void places of the *numerator*, with prefixing Cy[-] phers before the significant figures of the *numer[a]tor*, and then sign it for a *decimal*, so shall $\frac{5}{100}$ be .0[5] and $\frac{25}{1000}$ will be .025 and $\frac{72}{10000}$ will be .0072. Now by this we may easily discover the *denominator* having the *numerator*; for always the denominator of an *decimal fraction* consists of so many Cyphers, as th[e] *numerator* hath places, with a Unit prefixed before th[e] said Cyphers, *viz.* under the point or prick.

26. A *Decimal Number* or *Fraction*, is that which [is] expressed by *Primes*, *Seconds*, *Thirds*, *Fourths*, &c. an[d] is number decreasing. Here instead of *Natural* an[d] *Common Fractions*, as $\frac{3}{4}$ of a thing, we order the thin[g] or Integer into *Primes*, *Seconds*, *Thirds*, *Fourths*, *Fifth[s]* &c. that our expression may be consonant to ou[r] former order.

27. In *Decimal Arithmetick*, we always imagin (an[d] it would be very commodious if it were really so) that all intire Units, Integers, and things are divide[d] first into ten equal parts, and these parts so divided w[e] call *Primes*; and secondly, we divide also each of th[e] former *Primes* into other ten equal parts, and every o[f] these divisions we call seconds; and thirdly, we divid[e] each of the said Seconds into ten other equal parts [a]nd those so divided we call *Thirds* and so by decima[l] ting the former and sub-decimating these latter, we run on *ad infinitum*.

28. Let a pound sterling, Troy weight, Averdu[-] pois

pois weight, Liquid Measure, Dry measure, Long measure, time, dozen or any other thing, or Integer be given to be *decimally* divided; in this notion premised we ought to let the first Division be *Primes*, the next division *Seconds*, the next *Thirds*, &c. So one pound Sterling being 20 shillings, which divided into ten equal parts, the value of each part will be two shillings; therefore one *Prime* of a pound Sterling will stand thus (.1) which is in value 2 shillings, Three *Primes* will stand thus (.3) and that is in value 6 shillings. Again a *Prime* or .1 being divided into ten equal parts, each of those parts will be one *Second*, and is thus expressed, (.01) and its Value will be found to be 2d. farthing and $\frac{6}{10}$ of a farthing; and so will .05 signifie one shilling, or five *Seconds*. And if .01 be divided into ten other equal Parts, each of those parts so divided will be *Thirds*, and will stand thus .001, and its Value will be found to be 96 of a Farthing, or $\frac{96}{100}$ of a Farthing; and .009 *Thirds* will be 2d. and .64 of a Farthing, or $\frac{64}{100}$ of a Farthing, *&c.* So that .375 *l.* will be found to represent 7s. and 6d.; for the 3 *Primes* are 6 shillings, and the 7 *Seconds* are 1s. 4d. and $\frac{8}{10}$ of a penny, and the five *Thirds* are 1 penny and $\frac{2}{10}$ of a penny, both which added together make 7*s.* 6*d.*

29. If you put any bulk or body, representing an Integer if it be *decimally divided*; then the parts in the first decimation are *Primes*, the next *Seconds*, and the next decimation is *Thirds*, the next *Fourths*, &c. As let there be given a Bullet of Lead, or such like, whose weight let be 50 *l. Troy*, this call an Unit, Integer, or thing, then with the like weight and matter, make 10 other, the which together will be equal to 50 *l.* and will weigh each of them 5 *l.* a piece, take of the same matter, and equal to 5 *l.* make 10 more, then each of those will weigh 6 ounces a piece; also if again you take 6 ounces and thereof make 10 other small bullets each of them will weigh 12 penny weight *Troy*; and thus have you made *Primes*, *Seconds*, and *Thirds*, in respect of the Integer containing 50 *l. Troy*; and that 5 *Primes* is equal to the half mass, and 2 *Primes* and 5 *Seconds* is a quarter of the mass; and therefore

of the first division, 2 of the second division, and of the third division, will be equal in weight to ¼ quarter of the mass, and contain 6 l. and 3 ounces.

30. When a *decimal Fraction* followeth a whol *number*, you are to separate or part the *decimal* from th *whole number*, by a point or prick; so if .7 followed the *whole number* 32, set them thus 32. 7 You shall find that divers Authors have divers ways in expessing mixt *numbers*, as thus, 32|75 or 32 $\frac{75}{100}$ co 32.$\dot{7}\dot{5}$ but you will find that 32.75 thus placed and ex pressed is fittest for Calculation.

31. A mixt *number* hath 2 parts, the whole and th broken; the whole is that which is composed of Inte gers, and the broken is a Fraction annexed thereunto So the mixt *number* $36\frac{8}{12}$ being given, we say that 3 is the whole *Number*, which is composed of Integers, an the $\frac{8}{12}$ is the broken *Number* annexed, which shewet that one of the former Integers (of that 36) being di vided into 12 parts, this $\frac{8}{12}$ doth expres 8 of thos 12 parts more belonging to the said 36 Integers.

32. *Denominative numbers* are of one, or of many and those are of divers sorts and kinds, *viz. Singul* called Unit, as 1; and *Plural* called multitude; as 2, 4, 5, *Single* of one kind only, called *digits*, as 1, 2, 4, 5, 6, 7, 8, 9, and *Compounds* of many, 10, 11, 1 *&c.* 102, 367, *&c.*

Proportional, as Single, Multiple, Double, Tripl Quadruple, *&c.* Denominate as Pounds, Shilling Pence; Undenominate as 1, 2, 3, *&c.* Perfect is 28, 496, 8128, 130816, 2096128, *&c.* Whose part are equal to the numbers; imperfect, unequal and mor than the sum, as 12 to 1, 2, 3, 4, 6. Imperfect, unequa and less than the sum, as 8 to 1, 2, 4. Numbers Com mensurable. and Incommensurable, as 12 and 9 a Commensurable because three measures them both.

But 6 and 17 are Incommensurable because no or common *number* or *measure* can measure them; Line in form of a line, as ..... Superficial in form of Superficies or plane, as .... or ⁞⁞ ⁞⁞, *&c.* an numbe

number cubical or solid, in form of a Cube. These two latter are otherwise called figurative numbers. There are also other numbers called Tabular, as Sigus, Tangents, Secants, &c. Other that be called Logarithmetick or borrowed numbers, fitted to proportion for ease and speedy Calculation of all manner of Questions.

CHAP. II.

Of the Natural Division of Integers, and the several Denominations of the Parts.

1. BEfore we come to Calculation or the ordering of *Numbers* to operate any Arithmetical Question propoſed, we will lay down Tables of the Denomination of several Integers; and after that (having mentioned the several Species or kinds of Arithmetick) we shall immediately handle the Species of Numeration, which are the main Pillars upon which the whole Fabrick of this Art is built.

Of Money, Weights, &c.

2. The least Denomination or Fraction of Money used in *England* is a Farthing, from whence is produced the followed Tables, called the Table of Coyne, (*viz.*)

				And therefore,
1 *Farth.*		1 *Farthing*		l. s. d. qrs.
4 *Farth.*		1 *Penny*		1—20—12—4
12 *Pence*	make	1 *Shilling*		1—20·240 960
20 *Shill.*		1 *Pound*		1—12—48
				1— 4

The first of these Tables, *viz.* that on the left hand is plain and ease to be understood, and therefore needs

no directions. In the second Table above the line yo
have 1 *l.* 20 *s.* 12 *d.* 4 *qrs.* whereby is meant tha
1 pound is equal to 20 shillings, and one shilling
equal to 12 pence, and one penny is equal to 4 Far
things, under the line is 1 *l.* 20 *s.* 240 *d.* 960 *qr*
which signifies one pound to contain 20 shillings, c
240 pence, or 960 Farthings; in the second line be
low that is 1 *s.* 12 *d.* 48 *qrs.* the first standing unde
the Denomination of Shillings, whereby is to be note
that one shilling is equal to 12 pence, or 48 Farthing
and likewise that below that, one penny is equal i
value to four Farthings; understand the like reaso
in all the following Tables of Weight, Measure, Time
motion and Dozen.

Of Troy Weight.

The least Fraction or Denomination of weigh
used in *England*, is a grain of Wheat gathered out c
the middle of the Ear, and well dryed; from whenc
are produced these following Tables of Weight, calle
Troy weight.

32 *Grains of Wheat*		24 *Artificial grains*
24 *Artificial Grains*	make	1 *Penny weight*
20 *Penny weight*		1 *Ounce*
12 *Ounces*		1 *Pound Troy weight*

And therefore

l.	*oun.*	*p.w.*	*grains.*
1	15	43	24
1	12	240	5760
	1	20	480
			24

Troy weight serveth only to weigh bread, gold, silve
and Electuaries; it also regulateth and prescribeth
how to keep the Mony of *England* at a certa
standa

ſtandard. The Goldſmiths have divided the Ounce *Troy weight* into other parts, which they generally call Mark weight; the denominative parts thereof are as followeth, *viz*, A Mark (being an ounce Troy) is divided into 24 equal parts, called Carects and each Carect into grains, ſo that in a Mark are 96 Grains; by this weight they diſtinguiſh the different fineneſs of their Gold, for if to the fineneſs of Gold be put 2 Carects of Alloy (which is of Silver, Copper, or other baſer Metal, with which they uſe to mix their Gold or ſilver to abate the fineneſs thereof) both making when cold but an ounce, or 24 Carects, then this Gold is ſaid to be 22 Carects fine, for if it come to be refined the 2 Carects of Alloy will fly away and leave only 22 Carects of pure Gold, the like to be conſidered of a greater or leſſer quantity; and as the fineneſs of Gold is eſtimated by Carects, ſo the fineneſs of Silver is diſtinguiſhed by ounces; for if a pound of it be pure, and looſeth nothing in the Refining, ſuch ſilver is ſaid to be twelve ounces fine, but if it loſeth any thing, it is ſaid to contain ſo much fineneſs as the loſs wanteth of 12 ounces, as if it loſe an ounce it is ſaid to be 11 Ounces fine, and if it loſe one ounce 14 penny weight, then it is ſaid to be 10 ounces 6 penny weight fine, and that which loſeth 2 ounces 4 penny weight 16 grains is ſaid to be 9 ounces 15 penny weight 8 grains fine, *&c.* the like of a greater or leſſer quantity.

Of Apothecaries Weights.

4. The *Apothecaries* have their Weights deduced from Troy Weight, a pound *Troy*, being the greateſt Integer, a Table of whoſe diviſion and ſub-diviſion followeth, *viz.*

1 *pound*		12 *ounces*		And therefore			
1 *ounce*	makes	8 *drams*		*l.*	*oun.*	*dram.*	*ſcrup.*	*gr.*
1 *dram*		3 *ſcruples*		1	12	8	3	20
1 *ſcrup.*		20 *grains*		1	12	96	288	5760
					1	8	24	480
						1	3	60
							1	20

5. Thus

5. Thus much concerning *Troy weight*, and its derivavite weights (which as was said before) serve to weigh Bread, Gold, Silver, and Electuaries; now besides *Troy-weight* there is another kind of weight used in *England*, commonly known by the name *Auerdupois* weight (a pound of which is equal to 11 ounces 12 penny weight *Troy weight*) and it serveth to weigh all kinds of Grocery-Wares, as also Butter, Cheese, Flesh, Wax, Tallow, Rozen, Pitch, Lead, and all such kind of Garbel, the Table of which weight is as followeth.

The Table of Averdupois Weight.

4 *quarters of a dram*	Make	1 *dram*
16 *drams*		1 *ounce*
16 *ounces*		1 *pound*
28 *pounds*		1 *quarter of a hundred*
4 *quarters*		1 *hundred-weight, or* 112
20 *hundred*		1 *Tun*

And therefore,

Tun	*C.*	*qrs.*	*l.*	*oun.*	*dra.*	*qrs*
1	20	4	28	16	16	4
1	20	80	2240	35840	573440	2293760
	1	4	112	1792	28672	114688
		1	28	448	7168	28672
			1	16	256	1024
				1	16	64
					1	4

Wool is weighed with this Weight, but only the Divisions are not the same; A Table whereof followeth.

A Table of the denominative Parts of Wool Weight.

7 *Pounds*	Make	1 *Clove*
2 *Cloves*		1 *Stone*
2 *Stones*		1 *Todd*
6 *Todd* 1 *Stone*		1 *Wey*
2 *Weyes*		1 *Sack*
12 *Sacks*		1 *Last*

And

And therefore

Last	*Sacks*	*Wey*	*Todd*	*Stone*	*Cloves*	*l.*
1	12	2	$6\frac{1}{2}$	2	2	7
1	12	24	156	312	624	4368
	1	2	13	26	52	364
		1	$6\frac{1}{2}$	13	26	128
			1	2	4	28
				1	2	14
					1	7

Note that in some Countrys the *Wey* is 256 *l. Averdupois.* as is the *Suffolk Wey*; but in *Essex* there is 336 pound in a *Wey.*

6. The least Denominative part of Liquid measure is a pint, which was formerly taken from *Troy Weight*, (a pound of Wheat *Troy Weight* making 1 pint of liquid measure) but in regard of the difference between the Brewers and the Farmers of his Majesty's Excise concerning the gauging of Vessels occasioned by the different Opinions of Artists, concerning the solid Inches in a Gallon; it was lately decided by Act of Parliament, the Statute making 282 solid Inches in a Beer-Gallon, and 231 in a Wine-measure and consequently the Pint Beer-Measure to contain $35\frac{1}{4}$ solid Inches, and the Pint Wine-measure to contain $28\frac{7}{8}$ cubical or solid Inches, from whence is drawn the following Table.

The Table of Liquid Measure.

$25\frac{1}{4}$ *cubical Inch*	make	1 *pint beer measure*
$28\frac{7}{8}$ *cubical Inch*		1 *pint wine measure*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
8 *gallons*		1 *firk. of ale, soap, or herr.*
9 *gallons*		1 *firk. of beer*
10 *gall. and a half*		1 *firk. of Salmon or Eels*
2 *firkins*		1 *Kilderkin*
2 *kilderkins*		1 *barrel*
42 *gallons*		1 *Tierce of wine*
63 *gallons*		1 *hogshead*
2 *hogsheads*		1 *pipe or butt*
3 *pipes or butts*		1 *Tun of wine*

And

And therefore,

Tuns	*pipes*	*hhds*	*gal.*	*pts.*
1	2	2	63	8
1	2	4	252	2016
	1	2	126	1008
		1	63	504
			1	8
				1

7. The leaſt Denominative part of dry meaſure alſo a pint, and this is likewiſe taken from *Troy weight*. The Table of whoſe diviſion followeth.

The Table of Dry Meaſure.

1 *pint*		1 *pint*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
2 *gallons*		1 *peck*
4 *pecks*	make	1 *buſhel*
4 *buſhels*		1 *Comb*
2 *Combs*		1 *quarter*
4 *quarters*		1 *Chaldron*
5 *quarters*		1 *Wey*
2 *Weys*		1 *Laſt*

And therefore,

laſt	*wey*	*qrs.*	*com.*	*buſh.*	*peck*	*gall.*	*pints*
1	2	5	2	4	4	2	8
1	2	10	20	80	320	640	5120
	1	2	10	40	160	320	2560
		1	5	8	32	64	512
			1	4	16	32	256
				1	4	8	64
					1	2	16
						1	8

8. The least Denominative part of *Long Measure* is a Barly-Corn well dryed and taken out of the middle of the Ear; whose Table of parts followeth.

The Table of Long Measure.

3 *barly-corns*	make	1 *inch*
12 *inches*	make	1 *foot*
3 *Feet*	make	1 *yard*
3 *feet 9 inches or yard and quart.*	make	1 *Ell English*
6 *feet*	make	1 *fathom*
5 *yards and a half*	make	1 *pole or perch*
40 *poles or perches*	make	1 *furlong*
8 *furlongs*	make	1 *English mile.*

And therefore,

mile	*furl.*	*poles*	*yards*	*feet*	*inches*	*barl.corns*
1	8	40	$5\frac{1}{2}$	3	12	3
1	8	320	1760	5280	63360	190080
	1	40	220	660	7920	23760
		1	$5\frac{1}{2}$	$16\frac{1}{2}$	198	594
			1	3	36	108
				1	12	36
					1	3

And note that the yard as also the ell, is usually divided into 4 quarters, and each quarter into 4 Nails.

Note also that a Geometrical Pace is 5 feet; and there are 1056 such Paces in an *English* mile.

2. The parts of the Superficial measures of land are such as are mentioned in the following Table, *viz.*

The Table of Land Measure.

40 *Square Poles or Perches*	make	1 *Rood or quarter of an Acre.*
4 *Roods*	make	1 *Acre.*

By

By the foregoing Table of long Measure, you informed what a pole, or (which is all one) perch and by this that 40 square perches are 1 Rood. N by a square perch is a Superficies very aptly resemb by a square Trencher, ever side thereof being a per or 5 Yards and a half in length, 40 of them is a Ro and 4 Roods an Acre. So that a Superficies that is perches long and 4 broad is an Acre of Land, the A containing in all 160 square Perches.

10. The least denominative part of Time is a M nute, the greatest Lucæ being a Year; from wher is produced this following Table.

The Table of Time.

1 *Minute*			1 *Minute*
60 *Minutes*			1 *Hour*
24 *Hours*		make	1 *Day natural*
7 *days*			1 *Week*
4 *Weeks*			1 *Month*
13 *Months* 1 day & 6 hours			1 *Year*

But the Year is usually divided into 12 unequal Ca lendar Months, whose names and the number of Da that they contain follow, *viz.*

	days
January	31
February	28
March	31
April	30
May	31
June	30
July	31
August	31
September	30
October	31
November	30
December	31

So that the Year containeth 3 Days, and 6 Hours, but the 6 Ho is not reckoned but only every 4 year, and then there is a day added the latter end of *February*, and then containeth 29 days, and that year called Leap-year, and containeth 3 days.

A

And here note that as the Hour is divided into 60 Minutes, so each Minute is subdivided into 60 *Seconds*, and each *Second* into 60 *Thirds*, and each *Third* into 60 *Fourths*, &c.

The Tropical Year by the exactest observations of the most accurate Astronomers is found to be 365 Days, 5 Hours, 49 Minutes, 4 *Seconds*, and 21 *Thirds*.

CHAP. III.

Of the Species or Kinds of Arithmetick.

1. ARithmetick is either Natural, Artificial, Analytical, Algebraical, Lineal or Instrumental.

2. Natural Arithmetick is that which is performed by the Numbers themselves; and this is either Positive or Negative. Positive which is wrought by certain infallible numbers propounded, and this either Single or Comparative; Single which considereth the nature of *numbers* simply by themselves; and Comparative, which is wrought by *numbers* as they have Relation one to another. And the Negative part relates to the Rule of *False*.

3. Artificial (by some called Logarithmetical) Arithmetick is that which is performed by Artificial or borrowed *numbers* invented for that purpose, and are called Logarithms.

4. Analytical Arithmetick is that which shews from a thing unknown to find truly that which is sought; always keeping the Species without Change.

5. Algebraical Arithmetick, is an obscure and hidden Art of Accompting by numbers in resolving of hard Questions.

6. Lineal Arithmetick, is that which is performed by fitted lines to porportions, as Geometrical projections.

7. Instrumental Arithmetick, is that which is performed by Instruments fitted with Circular and Right lines of Proportion, by the Motion of an Index or otherwise.

8. The

8. The parts of Single Arithmetick are Numerati and the Extraction of Roots.

9. Numeration is that by which certain kno numbers propounded, we discover another numb unknown.

10. Numeration hath four Species; *viz.* Additi Substraction, Multiplication, and Division.

CHAP. IV.

Of Addition of whole Numbers.

1. ADdition is the Reduction of two or more *nu bers* of like kind together into one Sum Total. Or it is that by which divers *numbers* are add together, to the end that the Sum or Total value them all may be discovered.

The first *number* in every addition is called the Add ble *number*, the other, the *number* or *numbers* added, a the *number* invented by the Addition is called the *A gregate* or *Sum* containing the value of the *Addition*.

The Collation of the *numbers*, is the right placing the *numbers* given respectively to each denominatio and the Operation is the Artificial adding of t *numbers* given together in order to the finding out the *Aggregate* or *Sum*.

2. In Addition, place the *Numbers* given respectiv the one above the other, in such sort, that the li degree, place or denomination, may stand in the sa Series, *viz.* Units under Units, Tens under Tens, Hu dreds under Hundreds, *&c.* Pounds under Poun Shillings under Shillings, Pence under Pence, *&* Yards under Yards, Feet under Feet, *&c.*

3. Having thus placed the *numbers* given (as befo and drawn a line under them, add them together, b ginning with the lesser Denomination, *viz.* at the rig hand and so on, subscribing the sum under the li Respectively; as for Example.

Let there be given 3352 and 213 and 133 to be added together, I ſet the Units in each particular *number* under each other, and ſo likewiſe the Tens under the Tens, *&c.* and draw a line under them as in the Margent, then I begin at the place of Units and add them together upwards, ſaying, 3 and 3 are 6 and 2 make 8 which I ſet under the line, and under the ſame Figures added together; then I proceed to the next place, being the place of Tens, and add them up in the ſame manner as I did the place of Units, ſaying 3 and 1 are 4 and 5 are 9, which I likewiſe ſet under the line reſpectively; then go to the place of Hundreds, and add them up as I did the other, ſaying 1 and 2 are 3 and 3 are 6, which alſo ſet under the line; and laſtly I go to the place of Thouſands, and becauſe there are no other figures to add to the 3, I ſet it under the line in its reſpective place, and ſo the work is finiſhed; and I find the ſum of the 3 given Numbers to be 3698.

3352
213
133
3698

4. But if the Sum of the Figures of any Series exceeds ten, or any *number* of tens, ſubſcribe under the ſame the Exceſs above the tens, and for every ten carry one to be added to the next Series towards the left hand, and ſo go on until you have finiſhed your addition; always remembring, that how great ſoever the ſum of the Figures of the laſt Series is, it muſt all be ſet down under the line reſpectively. So 3678 being given to be added to 2357, I ſet them down as is before directed, and as you ſee in the Margent with a line drawn under them, then I begin and add them together, ſaying 7 and 8 are 15, which is 5 above 10, wherefore I ſet 5 under the line and carry 1 for the 10 to be added to the next Series, ſaying 1 that I carried and 5 is 6 and 7 are 13, wherefore I ſet down 3 and carry 1 (for the ten) to the next Series, then ſay 1 that I carried and 3 are 4 and 6 are 10, now becauſe it comes to juſt 10 and no more, I ſet 0 under the line and carry 1 for the 10 to the next, and ſay, 1 that

3678
2357
6035

that I carried and 2 are 3 and 3 are 6, which I set down in its Respective place, thus the addition is ended, and the total Sum of these *numbers* is found to be 6035, several Examples of this kind follow.

Numbers to be added

354867
573846
785946
347205

Sum 2061864

Numbers to be added

748647
465834
76483
648300

Sum 1939264

Numbers to be added

45346
38074
8437
923
76

Sum 92850

50 If the Numbers given to be added, are contained under divers denominations; as of Pounds, Shillings, Pence and Farthings; or of Tuns, Hundreds, Quarters, Pounds, *&c.* Then in this case having disposed of the *Numbers*, each Denomination under other of like kind; beginning at the least Denomination, (minding how many of one denomination do make an Integer of the next) and having added them up, for every Integer of the next greater denomination that you find therein contained, bear an Unit in mind to be added to the said next greater denomination, expressing the excess respectively under the line, proceed in this manner until your addition be finished; the following Examples will make the Rule plain to the Learner. Thus these several sums being given to be added *viz.* 136 *l.* 13 *s.* 4 *d.* 2. *qrs.* and 79 *l.* 07 *s.* 10 *d.* 3 *qrs.* and 33 *l.* 18 *s.* 09 *d.* 1 *qr.* also 15 *l.* 09 *s.* 07 *d.* 00 *qrs.* The *Numbers* being disposed according to order will stand as in the Margent. Then I begin at the denomination of Farthings

and

d add them up; saying 1 and
are 4 and 2 make 6, now I
nider that 6 Farthings is 1
nny, and 2 Farthings, where-
re I set down the 2 Farthings
its place under the line, and
ep 1 in mind to be added to
e next denomination of Pence;
en I go on, saying 1 that I car-
d and 5 are 6 and 9 are 15 and 10 are 25 and 4 are
, now I consider that 29 pence are 2 shillings and
pence, whereof I set the 5 pence in order under
e line and keep 2 in mind for the 2 shillings, to be
ded to the shillings; then I go on, saying, that 2 I
rried and 9 are 11; and 18 are 29, and 7 are 36,
d 13 are 49; then I consider that 49 shillings are
pounds and 9 shillings, wherefore I set the 9 shillings
der the line, and carry two for the 2 pounds, to the
xt and last denomination of pounds, and proceed,
ying 2 that I carried and 5 make 7, and 3 are 10,
d 9 are 16, and 9 are 25; then I set down 5 and
rry 2 for the tens, and proceed, saying, 2 that I
rry and 1 is 3, and 3 are 6, and 7 are 13, and 3
ake 16; I set down 6 and carry 1 for the 10, and
on, saying 1 that I carried and 1 are 2, which I set
its place under the line, and the work is finished;
d thus I find the Sum of the foresaid *Numbers* to be
l. 9 *s.* 5 *d.* 2 *qrs.* This to the ingenious Practi-
oner is sufficient, but I shall (for the further stumb-
ting of weaker apprehensions) explain the opera-
on of another Example in *Troy weight*; and here the
arner must take notice of the Table of *Troy weight*
entioned or set down in the third Section of the se-
nd Chapter. The *numbers* given in this Example
: 38 *l.* 7. *oz.* 13. *p.w.* 18 *gr.* And 50 *l.* 10 *oz.* 10 *p.w.*
gr. And 42 *l.* 08 *oz.* 05 *p.w.* 16 *gr.* And in
der to the Addition thereof, I place them as you
, and proceed to operation; saying, 16 and 12 are
, and 18 are 46; now because 24 *grains* make

	l.	s.	d.	qrs.
	136	13	04	2
	79	07	10	3
	33	18	09	1
	151	09	05	0
	265	09	04	2

1 *penny*

1 *penny weight*, 46 *grains* are 1 *penny weight* and 22 *grains*; wherefore I ſet down 22, and carry 1 for the *penny weight*, and going on I ſay 1 that carry and 5 make 6, and 10 are 16, and 13 are 29, which is one ounce and 9 *penny weight*, I ſet down 9 in its place under the lin and carry 1 to the ounces, ſaying 1 that I carry and are 9, and 10 are 19, and 7 are 26, and becauſe 2 *ounces* make 2 *pound* 2 *ounces*, I ſet down 2 for the *oun ces*, and carry 2 to the *pounds*: going on, 2 that I carr and 2 are 4, and 8 make 12, that is 2 and go 1; ther 1 I carry and 4 are 5 and 5 are 10, and 3 are 13, whic I ſet down as in the Margent, and the work is finiſhe and I find the ſum of the ſaid *numbers* to amount to 132 2 *oz.* 1 *p.w.* 22 *gr.* This is ſufficient for the underſtand ing of the following Examples, or any other tha ſhall come to thy View. The Way of proving thei or any Sums in this Rule is ſhewed immediately afte the enſuing Examples.

l.	*oz.*	*p.w.*	*gr*
38	07	13	1
59	10	10	1
42	08	05	1
132	02	09	2

Addition of Engliſh Money.

l.	*s.*	*d.*	*qrs.*
436	12	07	1
184	00	10	3
768	17	04	2
564	11	11	0
1954	12	09	2

l.	*s.*	*d.*	*qrs.*
48	15	11	1
76	10	07	3
18	00	05	3
24	19	09	2
168	06	10	1

Addition of Troy Weight.

l.	*oz.*	*p.w.*	*gr.*
15	07	13	12
18	06	04	20
11	10	16	18
09	04	10	22
19	11	11	04
22	00	00	00
97	05	04	04

l.	*oun.*	*p.w.*	*gr.*
145	09	12	18
726	08	14	10
380	07	06	13
83	10	16	20
130	00	10	12
74	07	15	00
1541	08	16	00

Additi

Addition of Apothecaries Weights.

l.	oun.	dr.	scr.	gr.
48	07	1	0	14
74	05	5	2	10
64	10	7	1	16
17	08	1	0	11
34	09	6	1	09
240	05	6	1	00

l.	oun.	dr.	scr.	gr.
60	03	4	0	10
48	10	6	0	14
34	08	2	1	15
18	11	2	2	11
160	07	1	2	15
35	02	5	1	07
358	07	7	0	12

Addition of Averdupois Weight.

Tun	C.	qrs.	l.
75	13	1	15
48	07	3	21
50	11	1	17
21	07	0	25
12	16	0	11
18	16	0	05

l.	oun.	dr.
36	10	12
22	11	13
11	07	04
15	04	10
20	00	09
106	03	00

Addition of Liquid Measure.

Tun	Pipe	hhd.	gall.
45	1	1	48
15	0	1	17
38	0	0	47
12	1	0	56
21	1	1	18
33	1	1	60

Tuns	hhds.	gall.	pts.
30	3	40	4
12	0	28	6
47	5	60	5
57	3	22	3
17	0	00	0
166	1	26	2

Addition of Dry Measure.

Chald.	*qrs.*	*bush.*	*pec.*
48	3	7	3
13	1	4	0
54	0	6	2
16	3	6	1
40	1	0	1
173	3	0	3

qrs.	*bush.*	*pec.*	*gal.*
17	3	1	1
50	1	3	0
14	5	3	1
40	2	0	1
30	0	3	0
152	5	3	1

Addition of Long Measure.

yds.	*qrs.*	*na*
35	3	3
14	1	2
74	2	3
38	0	1
30	1	0
15	0	0
218	1	1

ells	*qrs.*	*nails*
56	1	
13	3	
48	2	
50	1	
74	0	
17	1	
260	2	

Addition of Land Measure.

Acre	*Rood*	*perc*
12	3	18
14	0	24
30	2	19
48	3	30
28	1	38
50	3	26
185	3	35

Acre	*Rood*	*perc*
86	1	3
47	3	2
73	2	1
60	0	0
04	2	0
14	1	11
286	3	2

The Proof of Addition.

6. *Addition* is proved after this manner, when you ve found out the ſum of the Numbers given, then parate the uppermoſt line from the reſt, with a ſtroke daſh of the pen, and then add them all up again as u did before, leaving out the uppermoſt line, and ving ſo done add this new invented ſum to the up- rmoſt line you ſeparated, and if the ſum of thoſe lines be equal to the ſum firſt found out, then the ork was performed true, otherwiſe not: As for Ex- nple, let us prove the firſt Example of *Addition* of oney whoſe ſum we found to be 265 *l.* 9 *d.* 2 *qrs.* d which we prove thus, having parated the uppermoſt num- r from the reſt, by a line as u ſee in the Margent, then I d the ſame together again, lea- g out the ſaid uppermoſt line, d the ſum thereof I ſet under e firſt ſum or true ſum, which th amount to 128 *l.* 16 *s.* 01 *d.* *qrs.* then again I add this new m to the uppermoſt line that fore was ſeparated from the t, and the ſum of theſe two 265 *l.* 09 *s.* 05 *d.* 2 *qrs.* the ne with the firſt Sum, and therefore I conclude at the Operation was rightly performed.

l.	*s.*	*d.*	*qrs.*
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2
128	16	01	0
265	07	05	2

7. The main end of *Addition* in Queſtions Reſolva- thereby, is to know the ſum of ſeveral Debts, rcels, Integers, *&c.* Some Queſtions may be theſe, ut follow.

Queſt. 1. There was an old Man whoſe age was re- ired, to which he replyed, I have ſeven Sons, each ving two years between the birth of each other, and the 44 year of my age my eldeſt Son was born, ich is now the age of my youngeſt; I demand at was the Old Mans age?

Now to resolve this Question, first set down the Fathers age at the birth of his first Child, which was 44, then the difference between the eldest and the youngest which is 12 years, and then the age of the youngest which is 44, and then add them all together, and their sum is 100 the compleat Age of the Father.

44
12
44
100

Quest. 2. A *Man* lent his Friend, at several times these several Sums, (*viz.*) at one time 63 *l.* at another time 50 *l.* at another time 48 *l.* at another time 156 *l.* now I desire to know how much was lent him in all.

Set the Sums lent one under another, as you see in the *Margent*, and then add them together, and you will find their Sum to amount to 317 *l.* which is the Total of all the several Sums lent, and so much is due to the Creditor.

63
50
48
156
317

Quest. 3. From *London* to *Ware* is 20 miles, thence to *Huntington* 29 miles, thence to *Stamford* 21 miles, then to *Tuxford* 36 miles, thence to *Wentbridge* 25 miles from thence to *York* 20 miles. Now I desire to know how many miles it is from *London* to *York* according to this reckoning.

Now to answer to this Question, set down the several distances given, as you see in the Margent, and add them together, and you will find their Sum to amount to 151, which is the true distance in miles between *London* and *York*.

20
29
21
36
25
20
151

Quest. 4. There are two numbers, least the where of is 40, and their Difference is 14, I desire to know what is the greater number, and also what is the Sum of them both? First, set down the least, *viz.* 40, and 14 the difference, and add them together, and their sum is 54 for the greatest number,

4
11
greatest 5
least 4
sum 9

th

then I ſet (40 the leaſt) under 54 (the greateſt) and add them together, and their Sum is 94 equal to the greateſt and leaſt numbers.

CHAP. V.

Of Subſtraction of whole Numbers

1. *Subſtraction* is the taking of a leſſer number out of a greater of like kind, whereby to find out a third number, being or declaring the inequality, exceſs, or difference between the numbers given; or *Subſtraction* is that by which one number is taken out of another number given, to the end that the reſidue or remainder may be known, which remainder is alſo called the *Reſt*, *Remainder*, or *Difference* of the numbers given.

2. The number out of which *Subſtraction* is to be made, muſt be greater, or at leaſt equal with the other number given; the higher or ſuperiour number is called the major number, and the lower or inferiour is called the minor number, and the operation of *Subſtraction* being finiſhed, the Reſt or Remainder is called the difference of the Numbers given.

3. In *Subſtraction* place the Numbers given reſpectively, the one under the other, in ſuch ſort as like degrees, places, or denominations may ſtand in the ſame Series, *viz.* Units under Units, Tens under Tens, *&c.* Pounds under Pounds, *&c.* Feet under Feet, and Parts under Parts, *&c.* This being done, draw a line underneath, as in *Addition.*

4. Having placed the Numbers given as is before directed, and drawn a line under them, ſubſtract the lower number (which in this caſe muſt alwayes be leſſer than the uppermoſt) out of the higher number, and ſubſcribe the difference, or remainder reſpectively below the line; and when the Work is finiſhed, the

number below the line will give you the Remainder. As for Example, let 364521 be given to be ſubſtracted from 795836, I ſet the leſſer under the greater as the Margent, and draw a line under them, then beginning at the Right hand, I ſay 1 out of 6 and there remains 5, which I ſet in order under the line; then I proceed to the next, ſaying 2 from 3 reſts 1, which I note alſo under the line, and thus I go on until I have finiſhed the Work, and then I find the Remainder or Difference to be 431315.

795836
364521
431315

5. But if it ſo happen (as commonly it doth) that the lowermoſt number or figure is greater than the uppermoſt; then in this caſe add ten to the uppermoſt number, and ſubſtract the ſaid lowermoſt number from their Sum, and the remainder place under the Line, and when you go to the next Figure below pay an Unit by adding it thereto for the ten you borrowed before, and ſubſtract that from the higher number or figure: And thus go on until your Subſtraction be finiſhed. As for Example, Let 437503 be given from whence it is required to ſubſtract 153827, I diſpoſe of the numbers as is before directed, and as you ſee in the margent; then I begin ſaying 7 from 3 I cannot, but (adding 10 thereto I ſay) 7 from 13 and there remains 6 which I ſet under the Line in order; then I proceed to the next Figure, ſaying 1 that I borrowed and 2 is 3 from 0 I cannot, but 3 from 10 and there remains 7, which I likewiſe ſet down as before; ; then 1 that I borrowed and 8 is 9 from 5 I cannot, but 9 from 15 and there remains 6; then 1 I borrowed and 3 is 4, from 7 and there remains 3; then from 3 I cannot, but 5 from 13 and there remains 8; then 1 I borrowed and 1 are 2, from 4 and there reſts 2: And thus the Work is finiſhed; and after the numbers are ſubſtracted one from another, the Inequality, Remainder, Exceſs or Difference is found to be

437503
153827
283676

283676

283676. Examples for thy further Experience may be these that follow.

From	3475015	*From*	3615746
Take	738642	*Take*	5864
Rests	2736374	*Rests*	3609882

6. If the *Sum* or *Numbers* to be *Substracted*, are of several Denominations, place the lesser *Sum* below the greater, and in the same rank and order as is shewed in Addition of the same *Numbers*; then begin at the Right hand and take the lower *number* out of the uppermost if it be lesser; but if it be bigger than the uppermost, then borrow an Unit from the next greater Denomination, and turn it into the Parts of the less Denomination, and add those parts to the uppermost Number, and from their *Sum* substract the lowermost, noting the remainder below the Line; then proceed and pay 1 to the next Denomination for that which you borrowed before, and proceed in this order until the work be finished. An Example of this Rule may be this that followeth, let 375 *l.* 13 *s.* 07 *d.* 1 *qr.* be given, from whence let it be required to *substract* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* In order whereunto I place the numbers as you see in the Margent, and thus I begin at the least Denomination, saying two from one I cannot, therefore I borrow one penny from the next Denomination and turn it into Farthings, which is 4, and adding 4 to 1 which is 5, I say, but 2 from 5 and there remains 3, which I put under the line; then going on, I say, 1 that I borrowed and 3 is 4, from 7 and there rests 3; then going on, I say 16 from 13 I cannot, but (borrowing one pound and turning it into 20 shillings, I add it to 13, and that is 33) wherefore I say, sixteen from 33 and there remains 17, which I set under the line and go on, saying 1 that I borrowed and 7 is 8, from 5 I cannot, but 8 from 15 and there remains 7; the one that I

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3

borrowed and 5 is 6, from 7 there reſts 1, and o fro
3 reſts 3, and the work is done: And I find the r
mainder or difference to be 317 *l.* 17 *s.* 03 *d.* 3 *q*

Another Example of *Troy-Weight* may be this,
would ſubſtract 17 *l.* 10 *oz.* 11 *p.w.* 20 *gr.* from 24
05 *oz.* 00 *p.w.* 08 *gr.* I place
the Numbers according to the
Rule, and begin, ſaying 20 from
8 I cannot, but borrow 1 *penny*
weight, which is 24 *grains*, and
add them to 8, and they are 32,
wherefore I ſay 20 from 32 reſt
12; then 1 that I borrowed and
11 is 12, from 00 I cannot, but 12 from 20 (borrow
ing an Ounce which is 20 *penny weight*) and there re
main 8; then 1 that I borrowed and 10 is 11, from
I cannot, but 11 from 17 and there reſts 6; then 1 th
I borrowed and 7 is 8, from 4 I cannot, but 8 fro
15 and there reſts 6; then 1 that I borrowed and 1 iss
from 2 and there reſts nothing; ſo that I find the R
mainder or difference to be 6 *l.* *oz.* 8 *p.w.* 12 *g*.

	l.	*oz.*	*p.w.*	*g*
	24	05	00	0
	17	10	11	2
	06	06	08	11

7. It many times happeneth that you have marr
Sums or *Numbers* to be *ſubſtracted* from one *number*;
ſuppoſe a Man ſhould lend his Friend a certain ſum
money, and his Friend had paid him part of his Deb
at ſeveral times, then before you can convenient
know what is ſtill owing, you are to add the ſever
Numbers or *Sums* of Payment together, and *ſubſtra*
their *Sum* from the whole Debt, and the Remainder
the *Sum* due to the Creditor, as ſuppoſe A lendeth
B 564 *l.* 13 *s.* 10 *d.* and B
hath repaid him 79 *l.* 16 *s.*
08 *d.* at one time, and
163 *l.* 18 *s.* 11 *d.* at ano-
ther time, and 241 *l.* 15 *s.*
08 *d.* at another time; and
you would know how the
Accompt ſtandeth between
them, or what is more due
to A. In order whereunto

	l.	*s.*
Lent	564	11 — 1
Paid at ſeveral payments	79	16 — 0
	163	18 — 1
	241	15 — 0
Paid in all	485	11 — 0
Remains	79	02 — 0

I fir

I first set down the *Sum* which A lent, and draw a line underneath it, then under that line set the several *Sums* of payment as you see in the Margent; and having brought the several Sums of payment into one total by the fifth Rule of the fourth Chapter foregoing, I find their *Sum* amounteth to 485 *l.* 11 *s.* 3 *d.* which I substract from the *Sum* first lent by A. by the sixth Rule of this Chapter, and I find the Remainder to be 79 *l.* 2 *s.* 7 *d.* And so much is still due to A.

When the Learner hath good knowledge of what hath been already delivered in this and the foregoing Chapter, he will with ease understand the manner of working the following Examples.

Substraction of whole Money.

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*qrs*
Borrowed	374	10	03	700	10	11	2
Paid	79	15	11	9	03	11	3
Remains	304	14	04	691	06	11	3

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*qrs.*
Borrowed	1000	00	00	711	03	00	0
Paid	19	00	06	11	13	00	1
Rem. due	980	19	06	699	09	11	3

Borrowed	3300	00	00	0
Paid at several payments	170	10	00	0
	361	13	10	1
	590	03	04	3
	73	04	11	3
Paid in all	1195	12	02	3
Remain due	2104	07	09	3

Subſtraction of Troy Weight.

	l.	*oz.*	*p.w.*	*gr.*
Bought	174	00	13	00
Sold	78	04	16	15
Remains	95	07	16	09

	l.	*oz.*	*p.w.*	*gr.*
Bought	470	10	13	00
Sold at ſeveral Times	60	00	00	00
	35	10	18	00
	16	07	09	08
	48	04	00	00
	61	11	19	23
	23	00	00	00
Sold in all	245	10	07	07
Rem. unſold	225	00	05	17

Subſtraction of Apothecaries Weights.

	l.	*oz.*	*dr.*	*ſcr.*	*gr.*	*l.*	*oz.*	*dr.*	*ſcr.*	*grs*
Bought	12	04	3	0	00	20	00	1	0	07
Sold.	8	05	1	1	15	10	00	1	2	12
Remains	3	11	1	1	05	9	11	7	0	15

Subſtraction of Averdupois Weight.

	C.	*qrs.*	*l.*	*Tun*	*C.*	*qrs.*	*l.*	*oz.*	*dr.*
Bought	25	0	15	5	07	1	10	10	05
Sold	16	2	20	3	17	1	16	09	13
Remains	18	2	20	1	09	3	22	00	08

Sub-

Substraction of Liquid Measure.

	Tun	hhd.	gall.	Tun.	hhd.	gall.	pec.
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remains	23	3	53	44	3	58	6

Substraction of Dry Measure.

	Chald.	qrs.	bush.	pec.	Chal.	qrs.	bush.	pec.
Bought	100	0	00	0	73	2	3	2
Sold	54	1	04	3	46	2	3	3
Remains	45	2	03	1	26	3	7	3

Substraction of Long Measure.

	yards	qrs.	nails	yards.	qrs.	nails
Bought	160	1	0	344	0	1
Sold	64	1	2	177	1	3
Remains	95	3	2	166	2	2

Substraction of Land Measure.

	Acres	rood.	per	Acres	rood.	per.
Bought	140	2	13	600	0	00
Sold	70	3	22	54	0	16
Remains	69	2	31	545	3	24

The Proof of Substraction.

8. When your *Substraction* is ended, if you desire

to

to prove your work, whether it be true or no, then add the remaindert to the minor *Number*, and if the *Aggregate* of these two be equal to the major *Number* then is your Operation true, otherwise false; thus let us prove the first *Example* of the fifth Rule of this *Chapter*, where after *Substraction* is ended, the *Numbers* stand as in the *Margent*; the Remainder or difference being 283676. Now to prove the Work, I add the said Remainder 283676 to the minor number 153827, by the fourth Rule of the foregoing Chapter, and I find the Sum or *Aggregate* to be 437503 equal to the major Number, or Number from whence the lesser is *substracted*; behold the work in the *Margent*.

437503
153827
283676

437503
153827
283676

The Proof of another *Example* may be of the first *Example* of the sixth *Rule* of this *Chapter*, where it is required to *substract* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* from 375 *l.* 13 *s.* 07 *d.* 1 *qr.* and by the *Rule* I find the *Remainder* to be 317 *l.* 17 *s.* 3 *d.* 3 *qrs.* now to prove it, I add the said *Remainder* 317 *l.* 17 *s.* 3 *d.* 3 *qrs.* to the minor *number* 57 *l.* 16 *s.* 03 *d.* 02 *qrs.* and their sum is 375 *l.* 13 *s.* 07 *d.* 1 *qr.* equal to the major *number*, which proves the work to be true, but if it had happened to have been either more or less than the said major *number*, then the *operation* had been false.

l.	*s.*	*d.*	*qrs.*
375—	13—	07—	1
57—	16—	03—	2
317—	17—	03—	3
375—	13—	07—	1

9. The general effect of *Substraction* is to find the differences or excess between two *numbers*, and the rest when a payment is made in part of a greater Sum, the date of Books printed, the age of any thing by knowing the present year, and the year wherein they were made, created or built, and such like.

The Questions appropriated to this Rule are such as follow.

Quest. 1.

Queſt. 1. What difference is there between one thing of 125 foot long and another of 66 foot long?

To reſolve this Queſtion, I firſt ſet down the major or greater *number* 125, and under it the minor or leſſer *number* 66, as is directed in the third *Rule* of this Chapter, and according to the fourth Rule of the ſame I *ſubſtract* the minor from the major, and the Remainder, Exceſs or Difference I find to be 59; ſee the Work in the *Margent*.

125
66
59

Queſt. 2. A Gentleman oweth a *Merchant*, 365 *l.* whereof he hath paid 278 *l.* what more doth he owe?

To give an *Anſwer* to this *Queſtion*, I firſt ſet down the major *number* 365 *l.* and under it I place 278 the *minor*, and *ſubſtract* the one from the other, and thereby I diſcover the Exceſs, Difference or Remainder to be 87, and ſo much is ſtill due to the Creditor. As *per Margent*.

365
278
87

Queſt. 3. An obligation was written; a book printed, a Child born, a Church built, or any other thing made in the year of our Lord 1572, and now we account the year of our Lord 1687, the *Queſtion* is to know the age of the ſaid things, that is, how many years are paſſed ſince the ſaid things were made; I ſay if you *ſubſtract* the leſſer *number* 1572, from the greater 1687, the remainder will be 115; and ſo many yeaas are paſt ſince the making of the ſaid things; as by the Work in the *Margent*.

1687
1572
115

Queſt. 4. There are three Towns lie in a ſtreight line, *viz. London*, *Huntington*, and *York*, now the Diſtance between the fartheſt of theſe Towns, *viz. London* and *York* is 151 miles, and from *London* to *Huntington* is 49 miles, I demand how far it is from *Huntington* to *York*.

To

To resolve this *Question*, *substract* 49 the distance between *London* and *Huntington*, from 151 the distance between *London* and *York*, and the Remainder is 102, for the true distance between *Huntington* and *York*. See the Work in the *Margent*.

151
49
102

CHAP. VI.

Of Multiplication of whole Numbers.

1. *MUltiplication* is performed by two *numbers* of like kind for the *Production* of a third, which shall have such reason to the one, as the other hath to Unit, and in Effect is a most brief and artificial compound *Addition* of many equal *Numbers* of like kind into one Sum. Or *Multiplication* is that by which we *multiply* two or more *numbers*, the one into the other, to the end that their Product may come forth, or be discovered.

Or, *Multiplication*, is the increasing of any one *number* by another; so often as there are Units in that *number*, by which the other is increased, or by having two *numbers* given to find a third, which shall contain one of the *Numbers* as many times as there are Units in the other.

2. *Multiplication* hath three parts, first the *Multiplicand*, or *number* to be *multiplyed*. Secondly, the *multiplyer*, or *number* given, by which the *multiplicand* is to be *multiplied*. And thirdly, the *product* or *number*, produced by the other two, the one being multiplyed by the other, as if 8 were given to be multiplyed by 4. I say 4 times 8 is 32, here 8 is the *Multiplicand*, and 4 is the *multiplyer*, and 32 is the Product.

8
4
32

3. *Multiplication* is either single by one Figure, or compound that consists of many.

Single

Single *Multiplication* is ſaid to conſiſt of one figure, becauſe the *Multiplicand* and *Multiplyer* conſiſt each of them of a Digit, and no more, ſo that the greateſt product that can ariſe by ſingle *Multiplication* is 81, being the ſquare of 9; and Compound *Multiplication* is ſaid to conſiſt of many figures, becauſe the *Multiplicand* or *Multiplier* conſiſts of more places than one; as if I were to multiply 436 by 6, it is called Compound, becauſe the *Multiplicand* 436 is of more places than one, (*viz*) 3 places.

4. The Learner ought to have all the varieties of ſingle *Multiplication* by heart before he can well proceed any further in this Art, it being of moſt Excellent Uſe, and none of the following Rules in *Arithmetick* but what have their principal dependance thereupon, which may be learnt by the following Table.

Multiplication Table.

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

The uſe of the precedent Table is this. In the uppermoſt Line or Column you have expreſſed all the digits from 1 to 9; and likewiſe beginning at 1 and going downwards in the ſide Column you have the ſame; ſo that if you would know the Product of

any

any two ſingle numbers multiplyed by one anothe look for one of them (which you pleaſe) in the up permoſt Column, and for the other in the ſide Column and running your eye from each figure along the re ſpective Column, in the common Angle (or place where theſe two Columns meet, there is the produc required. As for Example, I would know how muc is 8 times 7, firſt I look for 8 in the uppermo Column, and 7 in the ſide Column; then do I ca my eye from 8 along the Column downwards fro the ſame, and likewiſe from 7 in the ſide Column, caſt my eye from thence towards the Right-hand and find it to meet with the firſt Column at 56, ſo tha I conclude 56 to be the Product required, it would have been the ſame if you had looked for 7 in th top, and 8 on the ſide, the like is to be underſtoo of any other ſuch Numbers. The Learner being per fect herein, it will be neceſſary to proceed.

5. In Compound *Multiplication*, if the *Multiplicand* conſiſts of many places, and the *Multiplyer* of bu one figure; firſt ſet down the *Multiplicand*, and under it place the *Multiplyer* in the place of Units and draw a Line underneath them; then begin and multiply the *Multiplier* into every particular figure of the *Multiplicand*, beginning at the place o Units, and ſo proceed towards the left hand, ſetting each particular Product under the Line, in order a you proceed, but if any of the Products exceed 10 o any number of Tens, ſet down the Exceſs, and for every 10 carry a Unit to be added to the next product always remembring to ſet down the Total product o the laſt figure; which work being finiſhed, the Sum or Number placed under the Line ſhall be the true and Total Product required. As for Example, I would multiply 478 by 6, firſt I ſet down 478, and underneath it 6 in the place of Units, and draw a line underneath them as in the Margent, then I begin, ſaying 6 times 8 is 48, which is 8 above 4 Tens, therefore I ſet down 8 (the exceſs) and bear 4 in mind for the four Tens, then I proceed, ſay-

478
6
2868

ing

6 times 7 is 42, and 4 that I carried is 46, I then ſet down 6 and carry 4, and go on, ſaying 6 times 4 is 24, and 4 that I carried is 28, and becauſe it is the laſt figure, I ſet it all down, and ſo the work is finiſhed, and the product is found to be 2868, as was required.

6. When in Compound *Multiplication* the Multiplier conſiſteth of divers places, then begin with the figure in the place of Units in the *Multiplyer*, and multiply it into all the figures in the multiplicand, placing the product below the line as was directed in the laſt Example; then begin with the figure of the ſecond place of the multiplier, (*viz.*) the place of Tens, and multiply it likewiſe into the whole multiplicand (as you did the firſt figure) placing its product under the product of the firſt figure, do in the ſame manner by the third, fourth and fifth, *&c.* until you have multiplyed all the figures of the multiplyer particularly into the whole multiplicand, ſtill placing the product of each particular figure under the product of its precedent figure; herein obſerving the following Caution.

A Caution In the placing of the product of each particular figure of the multiplier, you are not to follow the 2*d.* Rule of the 4*th.* Chapter, *viz.* not to place Units under Uunits, and Tens under Tens, *&c.* but to put the figure or Cypher in the place of Units of the ſecond line under the ſecond figure or place of the Tens in the line above it, and the figure or Cypher in the place of Units of the third line under the place of Tens in the ſecond line, *&c.* Obſerving this order till you have finiſhed the work, *viz.* ſtill placing the firſt figure of every line or product under the ſecond Figure or place of Tens in that which was above it, and having ſo done, draw a line under all theſe particular products, and add them together; ſo ſhall the ſum of all theſe Products be the Total product required.

As if it were required to multiply 764 by 27, I ſet them down the one under the other with a line drawn under-

underneath them ; then I begin, ſaying 7 times 4 is 28, then I ſet down 8, and carry 2, then ſay 7 times 6 is 42, and 2 that I carried is 44, that is 4 and go 4 ; then 7 times 7 is 49, and 4 that I carry is 53, which I ſet down becauſe I have not another Figure to multiply ; thus have I done with the 7, then I begin with the 2, ſaying 2 times 4 is 8, which I ſet down under (4) the ſecond Figure place of Tens in the Line above it, as you may in the Margent : Then I proceed, ſaying 2 time is 12, that is two and carry one, then 2 times 7 is and 1 that I carry is 15, which I ſet down beca 'tis the product of the laſt Figure ; ſo that the prod of 764 by 27 is 5348, and by 2 is 1528, which be placed the one under the other as before is direct and as you ſee in the Margent, and a Line dra under them, and they added together reſpectiv make 20628 the true Product required, being eq to 27 times 764.

Another Example may be this ; Let it be requi to multiply 5486 by 465, I diſpoſe of the Multiplicand and Multiplyer, according to the Rule, and begin multiplying the firſt Figure of the Multiplyer, which is five into the whole Multiplicand, and the Product is 27430 ; then I proceed and multiply the ſecond Figure (6) of the multiplier into the multiplicand, and find the product to amount to 32916 which is ſubſcribed under the other product reſpectively, then do I multiply the third and laſt figure (4) of the multiplyer into the multiplicand, and the Product 21944, which is likewiſe placed under the ſeco Line reſpectively ; then I draw a Line under the ſ Products (being placed the one under the other acco ing to this Rule) and add them together, and the ſu is 2550990 the true Product ſought, being equal 5486 times 465, or 465 times 5486.

54
4
27
3291
2194
25509

M

More Examples in this Rule are these following.

430865	6400758
4739	37496
3877785	38404548
1292595	57606822
3016055	25603032
1723460	44805306
2041869235	19202274
	240002821968

Compendium in Multiplication.

7. Although the former Rules are sufficient for all Cases in Multiplication, yet because in the Work of Multiplication many times great labour may be saved, I shall acquaint the Learner with some Compendiums in order thereto, *viz.* If the Multiplicand or Multiplyer, or both of them end with Cyphers, then in your multiplying you may neglect the Cyphers, and multiply only the significant Figures, and to the Product of those significant Figures, add so many Cyphers as the Numbers given to be multiplied did end with; that is, annex them on the Right hand of the said product, so shall that give you the true product required. As if I were to multiply 32000 by 4300, I set them down in order to be multiplyed as you see in the Margent, but neglecting the Cyphers in both numbers I only multiply 32 by 43, and the Product I find to be 1376, to which I annex the 5 Cyphers that are in the Multiplicand and Multiplyer, and then it makes 137600000 for the true Product of 32000 by 4300.

Si e numeris propositis unus vel uterque adjunctos habeat ad dextram circulos; omissis circulis fiat ipsorum numerorum multiplicatio, & facto demum tot insuper integrorum loci accensentur quot sunt omissi circuli in utroque factore, Clavis Mac. c. 4. 3.

32000	
4300	
96	
128	
137600000	

8. If

8. If in the Multiplyer Cyphers are placed between ſignificant figures, then multiply only by the ſignificant Figures neglecting the Cyphers, but here ſpecial notice is to be taken of the true placing of the firſt figure after the neglect of ſuch Cyphers or Cyphers; and therefore you muſt obſerve in what place of the multiplier the Figure you multiply by ſtandeth, and the firſt figure of that product under the ſame place of the product of the firſt figure of your multiplyer. As for Example, let it be required to multiply 37155 by 4007, firſt I multiply the multiplicand by 7, and the product is 2600976, then neglecting the Cyphers I multiply by 4, and that Product is 1486272, now I conſider that 4 is the fifth figure in the Multiplier, therefore I place two (the firſt figure of the product by four) under the fifth place of the firſt Product by 7, and the reſt in order, and having added them gether, the Total product is found to be 148653209. other Examples in this Rule are theſe following.

Si intermedio multiplicanti co circulus fuerit, ille negligi Alſted. Cap. 9. de Arithm.

37155
4007

260099
1486272

148653209

327586
6030

9827480
1965516

1975343580

7864371
20604

31457484
47186226
15728742

162037502084

9. If you are to multiply any Number by an U with Cyphers, (*viz.*) by 10, 100, 1000, *&c.* th annex ſo many Cyphers before the multiplicand, that *number* when the Cyphers are annexed is the P duct required; as if you would multiply 428 by 1 annex two Cyphers to 428 and it is 42800: If it w requi

quired to multiply 102 by 10000, annex 4 Cyphers d it gives 1020000 for the Product required.

The Proof of Multiplication.

10. Multiplication is proved by Diviſion, and to eak truth all other ways are falſe; and therefore it ll be moſt convenient in e firſt place, to learn Di- ſion, and by that to prove ultiplication. There is a ay (at this day generally uſed in Schools) to prove ultiplication, which is this, firſt add all the Figures the multiplicand together, as if they were ſimple umbers, caſting away the Nines as often as it comes ſo much, and noting the remainder at laſt, which th's caſe cannot be ſo much as 9 : Caſt likewiſe the ines out of the multiplier as you did out of the mul- plicand, and note that remainder; then multiply the emainders, the one by the other, and caſt the Nines at of that Product, obſerving the Remainder; and ſtly, caſt the Nines out of the Total Product, and if is remainder be equal to the remainder laſt found, en they conclude the Work to be rightly perform- l; but there may be given a thouſand (nay infinite) lſe Products in a multiplication, which after this anner may be proved to be true, and therefore this ay of proving doth not deſerve any Example; but e ſhall defer the Proof of this Rule till we come to rove Diviſion, and then we ſhall prove them both gether.

Non eſt quod aliam expectes examinandi viam; nam aliæ vulgares & falſæ ſunt, & nullo innixæ fundamento.

11. The general effect of Multiplication is contained the definition of the ſame, which is to find out a d. Number, ſo often containing one of the two given umbers as the other containeth Unit,

The ſecond effect is by having the length and readth of any thing (as a Parallelogram, or long lain) to find the ſuperficial Content of the ſame, and y having the ſuperficial Content of the Baſe and the ength to find out the ſolidity of any Parallelopipedon, ylinder or other ſolid figures. The

The third Effect is by the contents, price, value buying, selling, expence, wages, exchange, simpl interest, gain or loss of any one thing, be it Money Merchandize. *&c.* to find out the value, price, ex pence, buying, selling, exchange, or interest of an Number of things of like Name, Nature and Kind.

The fourth effect is (not much unlike the other by the Contents, Value, or Price of one part of an thing Denominated, to find out the Content, Valu or Price of the whole thing, all the parts into whic the whole is divided, multiplying the price of one o those parts.

The fifth effect is, to aid, to compound, and to mak other Rules, as chiefly the *Rule* of Proportion, ca llec the Golden Rule, or Rule of Three; also by it, thing of one Denomination are reduced to another.

If you multiply any number of Integers or the price of the Integer, the Product will discover the price o the Quantity or Number of Integers given.

In a Rectangular Solid, if you multiply the breadth of the Base by the depth, and that Product by the length, this last Product will discover the Solidity or Content of the same Solid.

Some Questions proper to this Rule may be these following:

Quest. 1. What is the Content of a square piece of Ground, whose length is 28 *perches*, and breadth 13 *perches*?

Answ. 364 square *perches*, for multiplying 28 the length by 13 the breadth, Product is so much.

Quest. 2. There is a square battle whose Flank is 47 Men, and the Files 19 deep, what number of *Men* doth that Battle contain? *Facit* 893; for multiplying 47 by 19, the Product is 893.

Quest. 3. If any one thing cost 4 shillings, what shall 9 such things cost? *Answer* 36 shillings; for multiplying 4 by 9, the Product is 36.

Quest. 4. If a piece of *Mony* or *Merchandize* be worth or cost 17 shillings, what shall 19 such pieces

of

Money or Merchandize cost? *Facit* 323 shillings, ch is equal to 16 *l.* 03 *s.*

Quest. 5. If a Soldier or Servant get or spend 14 *s.* Month, what is the Wages or Charges of 49 Sol- s or Servants for the same time? Multiply 49 by the Product is 686 *s.* or 34 *l.* 06 *s.* for the *Answer.*

Quest. 6. If in a day there are 24 hours, how many rs are there in a year, accounting 335 days to con- te the year? *Facit* 8760 hours, to which if you the 6 hours over and above 365 days as there is in ar; then it will be 8766 hours, now if you multi- this 8766, by 60, the number of Minutes in an r, it will produce 525960 for the number of Mi- s in a Year.

CHAP. VII.

Of Division of Whole Numbers:

DIVISION is the separating or parting of any Number or Quantity given into any parts assi- d; or to find how often one Number is contained nother: Or from any two Numbers given to find ird that shall consist of so many Units, as the one those two given Numbers is comprehended or con- ed in the other.

. Division hath three Parts or Numbers remarkable, First the Dividend. Secondly, the Divisor. Thirdly, Quotient. The Dividend is the Number given to parted or divided. The Divisor is the Number n, by which the Dividend is divided: Or it is the ber which sheweth how many parts the Dividend be divided into, And the Quotient is the number duced by the Division of the two given Numbers, one by the other.

o 12 being given to be divided by 3, or into three al parts, the Quotient will be 4. for 3 is contained in four times, where 12 is the Dividend, and 3 is the isor, and 4 is the Quotient.

3. In

3. In Division set down your Dividend, and dra a crooked line at each end of it, and before the line the left hand, place the Divisor, and behind that c the right hand, place the Figures of the Quotient, as in the Margent, where it is required to divide 12 by 3 : First I set down 12 the dividend, and on each side of it do draw a crooked line, and before that on the left han do I place 3 the divisor ; then do I seek how often is contained in 12, and because I find it 4 times, I p 4 behind the crooked line on the right hand of th Dividend, denoting the Quotient.

3) 12 (

4. But if when the divisor is a single Figure, th dividend consisteth of two or more places, then (ha ving placed them for the Work as is before directe put a point under the first figure and the left hand the dividend, provided it be bigger than (or equ to) the divisor, but if it be lesser than the divisc then put a point under the second Figure from the le hand of the Dividend, which Figures as far as th point goeth from the left hand are to be reckoned h themselves, as if they had no dependance upon th other part of the dividend, and for distinction sa may be called the dividual, that ask how often th divisor is contained in the dividual, placing the A swer in the quotient ; then multiply the divisor by th Figure that you placed in the Quotient, and set th Product thereof under the dividual ; then draw line under that product, and substract the said produ from the dividual, placing the remainder under th said line, then put a point under the next Figure the dividend, on the right hand of that which you p the point before, and draw it down, placing it on th right hand of the remainder, which you found Substraction ; which remainder with the said figure a nexed before it, shall be a new dividual ; then se again how often the divisor is contained in this n dividual ; and put the Answer in the quotient on t right hand of the figure which you put there befo then multiply the divisor by the last figure that y

at in the Quotient and ſubſcribe the Product under e Dividual, and make Subſtraction, and to the Remainder draw down the next Figure from the grand ..idend, (having firſt put a point under it) and put on the right hand of the Remainder for a new dividual as before, &c. and proceed thus till the Work finiſhed.

Obſerving this general Rule in all kinds of Diviſion, rſt to ſeek how often the diviſor is contained in the ividual; then (having put the anſwer in the Quotient) multiply the diviſor thereby, and ſubſtract the roduct from the dividual. An Example or two will ake the Rule plain. Let it be required to divide 184 by 6. I diſpoſe of the Numbers given as is bere directed, and as you ſee in the Margent, in order to the Work; then (becauſe the diviſor is more than 2 the firſt Figure of the dividend) I put a point under 1 the ſecond Figure, which makes the ividual, then do I ask how often 6 the iviſor is contained in 21, and becauſe I annot have it more than 3 times, I ut 3 in the Quotient, and thereby do I ultiply the diviſor (6) and the product 18, which I ſet in order under the dividual, and ſubſtract it therefrom, and ne Remainder (3) I place in order under the line, as ou ſee in the Margent.

```
6)2184(
  .
 21 for the
6) 2184 (3
  .
  18
  --
   3
```

Then do I make a point under the ext Figure of the dividend being 8, and raw it down, placing it before the Remainder 3, ſo have I 38 for a new dividual, then do I ſeek how often 6 is contained in 38, and becauſe I cannot have ore than 6 times, I put 6 in the Quotient, and thereby do I multiply the diſor 6, and the product (36) I put under ne dividual (38) and ſubſtract it therefom, and the remainder 2 I put under the Line, as ou ſee in the Margent.

```
6)2184(36
  ..
  18
  --
  38
  36
  --
   2
```

Then do I put a point under the next (and last) figure of the dividend (being 4) and draw it down to the remainder 2, and putting it on the Right hand thereof, it maketh 24 for a new dividual; then I seek how often 6 is contained in 24, and the Answer is 4, which I put in the quotient and multiply the Divisor (6) thereby; and the product (24) I put under the dividual (24) and substract it therefrom, and the Remainder is 0, and thus the Work is finished, and I find the Quotient to be 364, that is, 6 is contained in 2184 just 364 times, or 2184 being divided into 6 equal parts, 364 is one of those parts.

```
6)2184)364
...
18
---
38
36
---
24
24
---
00
```

Again, If it were required to divide 2646 by 7, into 7 equal parts, the Quotient would be found be 378, as by the following Operation appeareth.

```
7) 2646 (378
...
21
---
54
49
---
56
56
---
00
```

So if it were required to divide 946 by 8, the Quotient will be found to be 118, and 2 remaining and Division is ended. The Work followeth.

8) 946 (118
8
14
8
66
64
(2)

Many times the dividend cannot exactly be divided the diviſor, but ſomething will remain, as in the Example, where 946 was given to be divided by 8, quotient was 118 and there remaineth 2 after the ision is ended : Now what is to be done in this e with the Remainder, the Learner ſhall be taught en we come to treat of reducing (or Reduction) Fractions.

And here note that if after your Diviſion is ended, thing do remain, it muſt be leſſer than your divi- for otherwiſe your Work is not rightly performed.

Other Examples are ſuch as follow.

8) 73464 (9183
72
14
8
66
64
24
24
(0)

9) 13758 (1528
9
47
45
25
18
78
72
(6)

5. But if the Divisor consisteth of more places th one, then chuse so many Figures from the left side the dividend for a dividual as there are figures in t divisor, and put a point under the farthest Figure that Dividual to the Right hand, and seek how oft the first Figure on the left side of the Divisor, contained in the first Figure on the left side of t dividual, and place the Answer in the Quotient, a thereby multiply your Divisor, placing your produ under your dividual, and substract it therefrom, p cing the Remainder below the line; then put a poi under the next Figure in the Dividend, and draw down to the said Remainder, and annex it on the rig side thereof, which makes a new dividual, and proce as before, till the work is finished.

And if it so happen that after you have chosen yo first dividual (as is before directed) you find it to lesser than the divisor, then put a point under a figu more near to the right hand, and seek how often t first Figure on the left side of the divisor is contain in the two first Figures on the left side of the dividu and place the answer in the quotient, by which mul ply the divisor, and place the product thereof in der under the dividual, and substract it therefro and proceed as before.

Always remembring, that (in all the cases of Di sion) if after you have multiplyed your Divisor the Figure last placed in the Quotient, the product greater than the dividual, then you must cancel t Figure in the Quotient, and instead thereof put a gure lesser by a Unit (or one) and multiply he Di sor thereby, and if still the product be greater t the dividual, make the figure in the quotient yet le by a Unit, and thus do until your product be le than the dividual, or at the most equal thereto, a then make Substraction, &c.

So if you would divide 9464 by 24, the quoti will be found to be 394, I first put down the gi Numbers, as before is directed in the third Rule: N

beca

cauſe my Diviſor conſiſteth of two gures, I therefore put a point under e ſecond Figure from the left hand my Dividend, which here is 4, herefore I ſeek how often 2 the firſt gure (on the left ſide of the Diviſor) contained in 9) the like firſt in the vidual) the anſwer is 4, which I put in the quotient, d thereby multiply all the diviſor and find the pro- ct to be 96, which is greater than the dividual 94, hereof I cancel the 4 in the quotient, and inſtead ereof I put 3 (a Unit leſſer) and by it multiply the viſor 34, and the product is 72, which I ſubſtract om 94 the Dividual, and the Remainder is 22, then I make a point under the next figure 6 in the Divi- nd, and draw it down and place it the right ſide of the Remainder 22, d it makes 226 for a new dividual, w becauſe the dividual 226 conſiſt- h of a Figure more than the diviſor, erefore I ſeek how often 2 (the firſt ure of the diviſor is contained in 22 e two firſt the of diuidual) I ſay nine nes, wherefore I put 9 in the quott- t, and thereby multiply the Diviſor , the product (216) I place under the vidual 226, and ſubſtract it from it, and there re- aineth 10.

```
24) 9464 (3
                4
    ..
    72
   ----
    22
```

```
24) 9464 (39
    ..
   ----
    226
    216
   ----
     10
   ----
```

Then I go on and make a point under the next and ſt Figure (4) in the Dividend, and draw it down to e Remainder 10, and it maketh 104, for a new vidual, which is alſo a figure more than the Diviſor, d therefore I ſeek how often two is, contained in n. I anſwer five times, but multiplying my Diviſor 5, the product is 120, which is greater than the Di- ſor, and therefore I make it but 4, and by it multi- y the diviſor, and the product is 96, which being pla- d under, and ſubſtracted from the dividual, there re- aineth 8, and thus the whole work of this Diviſion ended, and I find that 9464 being divided by 24,

or in equal parts, is found to be 394, as was ſa
before, and the Remainder is 8, as you ſee in t
Work following.

```
24) 9464 (394
    ....
    72
    ---
    226
    216
    ---
    104
     96
    ---
     (8)
```

Another Example may be this, let there be requi
the quotient of 1183653 divided by 385, firſt I
ſpoſe of the *numbers* in order to their
dividing, and becauſe 118 the three
firſt Figures of the dividend is leſſer
than the diviſor 385, I therefore
make a point under the fourth
Figure, which is 3, and ſeek
how often 3 (the firſt Figure of
the diviſor) is contained in 11? The Anſwer is
which I put in the Quotient, and thereby multiply
Diviſor 385, and the Product is 1155 which I ſubſt
from the Dividual 1188, and there remains 28. T
(as before) I draw down the
next Figure, which is 6, and
place it before the Remainder
28, ſo have I 286 for a new
dividual, and becauſe it hath no
more Figures than the Diviſor, I
ſeek how often 3 (the firſt Figure in the diviſor
contained in 2 (the firſt Figure of the dividual)
the Anſwer is 0, for a greater number cannot be c
tained in a leſſer, wherefore I put 0 in the quoti
and thereby (according to the 5*th* Rule) I ſho
multiply my Diviſor, but if I do the product will be

```
385)1183653
    ...
    1155
    ----
      28
385 (1183653
    ..
    1155
    ----
     286
```

l o ſubſtracted from the dividual 286, the remainder the ſame ; wherefore I draw wn the next Figure (5) from dividend, and put it before ſaid Remainder 286, ſo have 865 for a new dividual, and auſe it conſiſteth of four pla-, (*viz.*) a place more than the iſor, I ſeek how often 3 (the t Figure of the diviſor, is con-ned in 28 (the two firſt of the idual) and I ſay there is 9 times 3 in 28, but mul-lying my whole diviſor (385) thereby I find the oduct to be 3545, which is greater than the divi-l 2865, wherefore I chooſe eight which is leſſer by Unit than nine, and thereby I multiply my diviſor 5, and the product is 3080, which ſtill is greater n the ſaid dividual, wherefore I chooſe another num-yet a Unit leſſer, *viz.* 7 ; and having multiplyed diviſor thereby, the Product is 2695, which is er than the dividual 2865, wherefore I put 7 in the otient, and ſubſtract 2695 from the dividual 2865, there remains 170, then I draw down the laſt fi-e (3) in the dividend, and place it before the ſaid mainder 170 , and it makes 03 for a new dividual, then r the Reaſon above ſaid) I k how often 3 is contained in , the anſwer is 5, but multi-ying the diviſor thereby, the oduct is (1925) greater than dividual, wherefore I ſay will bear 4 (a Unit leſſer) and it I multiply the Diviſor 385 the Product is 1540, which eſſer than the dividual, and erefore I put 4 in the Quo-nt, and ſubſtract the ſaid Product from the dividual, there remaineth 163, and thus the Work is fini-ed, and I find that 1183653 being divided by 385,

```
385)1183653(307
    ...
    1155
    ----
    2865
    2695
    ----
     170
```

```
385)1183653(3074
    ....
    1155
    ----
    2865
    2695
    ----
    1703
    1540
    ----
     163
```

or into 385 equal ſhares or parts, the Quotient (or one of thoſe parts) is 3074, and beſides there is 165 remaining.

And thus the Learner being well verſed in the Method of the foregoing Examples, he may be ſufficiently qualified for the dividing of any greater Sum or Number into as many parts as he pleaſeth, that is he may underſtand the Method of dividing by a Divi-ſor, which conſiſteth of 4 or 5, or 6, or any greater number of places, the Method being the ſame with the foregoing Examples in every reſpect.

Other Examples in Diviſion.

27986) 835684790 (29860

55972

275964
251874

240907
223888

170199
167916

Remains (22830)

196374) 473986018 (2413

392748

812380
785496

268841
196374

724678
589122

Remains (135556)

So if you divide 47386473 by 58736, you will find e Quotient to be 806, and 45257 will remain after e work is ended.

In like manner if you would divide 3846739204 by 3064, the quotient will be 7963 and the Remainder ter Division will be 100572.

Compendiums in Division.

IF any given Number be to be divided by another number that hath Cyphers annexed on the right le thereof, (omitting the Cyphers) you may cut off many Figures from the right nd of the Dividend, as there e Cyphers before the Divisor, d let the Remaining Numrs in the Dividend, be divid by the remaining number numbers in the divisor, obving this Caution, that if after your Division is end any thing remain, you are to annex thereto, the *mber* or *numbers* that were cut off from the *dividend*; d such new found *number* shall be the Remainder.

Et si Divisor adjunctos sibi habeat Circulos ad dextram, omissis circulis & abscissis totidem ultimis Figuris dividendi in numeris reliquis fiat divisio, in fine autem divisionis restituend sunt tum omissi circul. ; tum figuræ abscissæ. Ought. Cls. Matth. cap. 5. 8.

for Example: Let it be requi- 4|00)466|58(116
d to divided 46658 by 400; now 4
cause there are two Cyphers be- 6
re the Divisor, I cut off as ma- 4
Figures from before the *Di-* 26
dend, viz. 58. so that then there 24
ll remain only 466 to be divi- 258
d by 4, and the quotient will
116, and there will remain 2,
which I annex the two Figures
8) which were cut off from the
vidend, and it makes 258 for the
e remainder, so that I conclude
658 being divided by 400, the quotient will be 116,
d 258 remaineth after the Work is ended; as by
e Work in the Margent.

2. And hence it followeth that if the Diviſor be (1
or a Unit with Cyphers annexed, you may cut off ſo many figures from before the dividend, as there are Cyphers in the Diviſor, and then the figure or figures that are on the Left-hand, will be the Quo tient, and thoſe that are on the Right-hand will be th Remainder, after the Diviſion is ended : As thus, 45783 were to be divided by 10, I cut off the laſt F gure (3) with a daſh thus (4578|3) and the work done, and the quotient is 4578 (the number on th left hand of the daſh) and the Remainder is 3 (on th Right hand ;) in like manner if the ſame numbe 45783 were to be divided by 100, I cut off 2 Figur from the end thus (457|83) and the Quotient is 45 and the Remainder is 83. And if I were to divide th ſame by a 1000, I cut off 3 Figures from the end th (45|783) and the Quotient is 45, and 783 the R mainder, *&c.*

Diviſurus qu mcunque numerum p 10. Auferex dextra parte unica eamque primam figuram. Relic enim figur productum oſtendu Ablatum Reſiduum, &c. Gem. Fr Arith. part. 1.

6. The General Effect of Diviſion is contained the definition of the ſame (that is) by having two u equal numbers given to find a third number in ſuc proportion to the dividend, as the diviſor hath to Un or 1, it alſo diſcovers what reaſon or proportion the is between numbers, ſo if you divide 12 by 4, it quot 3, which ſhews the reaſon or proportion of 4 to 12 triple.

The ſecond Effect is by the ſuperficial meaſure content, and the length of any Oblong, Rectangul Parallelogram, or ſquare Plain known, to find out t breadth thereby, or contrariwiſe by having the ſupe ficies, and breadth of the ſaid Figure, to find out t length thereof. Alſo by having the ſolidity and leng of a Solid, to find the Superficies of the Baſe, *&c. e cont*

The third effect is, by the contents, reaſon, pri value, buying, ſelling, expences, wages, exchan intereſt, profit or loſs of any number of things (be Money, Merchandize, or what elſe) to find out t

cr

ntents, reaſon, price, value, buying, ſelling, ex-nce, wages, exchange, intereſt, profit or loſs, of y one thing of like kind.

The fourth effect is to aid, to compoſe, and to make ner Rules, but principally the Rule of Proportion, led the Golden Rule, or Rule of Three, and the duction of Moneys, Weights, and Meaſures, of e denomination into another, by it alſo Fractions abbreviated by finding a common meaſurer, unto e Numerator and Denominator, thereby diſcove-g commenſurable numbers.

If you divide the value of any certain quantity, the ſame quantity, the quotient diſcovers the rate value of the Integer, as if eight yards of Cloth coſt ſhillings; if you divide (96) the value or price the given quantity, by (8) the ſame quantity, the otient will be 12, which is the value or price of of thoſe yards, *& e contra.*

If you divide the Value or Price of any unknown antity, by the value of the Integer, it gives you in e Quotient that unknown quantity whoſe price is us divided; as if 12 ſhillings were the value of 1 rd, I would know how many yards are worth 96 ſhil-ngs: Here if you divide (96) the price or value of e unknown quantity, by (12) the rate of the Inte-r, or one yard, the quotient will be 8, which is the umber of yards worth 96 ſhillings.

ne Queſtions anſwered by Diviſion may be theſe following.

Queſt. 1. If 22 things coſt 66 ſhillings, what will 6 ch things coſt; *facit* 3 ſhillings, for if you divide 61 y 22, the Quotient is 3 for the Anſwer; ſo if 3*l.* rd or ells of any thing be bought or ſold for 108 6 ow much ſhall 1 yard or ell be bought or ſold for? *cit* 3*l.* for if you divide 108 *l.* by 36 yards, the notient will be 3 *l.* the price of the Integer.

Queſt. 2. If the Expence, Charges or Wages of 7 ears amount to 868 *l.* what is the Expence, Charges Wages of one year? *facit* 124 *l.* for if you divide

868

868 (the Wages of 7 years) by 7 (the Number o years) the Quotient will be 124 *l.*; for the Anſwer ſe the Work.

7) 868 (124
7
16
14
28
28
(0)

Queſt. 3. If the content of our Superficial Foot bo 144 Inches, and the breadth of a board be 9 inche how many inches of that board in length will mak ſuch a foot? *facit* 16 inches; for by dividing; 144 (th number of ſquare Inches in a ſquare Foot,) by 9 (th Inches in the breadth of the board) the Quotient is 1 for the number of Inches in length of that board t make a ſuperficial Foot.

9) 144 (16 *Inches*
9
54
54
(0)

Queſt. 4 If the content of an Acre of Ground b 160 ſquare Perches, and the length of a Furlong (pro pounded) be 80 Perches, how many Perches will ther go in breadth to make an Acre, *facit* 2 Perches; for you divide 160 (the number of Perches in an Acre by 80 (the length of the Furlong in Perches) th Quotient is 2 Perches; and ſo many in breadth of tha Furlong will make an Acre.

80) 160 (2 *Perches*

160

(0)

Queſt. 5. If there be 893 Men to be made up into a attle, the Front conſiſts of 47 Men, what *number* muſt here be in the File? *Facit* 19 deep in the File : For f you divide 893 (the *number* of men) by 47 (the *umber* in Front) the Quotient will be 19 File in depth; he Work followeth;

47) 893 (19 *deep in file*

47

423
423

(0)

Queſt. 6. There is a *Table* whoſe Superficial content ; 72 feet, and the breadth of it at the end is 3 feet, ow I demand what is the length of this Table? *Facit* 4 feet long; for if you divide 72 (the content of he Table in feet) by 3 (the breadth of it) the Quo- ient is 24 feet for the length thereof, which was re- uired. See the Operation as followeth;

3) 72 (24

6

12
12

(0)

The Proof of Multiplication and Diviſion.

Multiplication and *Diviſion* interchangeably prove ach other; for if you would prove a Sum in *Divi- ion*, whether the Operation be right or no, Multiply the

the *Quotient* by the *Divisor*; and if any thing remain after the *Division* was ended, add it to the Product, which Product (if your Sum was rightly *divided*) will be equal to the *Dividend*: And contrariwise, if you would prove a Sum in *Multiplication*, *divide* the *Product* by the *Multiplyer*, and if the work was rightly performed, the *Quotient* will be equal to the Multiplicand. See the Example where the Work is done and undone:: Let 7654 be given to be multiplyed by 3242, the Product will be 24814268 as by the Work appeareth.

```
  7654
  3242
 -----
 15308
 30616
 15308
 22962
 -----
 -----
 24814268
```

And then if you *divide* the said *Product* 24814268 by 3242 the *Multiplyer*, the *Quotient* will be 7654 equal to the given Multiplicand.

```
3242)24814268(7654
                ....
  22694
 -----
  21202
  19452
 -----
  17506
  16210
 -----
  12968
  12968
 -----
```

(o)

In like manner (to prove a Sum or Number in *Di-ſion*) If 24814268 were *divided* by 3242 the Quo-ent will be found to be 7654; then for proof, if ou multiply 7654 the Quotient by 3254 the *Diviſor*, he Product will amonnt to 24814268, equal to the *ividend.*

Or you may prove the laſt or any other Example in *ultiplication* thus, *viz. Divide* the Product by the Mul-plicand, and the Quotient will be equal to the Mul-plyer. See the Work.

7654
3242

15308
30616
15308
22962

7654)24814268(3243
....
22962

18522
15308

32146
30616

15308
15308

(o)

From whence there ariſeth this Corollary, that any Operation in *Diviſion* may be proved by *Diviſion*; for f after your *Diviſion* is ended, you divide the *dividend* by the Quotient, the new Quotient thence ariſing will be equal to the *Diviſor* of the firſt operation; for tryal whereof let the laſt Example be again repeated.

3242

3242) 24814268 (7654

22694

21202
19452

17506
16210

12968
12968

(o)

For Proof whereof divide again 24814268 by th Quotient 7654, and the Quotient hence will be equa to the first *Divisor* 3242; see the Work.

7654) 24814268 (3242

22962

18522
15308

32146
30616

15308
15308

(o)

But in proving *Division* by *Division*, the Learner is t observe this following Caution, that if after his *Divi sion* is ended there be any Remainder, before you g about to prove your Work, substract that Remainde out of our Dividend, and then work as before, as i the following Example, where it is required to divid 43876 by by 765, the Quotient here is 57, and the re mainder is 271; see thee Work following.

765

765) 43876 (57
..
3825

5626
5355
---
(271)

Now to prove this Work ſubſtract the Remainder 271 out of the *Dividend* 43876 and there remaineth 43605 for a new *dividend* to be divided by the former quotient 57, and the quotient thence ariſing is 765 equal to the given *Diviſor*, which proveth the Operation to be right.

43876
271
---
57) 43605 (765
...
399

370
342

285
285
---
(0)

Thus have we gone through the four Species of Arithmetick, *viz.* Addition, Subſtraction, Multiplication, and Diviſion; upon which all the following Rules and all other Operations whatſoever that are poſſible to be wrought by Numbers have their immediate dependance, and by them are reſolved. Therefore before the Learner make a further ſtep in this Art, let him be well acquainted with what hath been delivered in the foregoing Chapters.

Hæ ſunt igitur quatuor illæ ſpecies Arithmeticæ per quas omnia quæcunque deinceps dicenda ſunt vel quæ per numeros fieri poſſibile eſt, abſolvuntur. Quare eas quiſquis ex ante omnia perdiſces. Gem. Friſ. Arith. par. 1

CHAP.

CHAP. VIII.

Of Reduction.

1. *Reduction* is that which brings together 2 or more numbers of different denominations into one denomination; or it serveth to change or alter Numbers, Money, Weight, Measure of Time, from one denomination to another; and likewise to abridge Fractions to their lowest *Terms*. All which it doth so precisely, that the first *Proportion* remaineth without the least jot of *Error* or *VVrong* committed. So that it belongeth as well to *Fractions* as *Integers*, of which in its proper place. *Reduction* is generally performed either by Multiplication or Division; from whence we may gather, that,

Hills Arith. Ch. 13.152.

2. *Reduction* is either Descending or Ascending.

3. *Reduction* Descending, is when it is required to *reduce* a *Sum* or *Number* of a greater Denomination into a lesser; which *Number*, when it is so reduced shall be equal in value to the *number* first given in the greater Denomination; as if it were required to know how many *shillings*, *pence* or *farthings* are equal in value to an *hundred pounds*? or how many *ounces* are contained in 45 *hundred weight*; or how many *days*, *hours* or *minutes* there are in 240 *Years*, *&c.* And this kind of *Reduction* generally performed by Multiplication.

Wing. Arith. ch. 7.2,3,4.

4. *Reduction* is Ascending, is when it is Required to *Reduce* or *Bring* a *Sum* or *Number* of a smaller Denomination into a greater, which shall be equivalent to the given *number*; as suppose it were required to find out how many Pence, Shillings or Pounds are equal in value to 43785 *Farthings*; or how many *Hundreds* are equal to (or in) 3748 *pounds*, *&c.* and this kind of *Reduction* is always performed by *Division*.

5. When a *Sum* or *Number* is given to be reduced into another Denomination, you are to consider what

the

her it ought to be resolved by the Rule descending or scending, *viz.* by Multiplication or Division: If it e to be performed by Multiplication, consider how nany parts of the Denomination into which you would reduce it, are contained in a *Unit* or *Integer* of he given *Number*, and multiply the said given *number* hereby, and the product thereof will be the Answer to he Question. As if the Question were in 8 *pounds*, how many *shillings*? Here I consider, that in one *pound* are 20 *shillings*, nd that the number of *shillings* in 38 *pounds* will be 20 times 38, where I multiply 38 *l.* by 20, and that product is 760, and so nany *shillings* are contained in 38 *pounds*, as in the largent.

38	
20	
760	

But when there is a Denomination, or Denominaons between the *Number* given, and the *Number* reuired, you may (if you please) reduce it into the ext inferiour Denomination, and then into the next wer than that, *&c.* until you ve brought it into the Denoination required: As for Exmple, let it be demanded in 32 *pounds* how many *farthings*? rst, I multiply 132 (the *Numr* of *pounds* given by 20 to ring it into *shillings*) and it akes 2640 *shillings*, then do I ultiply the *shillings* (2640) by 2, to bring them into *pence*, d it produceth 31680, and so any *pence* are containedin 2640 *illings*, or 132 *pounds*; then do I ultiply the *pence*, *viz.* 31680 4 to bring them into *farthings* (because 4 *farthings* a *penny*) and I find the *product* thereof to be 126720, d so many *farthings* are in equal value to 132 *pounds*, e Work is manifest in the *Margent*.

132 *pounds*	
20	
2640 *shill.*	
12	
5280	
2640	
31680 *pence*	
4	
126720 *farth.*	

6. And if the *number* propounded to be reduced, to be divided, or wrought by the Rule Ascending, con-

conſider how many of the given *numbers* are equal to an *Unit* or *Integer*, in that denomination to which you would *reduce* your given *number*, and make that your *Diviſor* : and the given *number* your *Dividend* ; and the *Quotient* thence *ariſing* will be the *number* ſought or required : As for Example, Let it be required to reduce 2640 *ſhillings* into *pounds*, here I conſider that 20 *ſhillings* are equal to one pound , wherefore I divide 2640 (the given *Number*) by 20, and the *Quotient* is 132, and ſo many *pounds* are contained in 2640 *ſhillings*. In Reduction deſcending and aſcending the Learner is adviſed to take particular notice of the Tables delivered in the ſecond Chapter of this Book , where he may be informed what *Multipliers* or *Diviſors* to make uſe of in the reducing of any Number to any other Denomination whatſoever, eſpecially *Engliſh* Moneys, Weights, Meaſures, Time and Motion, but in this place it is not convenient to meddle with Foreign Coyns, Weights, or Meaſures.

```
                l.
2|0)264|0(13::
   ...
    2
   ---
    6
    6
   ---
     4
     4
    ---
     (0)
```

But if in Reduction Aſcending it happen that there is a denomination or denominations between the *number* given, and the *number* required, then you may *reduce* your *number* given into the next *ſuperiour* denomination, and when it is ſo reduced, bring it into the next above that, and ſo on until you have brought it into the Denomination required. As for Example,

Let it be demanded in 126720 *farthings* how many *pounds*? Firſt, I divide my given *number* (being *farthings*) by 4, to bring them into *pence*, (becauſe 4 *farthings* make one *penny*, and they are 31680 *pence*, then I devide 31680 *pence* by 12, and the *Quotient* giveth 2640 *ſhillings*, and then I divide 2640 *ſhillings* by 20, and the *quotient* giveth 132 *pounds*, which are equall in value to 126720 *farthings*. See the whole Work as it followeth.

	12)	20)	l.
4) (126720	(31680	(264|0	(132
.....	...	..	
12	24	2	
6	76	6	
4	72	6	
27	48	4	
24	48	4	
32	(0)	(0)	
32			
(0)			

7. When the *number* given to be reduced, conſiſteth divers denominations, as *pounds*, *ſhillings*, *pence* and *rthings*, or of *hundreds*, *quarters*, *pounds* and *ounces*, &c. en you are to reduce the higheſt (or greateſt) denonation into the next *Inferiour*, and add thereunto the *nber* ſtanding in that denomination which your greaſt or higheſt *number* is reduced to; then reduce that *un* into the next *Inferiour* Denomination, adding ereto the *number* ſtanding in that denomination; do until you have brought the *number* given into the nomination propoſed. As if it were required to duce 48 *l.* 13 *s.* 4 *d* into *pence*; firſt, I bring 48 *l.* o *ſhillings*, by multiplying it by 20, and the *product* 960 *ſhillings*, to which I add the 13 *ſhillings*, and y make 973, then I multiply 973 by 12, to bring *ſhillings* into *pence*, and they make 11676 *pence*, to ich I add the 10 *pence*, and they make 11686 *pence* the Anſwer, ſee the Work done.

48 *l.*

	l.	*s.*	*d.*
	48	13	10
	20		
	960 *ſhillings*		
Add	13		
Sum	973 *ſhillings*		
	12		
	1946		
	973		
	11676 *pence*		
Add	10		
Sum	11686 *pence*		

8. If (in Reduction Aſcending) after Diviſion is ended, any thing remain, ſuch Remainder is of the ſame Denomination with the Dividend.

Example. In 4783 *farth.* I demand how many *pound*

Firſt, I divide the given *number* of *Farthings*, (*viz.* 4783) by 4 to bring them into *pence*, and the Quotient is 1195 *pence*, and there remaineth 3 after the work of Diviſion is ended, which is 3 *farthings*.

Again, I divide 1195 *pence* (the ſaid *Quotient*) by 12 to reduce them into *ſhillings*, and the *Quotient* is 99 *ſhillings*, and there is a Remainder of 7, which is *pence*.

And then I divide 99 *ſhillings* (the laſt *Quotient*) by 20, to bring it into *pounds*, and the *Quotient* is 4 *l.* and there remaineth 19 *ſhillings*; ſo that I conclude that in 4783 (the propoſed *number* of *farthings*) there is 4 *pounds*, 19 *ſhillings*, 7 *pence*, 3 *farthings*, view the following Operation.

```
                12                2|0) (4 pounds
4) 4783 (1195                     9|9
   ....    ..
    4      108                    8|
   --     ---                    --
    07     115                (19) shillings
     4     108
   --     ---
    38 Rem. (7) pence
    36
   --                    l.  s.  d  qrs.
    23          facit    04—19—07—03
    20
   --
```

Remains (3) *farthings*

More Examples in Reduction of Coin.

Queſt. 1. In 438 *l.* how many *ſhillings*? *Facit* 8760 *ſhillings*, for by multiplying 438 by 20, the *Product* mounteth to ſo much. See the Work.

```
438 pounds
 20
-----
```

Facit 8760 *ſhillings*

Queſt. 2. In 467 *l.* how many *Pence*? Firſt, multiply the given *number* of *pounds* (467) by 20 to bring it to ſhillings, and it makes 9340 *ſhillings*, then multiply the *ſhillings* by 12, and it produceth 112080 *pence*, thus,

```
467 pounds
 20 ſhillings
-----
9340 ſhillings
  12
-----
18680
9340
-----
```

Facit 112080 *pence*

Or it may be resolved thus, *viz.* multiply the given *number* of *pounds* (467) by (240) the *number* of *pence* in a *pound*, and the Product is the same, *viz.* 112080 *pence*, as by the Operation appeareth.

467 *pounds*
240

18680
934

Facit 112080 *pence*

Quest. 3. In 5673 *l.* how many *farthings*? First Multiply the given *number* by 20, to bring it into *shillings*, and it produceth 113460 *shillings*, then multiply that *product* by 12, to bring it into *pence*, and it produceth 1361520 *pence*; then lastly, multiply *pence* by 4, and it produceth 5446080 *farthings*. the Operation.

5673 *pounds*
20

113460 *shillings*
12

226920
113460

1361520 *pence*
4

Facit 5446080 *farthings*

Or this Question might have been thus resolved, *viz.* Multiply 5673 (the given *number* of *pounds*) by 960 (the *number* of *farthings* in a *pound*) and it produceth the same Effect, as you may see by the Work

5673 *pounds*	20 *ſhillings*
960	12
340380	240 *pence*
51057	4
it 5446080 *farthings*	960 *farthings*

Otherwiſe thus; Firſt bring the given *number* 5673*l.* o *ſhillings*, and multiply the *ſhillings* by 48, the ber of *farthings* in a *ſhilling*, and the ſame Effect is reby likewiſe produced, *viz.*

5673 *pounds*	12 *pence*
20	4
113460 *ſhillings*	48 *farth.*
48	
907680	
543840	
Facit 5446080 *farthings*	

Theſe various ways of Operating are expreſſed to in- n the Judgment of the Learner, with the Reaſon of Rule; more ways may be ſhown, but theſe are ſuffi- nt even for the meaneſts Capacities.

Queſt. 4. In 458 *l.* 16 *s.* 7 *d.* 3 *qrs.* how many *far- gs*? To Reſolve this Queſtion conſider the ſeventh e of this Chapter, and work as you are there di- ted, and you will find the aforeſaid given *number* mount to 440479 *farthings*, *viz.*

l. s. d qrs.
458—16—07—3
20

9160 *shillings*
Add 16

Sum 9176 *shillings*
12

18352
9176

110112 *pence*
Add 07

Sum 11019 *pence*
4

440476 *farthings*
Add 3

Sum 440479 *farthings.*

This laſt Queſtion (or any other of this kind, w
where the *number* given to be reduced conſiſteth of
veral Denominations) may be more conciſely reſolv
thus, *viz.* when you multiply the pounds by 20,
bring them into ſhillings, to the product of the fi
Figure, add the Figure ſtanding in the place of Un
in the Denomination of ſhillings, but becauſe the f
Figure in the Multiplier is (0) I ſay 0 times 8 is
thing, but 6 is 6, which I put down for the firſt
gure in the product, then becauſe this Multiplier is
I go on no further with it, for if I ſhould, the wh
Product would be 0, but proceed, and when I co
to multiply by the ſecond Figure in the Multiplier,
to the Product of it, I add the Figure ſtanding in
place of Tens in the Denomination of ſhillings wh

1) saying 2 times 8 is 16, and (the said Figure) 1
7, then I set down 7, and carry an Unit to the Pro-
t of the next Figure as is directed in the fifth Rule
he sixth Chapter foregoing; and finish the Work.
hat you now have the whole Product and Sum of
lings at one operation, which is the same as before,
when you multiply the shillings by 12, to bring
n into pence (after the same manner) add to the
duct the number standing in the denomination of
ce, and so when you multiply the pence by 4 to
g them into farthings, add to the Product the num-
standing under the denominations of Farthings.
the last Question thus wrought.

l.	s.	d.	qrs.
458	16	07	3
20			
9176 *shillings*			
12			
18359			
9176			
110119 *pence*			
4			

Facit 440479 *farthings.*

fter the Method last prescribed (which if Rightly
idered, differeth not any thing from the *7th* Rule
his Chapter) are all the following Examples that
of the same nature wrought and resolved.

ueſt. 5. In 4375866 Farthings, I demand how ma-
Pounds, Shillings, Pence, and Farthings?

o resolve this Question; First, I divide the given
ber of Farthings by 4, and the Quotient is 1093966
ce, and there Remaineth 2 after the Division is
ed, (which by the *8th.* Rule foregoing) is two Far-
gs; then I divide 1093966 Pence by 12 and the

Quotient is 91163 Shillings, and there remaineth 1 after Diviſion, which by the ſaid 8*th*. Rule is ſo many Pence, *viz*. 10 *d*. then I divide 91163 Shillings by 20, and the Quotient is 4558 *l*. and there remaineth 3 Shillings, ſo the work is finiſhed, and I find that 4375866 Farthings there are 4558 *l*. 03 *s*. 10 *d*. 2 qrs. See the Operation,

	12)	20	l.
4) 4375866	(1093966	(9116|3	(4558
4	101	8	
37	13	11	
36	12	10	
15	19	11	
12	12	10	
38	76	16	
36	72	16	
26	46	(03) *shillings*	
24	36		
26	(10) *pence*		
24			
(2) *farthings*			

l. s. d. qrs.

Facit 4558——03——10——2

Queſt. 6. In 4386 *l*. I demand how many Groats?

To Reſolve this Queſtion, I reduce the given number of Pounds into Shillings, and they are 87[illegible] Shillings, now I conſider that in a Shilling are 3 Groats, therefore I multiply the Shillings by 3, and it Proceeth 263160 Groats. See the Work.

4386 *pounds*
20

87720 *ſhillings*
3

Facit 263160 *groats*

This Queſtion might have been otherwiſe reſolved
s, *viz.* conſidering that in a Pound (or 20 ſhillings)
re are 3 times 20 Groats, which make 60, by
ich I multiply the number of Pounds given, and
produceth the ſame Effect at one Operation, as
loweth.

4386 *pounds*	20
60 *groats in* 20 *s.*	3
Facit 263160 *groats in* 4386 *l.*	60

Queſt. 7. In 43758 three Pences, I deſire to know
w many Pounds?
To reſolve this (and many ſuch like) Queſtions; Firſt
divide my given number of Pences by 4, becauſe
three Pences are in a ſhilling, and the Quotient is
9 39 ſhillings, and there remaineth 2 after Diviſion
ended, which is 2 three Pences (by the 8*th.* Rule of
s Chapter) which are equal in value to 6 *d.* then I
vide 10939 Shillings by 20, and the quote giveth
6 *l.* and 19 *s.* Remain; ſo that I conclude in 43758
ces of three pence *per* piece, there are 546 *l.* 19 *s.*
d. as by the Work appeareth.

2|0 l. s. d.
4) 43758 (1093|9 (546—19—06
. . . .
4 10
37 9
36 8
15 13
12 12
38 19 *shillings*
36

(2) *three pences*, or 6 d.

This Queſtion might have been otherwiſe Reſolve thus, *viz.* firſt multiply the given Number of thr pences 43758, by three the Number of pence in thr pence, and the product (*viz.* 131274) is the Numb of pence equal to the given Number of three pence which number of pence may be brought into poun by dividing by 12 and by 20, and the Quotient y will find to be equal to the former work, *viz.* 54 19 *s.* 6 *d.*

43758
3

2|0) l. s. d.
12) 131274 (1093|9 (546—19—06
. . . .
12 10
112 9
108 8
47 13
36 12
114 *rem.* (19) *ſhillings.*
108

Remains (6) *pence*

Or thus, divide the given *Number* of 3 pences by *number* of 3 pences in a pound or 20 ſhillings which you will find to be 80, if you multiply 20 *s.* 4, the *number* of three pences in a ſhilling) and will find the quote to be 546 *l.* as before, and a mainder of 78 three pences, and if you divide thoſe three pences by 4 (becauſe there are 4 three pen- in a ſhilling) you will find the quote to be 19 *s.* 2 three pences Remain, which are equal to 6 *d.* ich is the ſame that was before found.

```
                          l.   s.  d.
8|0) 4375|8 (546—89—05          20
   ...                           4
   40                           ---
  ---                           80
   37
   32
  ---
   55
   48
  ---  s.
 4) 78 (19
   ..
    4
   ---
    38
    36
   ---
```

(2) *three pences or* 6 d.

Queſt. 8. In 4784 *l.* 13 *s.* how many pieces of $13\frac{1}{2}$ *d.* r piece?

This Queſtion cannot be reſolved by Reduction, de- ending, or aſcending, abſolutely, (becauſe $13\frac{1}{2}$ *d.* is o even part of a pound) but rather by them both intly, *viz.* by multiplication and Diviſion; for if you ring the number given into half pence, and divide he half pence, by the half pence, in $13\frac{1}{2}$ *d.* *viz.* 7, the quotient will be the Anſwer; for having

brought 4785 *l.* 13 *s.* into half pence, I find it make 2297112, which I divide by 27, (becauſe there are ſo many half-pence in $13\frac{1}{2}$*d.*) and the quote gives 85078 pieces of $13\frac{1}{2}$*d.* and 6 half pence remain over and above; obſerve the work following.

l.	s.	d.
4785	—13	$13\frac{1}{2}$
20		2
95713 *ſhilling*		27 *half-pence*
24 *half-pence in a ſhilling*		
382852		
191426		

2297112 *half-pence in the given number.*

d.

27) 2297112 (85078 *pieces of* $13\frac{1}{2}$

216

137
135

211
189

222
216

Remain (6) *half-pence*

It would have produced the ſame anſwer if you had reduced your given number into farthings, and divided by the farthings in $13\frac{1}{2}$*d. viz.* 54 (for always the Dividend and the Diviſor muſt be of one Denomination) and then you would have had a Remainder of 12 farthings, which are equal in value to the former Remainder of 6 half-pence, as you may prove at your leiſure. *Queſt.* 9

Queſt. 9. In 540 Dollars at 4 *s.* 4 *d. per* Dollar how many pounds *ſterling*?

Firſt, Bring your given Number of Dollars into Pence, and then your Pence into Pounds according to former Directions. Thus in 4 *s.* 4 *d.* (*viz.* a Dollar) you will find 52 pence, by which multiply the Dollars, and it produced 28080 pence, which if you divide by 240 (the pence in one pound) the quote will give you 117 *l.* which are equal in value to the dollars, at 4 *s.* 4 *d. per* dollar obſerve the Operation.

		s.	d.
540		4	4
52		12	
1080		52 *pence*	
2700			
28080	*l.*		
240)	2808|0 (117		
	24		
	40		
	24		
	168		
	168		
	(0)		

The foregoing Queſtion might have been otherwiſe wrought, thus, *viz.* Multiply (540) your given number of Dollars, by 13 the number of Groats in a Dollar (or 4 *s.* 4 *d.*) and it produceth 7020 groats, which divide by 60 (the groats in 1 pound or 20 ſhillings) the quote is 117 *l.* as before. See the Work.

	s.	d.
540	4	4
13	3	
1620	13	
540		

6|0)702|0(117

6

10
6

42
42

(0)

Queſt. 10. In 547386 pieces of $4\frac{1}{2}$*d. per* piece demand how many Pounds, Shillings, and Pence?

Firſt, Bring your given number of four pence ha penies all into half-pence, which you will do if y multiply by 9 the number of half-pence in $4\frac{1}{2}d.$ a the product is 4926474 half-pence, which are brou into pounds, if you divide them by 24 (the ha pence in a ſhilling) and 20 (the ſhillings in a pour t makes 10263 *l.* 09 *s.* 9 *d.* as by the Work.

547

547386
9

d.
$4\frac{1}{2}$
2

2|0) l. 9 *half-pence*

24) 4926474 (20526|9 (10263

48 2

126 05
122 4

64 12 l. s. d.
48 12 *facit* 10263—09—09

167 6
144 6

234 *rem.* (09) *ſhillings*
216

Rem. (18) *half-pence or* 9 d.

Queſt. 11. In 4386 *l.* I demand how many pieces of *d.* of 4 *d.* and of 2 *d.* of each an equal Number? ut is to ſay, what Number of Six-pences, Groats, and o pences, will make up 4386 *l.* and the Number of ch equal?

The way to reſolve queſtions of this Nature, is to d the ſeveral pieces (into which the given Number to be brought) into one Sum, and to reduce the gi- n Number into the ſame denomination with their m, and to divide the ſaid given Number (ſo Redu- d) by the ſaid Sum, and the Quotient will give you e exact Number of each piece. And after the ſame ethod will we proceed to Reſolve the preſent Que- ſon, *viz.*

4386 *l.*?

4386 *pounds*
240 *pence*

175440
8772

12) 1052640 (87720
96

92
84

86 *facit* 87720 *pieces of*

6
4
2

Sum 12 *pence*

d. d. d.
6—4—2

84

24
24

(0)

So that I conclude by the operation that 87720 ſi
pences, and 87720 groats, and 87720 two pences a
juſt as much as (or equal to) 4386 *l.* or if you adm
of 5 *s.* to be thus divided, it is equal to 5 ſix pence
and 5 four pences or Groats, and 5 two pences. *For*
two Right lines (or two Numbers) be given, and one
them be divided into as many Parts, or Segments as y
pleaſe, the Rectangle (or Product) comprehended under t
two whole Right lines (or numbers given) ſhall be equal
all the Rectangles (or Products) contained under the who
line (or Number) and the ſeveral Segments (or Parts) in
which the other line (or Number) is divided, Eucl. 2.

Another Queſtion of the ſame Nature with th
laſt may be this following, *viz.*

Queſt. 12. A Merchant is deſirous to Change 148
into pieces of 13*d.*½ of 12 *d.* of 9 *d.* of 6 *d.* a
of 4 *d*; and he will have of each ſort an equal Nu
ber of pieces, I deſire to know the number?

Do as you were taught in the laſt queſtion, *v*
add the ſeveral pieces together, and reduce the Su
in

into half-pence, then reduce the Sum to be changed, *viz.* 148 *l.* into the ſame denomination, and divide the greater by the leſſer, and in the Quotient you will find the Anſwer, *viz.* 798 is the Number of each of the pieces required, and, 18 remaineth, which is 18 half-pence by the 8*th.* Rule of this Chapter. See the Work as followeth.

l.		d.
148		$13\frac{1}{2}$
240	*pence in a* l.	12
		9
5920		6
296		4
35520	*pence in* 148 l.	*Sum* 44
2		$2\frac{1}{2}$
71040	*half-pence*	89 *half-pence*

89) 71040 (798 *pieces of each ſort*

623

874

801

730

712

Remain (18) *half-pence*

The truth of the two foregoing Operations will thus be proved, *viz.* multiply the Anſwer by the parts, or pieces into which the given Number was reduced, and having added the ſeveral Products together, if their Sum be equal to the given Number, the Anſwer is Right, otherwiſe not.

So the Anſwer to the 11*th.* Queſtion was 87720, which is proved as followeth, *viz.*

87720

		l.
87720	*Six-pences make*	2193
	Four-pences make	1462
	Two-pences make	731

The total Sum of them 4386 *which was the Sum given to be changed.*

The Anſwer to the 12*th.* Queſtion was 798, and 18 half-pence remained after the Work was ended, now the truth of the work may be proved as the former was, *viz.*

			l.	s.	d.
798	*Pieces of* 13½	*make*	44	17	09
	Pieces of 12	*make*	39	18	00
	Pieces of 9	*make*	29	18	06
	Pieces of 6	*make*	19	19	00
	Pieces of 4	*make*	13	06	00
and 18 *half-pence, or* 9 d.		*remains*	00	00	09
The Total Sum of them			148	00	09

which Total Sum is equal to the Number that was firſt given to be changed, and therefore the Operation was rightly performed.

Reduction of Troy-weight.

We come now to give the Learner ſome Examples in *Troy-weight*, wherein we ſhall be brief, having given ſo large a Taſte of *Reduction* in the foregoing Examples of Coyn, and now the Learner muſt be mindful of the Table of *Troy-weight* delivered in the ſecond Chapter of this Book.

Queſt. 13. In 482 *l.* 07 *oz.* 13 *p.w.* 21 *gr.* how many Grains?

Multiply by 12, by 20, and by 24, taking in the Figures ſtanding in the ſeveral denominations, according to the Direction given in the 7*th.* Rule of this Chapter, and you will find the Product to be 278001 Grains, which is the Number required, or Anſwer to the Queſtion. See the whole work as followeth.

48

l. *oz.* *p.w.* *gr.*
482—07—13—21
12

971
482

5791 *ounces*
20

115833 *penny weight*
24

463333
231668

Facit 2780013 *grains*.

Queſt. 14. In 2780013 *grains*, I demand how many Pounds, Ounces Penny-Weights, and Grains?

This is but the foregoing Queſtion inverted, and is reſolved by dividing 24 by 20, and by 12, and the Anſwer is 482 *l.* 07 *oz.* 13 *p.w.* 21 *gr.*

	2|0)	12)	*l.*
24) 2780013	(11583|3	(5791	(482
24	10	48	
38	15	99	
24	14	96	
140	18	31	
120	18	24	
200	3 *Rem.*	(7) *ounces.*	
192	2		
81 *Rem.*	(13 *penny-weight*		
72			
93		*l.* *oz.* *p.w.* *gr.*	
72 *facit*		482—07—13—21	
Remain (18) *grains*			*Queſt.*

Queſt. 15. A Merchant ſent to a Goldſmith 15 Ingots of Silver each containing in weight 2 *l.* 4 *oz.* and ordered it to be made into Bowls of 2 *l.* 8 *oz. per* Bowl, and Tankards of 1 *l.* 6 *oz. per* piece, and Salts of 10 *oz.* 10 *p.w. per* Salt, and Spoons of 1 *oz.* 18 *p.w. per* Spoon; and of each an equal number, I deſire to know how many of each ſort he muſt make?

This queſtion is of the ſame Nature with the 11 and 12 queſtions foregoing, and may be anſwered after the ſame Method, *viz.* Firſt, add the weight of the ſeveral Veſſels (into which the Silver is to be made) into one Sum, and reduce it to one Denomination, and they make 1248 *penny weights*, then reduce the weight of the Ingot into the ſame denomination, *viz. penny weights*, (and it makes 560 *penny weights*) and multiply them by the Number of Ingots, *viz.* 16, and the product will give you the weight of the 16 Ingots, *viz.* 8960, then divide this product by the weight of the Veſſels, *viz.* 1248, and the Quotient giveth you the Anſwer to the Queſtion, *viz.* 7. and 224 *p.w.* remaining over and above.

l.	*oz.*
2	4
12	
28	
20	
560 *penny weights*	
16 *Ingots*	
3360	
560	
8960	

l.	*oz*	*p.w*
2	08	00
1	06	00
0	10	10
0	01	18
Sum 5	02	08
12		
62		
20		
1248 *p.weights*		

1248) 8960 (7 *Veſſels of each*
8736

Rem. (224) *penny weights*

The

The Proof of the Work is as followeth, viz.

		l.	*oz.*	*p.w.*
Bowls of 2—08—00	*per Bowl is*	18—	08—	00
Tank. of 1—06—00	*per Tank. is*	10—	06—	00
Salts of 0—10—10	*per Salt is*	06—	01—	10
Spoons of 0—01—18	*per Spoon is*	01—	11—	04
224 *penny weight remaining is*		00—	11—	04
Total Sum		37—	04—	00

So that you see the Sum of the Weights of each ssel, together with the Remainder is 37 *l.* 4 *oz.* hich is equal to the Weight of the 16 Ingots delive-d. For if 37 *l.* 04 *oz.* be reduced to Penny Weights, makes 8960.

Reduction of Averdupois Weight.

In Reducing *Averdupois Weight*, the Learner must ve Recourse to the Table of *Averdupois weight* deli-red in the 2*d.* Chapter foregoing.

Quest. 16. In 47 *C.* 1 *qr.* 20 *l.* how many Ounces? ltiply by 4, by 28, and by 16, and the last Pro-ct will be the Answer, *viz.* 84992 Ounces.

C.	*qrs.*	*d.*
47—	1 —	20
4		
189 *quarters*		
28		
1512		
380		
5312 *l.*		
16		
31872		
5312		

Facit 84992 *ounces* *Quest.*

Queſt. 17. In 84992 Ounces, I demand how many *C. qrs. l. oz.*

This is the foregoing Queſtion Inverted, and will be Reſolved if you divide by 16, by 28, and by 4, and the Anſwer is 47 *C.* 1 *qr.* 20 *l.* equal to the given Numbers in the foregoing Queſtion.

		28)	4)	*C. qrs. l. oz.*
16)	84992	(5312	(189	(47—1—20—00
	80	28	16	
	49	251	29	
	48	224	28	
	19	272	(1) *quarter*	
	16	252		
	32	(20) *pounds*		
	32			
	(0)			

Queſt. 18. A Chapman buyeth of a Grocer 4*C.* 1 14*l.* of Pepper, and ordered it to be made up in Parcels of 14 *l.* of 12 *l.* of 8 *l.* of 6 *l.* and of 2 *l.* and of each Parcel an equal number, now I would know the number of each parcel.

This Example is of the ſame nature with the 11 and 12, and 15 Queſtions foregoing, and after the ſame manner is reſolved. See the Operation as followeth.

C.	*qrs.*	*l.*	*l.*
4	1	14	14
4			12
			8
17			6
28			2
140			42 *pounds*
35			

42)490(11
42

70 *Facit* 11 *of parcels of each*
42

Rem. (28) *pounds*

Reduction Liquid Measure.

Queſt. 19. In 45 *Tun* of Wine, how many *Gallons*? Multiply by 4, and by 63 the product is 11350 Gallons for the Anſwer.

45
4
180
63
540
1080

Facit 11340 *gallons*

Queſt. 20. In 43 Rundlets of Wine, each containing Gallons, I demand how many Hogſheads?
Firſt, Find how many Gallons is in the 34 Rundlets, which you may do if you multiply 34 by 18, the content of a Rundlet, and the Product is 612 Gallons, which

which you may reduce into Hogſheads if you divide them by 63, and the Quote will be 9 Hogſheads, and 45 Gallons. See the Work.

34
18

272
34
---
63) 612) 9 *Hhds.*
567

Remain (45) *gallons*

facit 9 *Hhds* 45 *gallons*

Queſt. 21. In 12 Tun how many Runlets of 1[illegible] Gallons *per* Runlet?

Reduce your Tuns into Gallons, and divide them by 14, the Gallons in a Runlet, and the Quotient (21[illegible] is your Anſwer. See the Work following.

12
4

48
63

144
288
---
14) 3024 (216 *rundl.*
28

28
14

84
84
---
(0) *facit* 216 *runlets*

Reduct

Reduction of Long Measure.

Queſt. 22. I demand how many Fulongs, Poles, Inches and Barley Corns will reach from *London* to *York*, being accounted an 151 Miles?

151 *miles*
8 *furlongs in a mile*

1202 *furlongs*
40 *poles in a furlong*

48320 *poles*
11 *half yards*

48320
48320

531520 *half yards*
18 *inches in half a yard*

4252160
531520

9567360 *inches*
3 *barley corns in an inch*

Facit 28702080 *barley corns in* 151 *miles*

Queſt. 23. The Circumference of the Earth (as all other Circles are) is divided into 360 Degrees, and each degree into 60 Minutes, which (upon the Superficies of the Earth) are equal to 60 miles; now I demand how many Miles, Furlongs, Perches, Yards, Feet, and Barly-Corns will reach round the Globe of the Earth?

360 *degrees*
60 *minutes or miles in a degree*

21600 *miles about the Earth*
8 *furlongs in a mile*

172800 *furlongs about the Earth*
40 *perches in a furlong*

6912000 *poles or perches about the Earth*
11 *half yards in a perch*

6912000
6912000

2) 76032000 *half yards about the Earth*

(38016000 *yards*, viz. *the half yards*
3 *divided by* 2.

114048000 *feet about the Earth*
12 *inches in a foot*

228096000
114048000

1368576000 *inches about the Earth*
3 *barly-corns in an inch*

facit 4105728000 *barly-corns*

And so many will reach round the World, the whole being 21600 Miles, so that if any Person were to go Round, and go 15 Miles every Day, he would go the whole Circumference in 1440 Days which is 3 Years 11 Months, and 15 Days.

Reduction of Time.

Queſt. 24. In 28 Years, 24 Weeks, 4 Days, 16 Hours, 30 Minutes, how many Minutes?

years	*weeks*	*days*	*hours*	*min.*
28	24	4	16	30

52 *Weeks in a year.*

60
142

1489 *Weeks*
7

10364 *Days*
24

41462
20729

248752 *Hours*
60

14925150 *minutes*

Note, That in Reſolving the laſt Queſtion after the method expreſſed, there is loſt in every year 30 hours, for the Year conſiſteth of 365 Days and 6 hours, but by multiplying the Years by 52 Weeks, which is but 364 Days; You loſe 1 Day and 6 Hours every Year, wherefore to find an exact Anſwer, bring the odd Weeks, Days, and Hours into Hours, and then multiply the Years by the Number of Hours in a Year, *viz.* 8766, and to the Product add the hours contained in the odd time, and you have the whole time in hours, which bring into Minutes as before. See the laſt Queſtion thus reſolved.

weeks days hours
24—4—16
7

	days, hours	172
28	365—6	24
8766	24	
		694
172	1466	345
172	730	
197		4144 *hours*
228	8760 *hours in a year*	

249592 *hours*
60

14975510 *Minutes in* 28 *years and* 4144 *hou*

So you see that according to the Method first u
to resolve this Question, the Hours contained in t
given time are 248752, but according to the last, bo
or true Method, they are 249592 which exceeds t
former by 840 hours.

But for most occasions it will be sufficient to m
tiply the given years by 365, and to the Product a
the days in the odd time, if there be any, and th
there will be only a loss of 6 hours in every ye
which may be supplied by taking a fourth part of 1
given years, and adding it to the contained days, a
you have your desire.

Quest. 25. In 438657540 Minutes, how many ye
Facit 834 *years*, 4 *days*, 19 *hours*.

87

8766) *yea. days hou.*
) 43865754|0 (7310959 (834——4——19
42 70128
18 29815
18 26298
6 35179
6 35064
57 *days*
54 24) 115 (4
35 96
30 *Rem.* (19) *hours*
54
54
(0)

Quest. 26. I desire to know how many hours and utes it is since the Birth of our Saviour Jesus Christ his present year, being accounted 1677 years? his Question is of the same nature with the 24*th.* going and after the same manner is resolved, *viz*, tiply the given number of years by 8766, the pro- is 14700582 hours, and that by 60, and the pro- is 882034920 Minutes. See the work.

1677 *years*
8766 *hours in a year*

10062
10062
11739
13416

14700582 *hours in* 1677
60

882034920 *minutes* in 1677 *years*

Note that as Multiplication and Diviſion do int changeably prove each other, ſo Reduction Deſcend and Aſcending, prove each other by Inverting Queſtion, as the 13 and 14, and likewiſe the 16 17 Queſtions foregoing, by Inverſion, do int changeably prove each other, the like may be formed for the proof of any Queſtion in Reduct whatſoever.

Thus far have we diſcourſed concerning ſingle Ar metick, whoſe Nature and Parts are defined in ſecond, eighth, ninth, and tenth definitions of third Chapter of this Book, for although Reductio not reckoned or defined among the parts of ſi Arithmetick, yet conſidered Abſtractly, it is the pr effect of Multiplication and Diviſion; and as for extraction of Roots (which ought to be handle the next place as parts of ſingle Arithmetick) we omit it in this place, and refer the Learner to Mr. *Co* Decimal Arithmetick, which is (with great care pains) now publiſhed, together with his Logarit tical Arithmetick, ſhewing the Geneſis or Fa of the Logarithms, and their general uſes in A metick, *&c.* As alſo his Algebraical Arithmetick, taining the Doctrine of compoſing and reſolvi Equation, with all other Rules neceſſary for th derſtanding of that Myſterious Art, *&c.*

CHAP. IX.

Of Comparative Arithmetick, viz. *The tion of* Numbers *one to another.*

1. COmparative Arithmetick is that wh wrought by Numbers, as they are conſidered to have relation one to another, and this conſiſts either in Quantity, or in Quality. *Boetius lib.* 1.

2. R

2. *Relation* of Numbers in Quantity, is the *Refe-*
nce or *Reſpect*, that the Numbers
emſelves have one to another, *Vide Wing. A-*
ere the Terms or Numbers pro- *rith. cap.* 34.
unded are always two, the firſt
led the Antecedent, and the other the Conſequent.

3. The *Relation* of Numbers in Quantity conſiſts in
Differences, or in the rate or reaſon that is found
twixt the Terms propounded, the difference of two
mbers being the *Remainder* found
Subſtraction, but the rate or reaſon *Alſted. Mathe-*
twixt two Numbers is the Quotient *mat.lib.* 2. *cap.*
the Antecedent divided by the Con- 11. *&* 12.
uent. So 21 and 7 being given,
difference betwixt them will be found to be 14,
the rate or reaſon that is betwixt 21 and 7 will be
nd to be triple reaſon, for 21 divided by 7 quotes
the reaſon or rate.

4. The relation of Numbers in Quality, (otherwiſe
led Proportion) is the *Reference* or *Reſpect* that
Reaſon of Numbers have one unto another; there-
e the Terms given, ought to be more
n two. Now this Proportion or *Alſted Math.*
aſon between Numbers relating one *lib.* 2 *cap.* 21.
another, is either Arithmetical, or
ometrical.

5. Arithmetical Proportion (by ſome called Pro-
ſſion) is when divers Numbers differ one from ano-
r by equal *Reaſon*, that is, have equal differences.
So this *Rank* of Numbers 3, 5, 7, 9, 11, 13, 15, 17,
fer by equal *Reaſon*, *viz.* by 2 as you may prove.

2. In a *Rank* of Numbers that differ by Arithmeti-
Porportion, the ſum of the firſt and laſt term be-
multiplyed by half the Number of Terms, the pro-
t is the total ſum of all the Terms.

Or if you multiply the number of the Terms by the
ſum of the firſt and laſt Terms, the product
reof will be the total ſum of all the Terms.

So in the former Progreſſion given, 3 and 17 is 20,
ich multiplyed by 4 (*viz.* half the number of Terms)

the product gives 80, the ſum of all the Terms; multiply 8 (the Number of Terms) by 10 (half t ſum of the firſt and laſt Terms) the product gives as before.

So alſo 21, 18, 15, 12, 9, 6, 3, being given, t ſum of all the Terms will be found to be 84; for h the Number of Terms is 7, and the ſum of the fi and laſt (*viz.* 21 and 3) is 24, half whereof, (*viz.* multiplyed by 7 produceth 84, the ſum of the Ter ſought.

7. Three Numbers that differ by Arithmetical P portion, the double of the mean (or middle numb is equal to the ſum of the Extreams.

So 9, 12, and 15 being given, the double of mean 12 (*viz.* 24) is equal to the ſum of the Extre 9 and 15.

8. Four Numbers that differ by Arithmetical P portion (either continued or interrupted) the ſum the two Means is equal to the ſum of the two treams.

So 9, 12, 18, 21, being given, the ſum of 12 and 18 will be equal to the ſum of 9 and 21, *viz.* 30.; alſo 6, 8, 14, 16, being given, the ſum of 8 and 14, is equal to the ſum of 6 and 16, *viz.* 22, *&c.* *Vide Wingate rith. cap.*

9. Geometrical Proportion (by ſome called Geo trical Progreſſion) is when divers numbers differ cording to like Reaſon.

So 1, 2, 4, 8, 16, 32, 64, *&c.* differ by double ſon, and 3, 9, 27, 81, 243, 729, differ by triple ſon, 4, 16, 64, 256, *&c.* differ by quadruple ſon, *&c.*

10. In any numbers that increaſe by Geomet proportion, if you multiply the laſt Term by the tient of any one of the terms divided by anoth the Terms, which being leſs is next unto it, and h deducted, or ſubſtracted, the firſt Term out of Product, divide the remainder by a number that unit leſs than the ſaid Quotient, the laſt quot give the ſum of all the Terms.

o, 1, 2, 4, 8, 16, 32, 64, being
n, first I take one of the Terms,
8, and divide it by the Term
ch is less and next to it, (*viz.*
1) and the Quotient is 2, by
ch I multiply the last term 64,
the product is 128, from whence
bstract the first term (*viz.* 1.)

64
4) 8 (2
128
1
1) 127 (127

Remainder is 127, which divided by the Quotient
ade less by 1 (*viz.* 1.) the quote is 127, for the sum
ll the given *terms*, as by the Work in the Margent.

o if 4, 16, 64, 256, 1024, were given, the sum
ll the *terms* will be found to be
4. For first, I divide 64 one of
terms by his next lesser term,
the Quotient is 4, by which I
tiply the last term 1024, and it
duceth 4096; from whence I
tract the first term 4, and the
ainder is 4092, which I divide
he quote less 1 (*viz.* 3) and the
te is 1364, for the total sum of all the Terms, as
Margent.

1024
16) 64 (4
4096
4
3) 4092 (1364

o likewise if 2, 6, 18, 54, 162,
, were given the Sum or Total
ll the Terms will be found to
28. See the Work.

486
6) 18 (3
1458
2
2) 1456 (728

1. Three Geometrical Propor-
als given, the Square of the
n is equal to the Rectangle, or
duct of the Extreams.

o 8, 16, 32 being given, the Square of the Mean,
16 is 256, which is equal to the Product of the
reams 8 and 32, for 8 times 32 is equal to 256.

2. Of 4 Geometrical Proportional numbers given,
Product of the two Means is equal to the Product
he two Extreams.

o 8, 16, 32, 64, being given, I say that the pro-
t of the two Means, *viz.* 16 times 32, which is 512
qual to 8 times 64, the product of the Extreams.

Also if, 3, 9, 21, 69, were given (which are interrupted) I say 9 times 21 is equal to 3 times 63, which is equal to 189.

From hence ariseth that precious Gem in Arithmetick, which for the Excellency thereof is called the *Golden Rule*, or *Rule of Three*,

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CHAP. X.

The Single Rule of Three Direct.

1. THE Rule of Three (not undeservedly call'd the Golden Rule) is, that by which we find out a fourth *number*, in *proportion* unto *three* given *Numbers*, so as this *fourth Number* sought may bear the same Rate, Reason, or Proportion to the *third* (given) *number*, as the second doth to the first, from whence it also called the Rule of *Proportion*.

2. Four *Numbers* are said to be *Proportional*, when the first containeth or is contained by the second, as often as the third containeth, or is contained by the fourth. *Vide Wingates Arith. Chap.* 8 *Sect.* 4.

So these *numbers* are said to be *Proportionals*, *viz.* 3, 6, 9, 18, for as often as the first *number* is contained in the second, so often is the third contained in the fourth, *viz.* twice. Also 9, 3, 15, 5, are said to be *Proportional*, for as often as the first *number* containeth in the second, so often the third *number* containeth the fourth, *viz.* 3 times.

3. The Rule of Three is either simple or composed.

4. The simple (or single) Rule of *Three*, consisteth of 4 *numbers*, that is to say, it hath 3 *numbers* given to find out a fourth; and this is either Direct, or Inverse. *Vide Alsted. Math. lib.* 2. *cap.* 13.

5 The single Rule of *Three direct*, is when the *Proportion* of the first *term* is to the second, as the third to the fourth; or when it is required that the *number* sought

ght (*viz.*) the fourth *Number* muſt have the ſame portion to the ſecond, as the third hath to the firſt.

. In the Rule of *Three*, the greateſt difficulty is er the Queſtion is propounded) to diſcover the of the 3 *terms*, *viz.* which is the firſt, which e ſecond, and which the third, which that you may erſtand, obſerve, That (of the three given *numbers*) are always of one kind, and the other is of the e kind with the *Proportional number* that is ſought; n this Queſtion, *viz.* If 4 yards of Cloth coſt 12 lings, what will 6 yards coſt at that Rate? Here the *numbers* of one kind are 4 and 6, *viz.* they both ifie ſo many yards; and 12 ſhillings is the ſame kind h the *number* ſought, for the price of 6 yards is ght.

Again, obſerve, that of the 3 given *numbers*, thoſe that are of the ſame kind, one of them muſt be the t, and the other the third, and that which is of the e kind with the *number* ſought, muſt be the ſecond *nber* in the Rule of *Three*; and that you may know ich of the ſaid *numbers* to make your firſt, and ich your third, know this, that to one of thoſe *numbers* there is always affixed a demand, and that *nber* upon which the demand lieth muſt always be koned the third *number*. As in the forementioned eſtion, the demand is affixed to the *number* 6, for it demanded what 6 yards will coſt? and therefore 6 uſt be the third *number*, and 4 (which is of the ſame nomination (or kind) with it) muſt be the firſt, and nſequently the *number* 12 muſt be the ſecond, and n the *numbers* being plac'd in the forementioned or- r will ſtand as followeth, *viz.*

yards	*s.*	*yards*
4	12	6

7. In the Rule of *Three Direct* (having placed the *nbers* as is before directed) the next thing to be done ll be to find out the fourth *number* in proportion, hich (that you may do) multiply the ſecond *number*

by the third, and divide the product thereof by the first, (or which is all one) multiply the third *term* (or number) by the ſecond, and divide the product thereof by the firſt, and the Quotient thence ariſing is the 4th *number* in a direct proportion, and is the *number* ſought or Anſwer to the queſtion, and is of the ſame denomination that the ſecond *number* is of. As thus, let the ſame queſtion be again repeated, *viz.* If 4 yards of Cloth coſt 12 ſhillings, what will 6 yards coſt?

Having placed my *numbers* according to the 6th Rule (of this Chapter) foregoing, I multiply (the ſecond *number*) 12, by (the third *number*) 6, and the Product is 72, which Product I divide by (the firſt *number*) 4, and the quotient thence ariſing is 18, which is the fourth *Proportional* or *number* ſought, *viz.* 18, ſhillings, (becauſe the ſecond *number* is ſhillings) which is the price of the 6 yards, as was required by the queſtion. See the Work following.

yds.	*s.*	*yds.*	*s.*
If 4	12	6	18

6

4) 72 (18 *ſhillings*

4

32

32

(0)

Queſt. 2. Another Queſtion may be this, *viz.* If 7 *C.* of *Pepper* coſt 21 *l.* how much will 16 *C.* coſt at that Rate?

To reſolve which queſtion, I conſider that (according to the 6th Rule of this Chapter) the *terms* or *numbers* ought to be placed thus, *viz.* the Demand lying upon 16 *C.* it muſt be the third *number*, and that of the ſame kind with it muſt be the firſt, *viz.* 7 *C.* and 21 (being of the ſame kind with the *number* ſought) muſt be the ſecond *number* in this queſtion; then I proceed according

cording to this 7th Rule, and multiply the second *number* or the third, *viz.* 21 by 16, and the Product is 336, which I divide by the first *number* 7, and the Quotient is 48 *l.* which is the value of 16 *C.* of Pepper at the rate of 21 *l.* for 7 *C.* See the Work following.

C.	l.	C.
If 7	21	16

16

126

21

l.

7) 336 (48

28

56

56 *facit* 48 *l.*

(o)

8. If when you have divided the Product of the second and third numbers by the first, any thing remain after Division is ended, such Remainder may be multiplyed by the parts of the next inferiour Denomination, that are equal to an Unit (or Integer) of the second number in the Question, and the Product thereof divide by the first number in the Question and the Quotient is of the same Denomination with the parts by which you multiplyed the Remainder, and is part of the fourth number which is sought. And furthermore, if any thing remain, after this last Division is ended, multiply it by the parts of the next inferiour denomination equal to an Unit of the last Quotient, and divide the Product by the same Divisor (*viz.* the first number in the Question) and the quote is still of the same denomination with your Multiplyer; follow this method until you have reduced your Remainder into the lowest Denomination, &c. An Example or two will

will make the Rule very plain, which may be this following.

Queſt. 3. If 13 yards of Velvet (or any other thing) coſt 21 *l.* what will 27 yards of the ſame coſt at that Rate?

Having ordered and wrought my Numbers according to the 6 and 7 Rules of this Chapter, I find the Quotient to be 43 *l.* and there is a Remainder of 8, ſo that I conclude the price of 27 *yards* to be more than 43 *l.* and to the intent that I may know how much more, I work according to the foregoing Rule, *viz.* I multiply the ſaid Remainder 8 by 20 *s.* (becauſe the ſecond number in the Queſtion was Pounds) and the product is 160, which divided by the firſt number, *viz.* 13, it quotes 12, which are 12 ſhillings, and there is yet a Remainder of 4, which I multiply by 12 pence, (becauſe the laſt quotient was ſhillings) and the product is 48, which I divide by 13 (the firſt number) and the Quotient is 3 *d.* and yet there remaineth 9, which I multiply by 4 *farthings*, and the product is 36, which divided by 13 again, it quotes 2 *farthings*, and there is yet a remainder of 10, which (becauſe it cometh not to the value of a *farthing*) may be neglected, or rather ſet (after the 2 *farthings*) over the diviſor, with a Line between them, and then (by the 21 and 22 Definitions of the firſt Chapter of this Book) it will be $\frac{10}{13}$ of a *farthing*; ſo that I conclude, that if 13 *yards* of Velvet coſt 21 *l.* 27 *yards* of the ſame will coſt 43 *l.* 12 *s.* 03 *d.* $2\frac{10}{13}$ *qrs.* which Fraction is 10 thirteenths of a *farthing*. See the Operation as followeth.

yds. l. yds.
If 13 —— 21 —— 27
27

147
42

13) 567 (43 l. pounds
52

47
39

Remains (8)
Multiply 20

13) 160 (12 shillings
13

30
26

Remains (4)
Multiply 12

13) 48 (3 d. pence
39

Remains (9)
Multiply 4

—— qrs. farthings
13) 36 (2 $\frac{10}{13}$
26

l s. d. qrs.
Remains 10 facit 43—12—3 $2\frac{10}{13}$

Queſt. 4. Another Example may be this following, If 14 l. of *Tobacco* coſt 27 s. what will 478 l. coſt at that rate?

Work according to the laſt Rule, and you will find it to amount to 921 s. 13 d. $1\frac{3}{4}$ qrs. and by the 5th Rule

Rule of the 8*th*. Chapter 921 *s*. may be reduced to 46 *l*. 01 *s*. So that then the whole worth or value of the 478 *l*. will be 46 *l*. 01. *s* 10 *d*. 1 $\frac{2}{4}$ *qrs*. the whole Work followeth.

l. *s*. *d*.

If 14—27—478

27

3346
956

14) 12906 (921
....
126

30
28

2|0) 92|4 (46
..
8

26
14

12 *Remains* (12)
12 *Multiply* 12

01

24
12

14) 144 (10
..
14

Remains 4
Multiply 4

qrs.

4) 16 ($1\frac{2}{4}$
14

Rem. (2)

l. *s*. *d*. *qrs*.

Facit 46—01—10—$1\frac{2}{4}$

9 11

9. In the Rule of Three it many times happeneth, at although the first and third numbers be Homoge- al (that is, of one kind) as both Money, Weight, easure, *&c.* yet they may not be of one denomina- n, or perhaps they may both consist of many deno- inations, in which case you are to reduce both num- rs to one denomination; and likewise your second mber (if it consisteth (at any time) of divers deno- inations) must be reduced to the least name menti- ed, or lower if you please, which being done, mul- ply second and third together, and divide by the first, is directed in the *7th* Rule of this Chapter.

And note that always the Answer to the Question is the same denomination that your second number of, or is reduced to, as was hinted before.

Quest. 5. If 15 Ounces of Silver be worth 3 *l.* *s.* what are 86 Ounces worth at that Rate?

n this Question the numbers being ordered accord- g to the *6th* Rule of this Chapter, the first and third mbers are ounces, and the second number is of divers nominations, *viz.* 3 *l.* 15 *s.* which must be reduced shillings, and the shillings multiplyed by the third mber, and the product divided by the first, gives u the answer in shillings, *viz.* 430 shillings, which reduced to 21 *l.* 10 *s.* See the Work.

oz.	*l.*	*s.*	*oz.*
If 15	3	15	86

20

75
86

450
600

2|0) l. s.

15) 6450 (43|0 21.—10

60 4

45 3
45 2

(0) (10) *shillings*

In

In resolving the last Question, the Work would have been the same, if you had reduced your second number into pence, for then the Answer would been 5160 pence, equal to 21 *l.* 10 *s.* or if you had reduced the second number into farthings, the Quotient or Answer would have been 20640 farthings equal to the same, as you may prove at your leisure.

Quest. 6. If 8 *l.* of Pepper cost 4 *s.* 8 *d.* what will 7 *C.* 3 *qrs.* 14 *l.* cost?

In this Question the first *number* is 8 *l.* and the third is 7 *C.* 3 *qrs.* 14 *l.* which must be reduced to the same denomination with the first, *viz.* into pounds, and the second *number* must be reduced into pence; then multiply and divide according to the 7*th.* Rule foregoing, and you will find the Answer to be 6174 pence, which is reduced into 25 *l.* 14 *s.* 6. *d.*

l. s. d. C. qrs. l.

If 8 *cost* 4—8— *what will* 7—3—14 *cost?*

12 4

56 31

28

252

63

882

56 *second number*

5292

4410

12) 2|0) l.

8) 49392 (6174 (51|4 (25

48 60 4

13 17 11

8 12 10

59 54 14 *shillings*

56 48

32 (6) *pence*

32

l. s. d.

(o) *Facit* 25—14—6

Quest.

eſt. 7. If 3 *C.* 1 *qr.* 14 *l.* of Raiſins coſt 9 *l.* 9 *s.* will 6 *C.* 3 *qrs.* 20 *l.* of the ſame coſt?

re the firſt and third numbers each conſiſt of di-lenominations, but muſt be brought both into lenomination, *&c.* as you ſee in the Operation h followeth; the Anſwer is 388 *s.* which is re-l into 19 *l.* 8 *s.*

C.	qr.	l.		l.	s.		C.	qrs.	l.
3	1	14	*coſt*	9	9	*what will*	6	3	20 *coſt?*
4				20			4		
13				189			27		
28							28		
08							216		
27							56		
78 *pounds*							776 *pounds*		
							189 *ſecond number*		
6984									
6208									
776									

2|0) l. d.
378) 146664 (388 19—8
.... 2
1134
18
3326 18
3024
(08) *ſhillings*
3024
3024 l. s.
facit 19—8
(o)

ſt. 8. If in 4 *weeks* I ſpend 13 *s.* 4. *d* how long 3 *l.* 6 *s.* laſt me at that rate?

wer 2238 *days* equal to 6 *years*, 48 *days*. See *Work.*

If

s. d. *w.* *l. s.*
If 13—4 *require* 4 *what will* 53—06 *cost?*

12 7 20

30 28 *days* 1066
13 12

160 *pence* 2132
1066

12792 *pence*
28 *second number*

102336
25584

(365
16|0) 35817|6 (2238 (6 *years*
2190

32 *Rem.* (48) *days*
38
32

61 *ye. days*
48 *fac.* 6—48 $\frac{96}{160}$

137
128

Remains (96)

Quest. 9, Suppose the yearly Rent of a House, yearly Pension, or Wages be 73 *l.* I desire to know how much it is *per* day?

Here you are to bring the year into days, and if 365 days require 73 *l.* what will one day require?

Now when you come to multiply 73 by 1, the product is the same, for 1 neither multiplyeth nor divideth, and 73 cannot be divided by 365, because

Div

isor is bigger than the Dividend, wherefore bring 73 *l.* into ſhillings, and they make 1460, which ide by the firſt number 365, and the quote is 4 llings for the Anſwer, as you ſee in the Work.

days *l.* *day*
If 365 — 73 — 1
20

365) 1460 (4 *s.*
1460 *facit* 4 *s. per* Day

(o)

Queſt. 10. A Merchant bought 14 pieces of Broad th, each piece containing 28 yards, for which he e after the Rate of 13 *s.* 6½ *d. per* yard, now I re to know how much he gave for the 14 pieces hat Rate?

irſt, Find out how many yards are in the 14 pie- which you will do if you multiply the 14 pieces 28 (the number of yards in a piece) and it makes ; then ſay, If 1 yard coſt 13 *s.* 6 ½ *d.* what will yards coſt? Work as followeth; and the Anſwer will find to be 127400 half-pence, which reduced e 265 *l.* 8 *s.* 4 *d.* For after you have multiplyed r ſecond and third Numbers together, the Product 27400, which (according to the ſeventh Rule) ld be divided by the firſt number, but the firſt ber is 1, which neither multiplyeth nor divideth, therefore the Quotient or fourth number is the e with the Product of the ſecond and third, which n half-pence, becauſe the ſecond number was ſo ced. See the Work, as followeth.

28
14

112
28

392 *yards in the* 14 *pieces.*

yard	*s.*	*d.*		*yards*
If 1 *coſt*	13	—6½	*what will*	392 *coſt?*
	12			325 *the ſecond number*
	32			1960
	13			784
	162			1176
	2			2|0 *l.*
half-pence	325			24) 127400 (530|8 (265|6
				120 4
				74 13
				72 12
				200 10
	l.	*s.*	*d.*	10
Facit	265	—8—	4	192
				(0) *ſhillings*

Rem. (8) ½ *pence*, or 4 *d.*

Queſt. 11. A Draper bought 420 *yds* of broad-cloth and gave for it after the Rate of 14 *s.* 10 *d.*¾ *per* E *Engliſh*, now I demand how much he paid for th whole at that Rate?

Bring your Ell into quarters, and your given yar into quarters, the Ell is 5 quarters, and in 420 yar are 1680 quarters, then ſay, If 5 quarters coſt 14 10 ¾ *d.* (or 715 *farthings*) what will 1680 quarte coſt? *facit* 250 *l.* 0 5*s.* 00 *d.* See the Operation.

Ell	Yards
1	420
5	4
5 qrs.	1680 qrs.

qrs. s. d. s.
If 5 — 14 — 10¾ — 1680

12	715
28	8400
15	1680
	11760
178 d.	96|0) l.
4	5) 1201200 (24024|0 (250
715 qrs.	10 192
l. s. d.	20 482
Excit 250—5—00	20 480

12 Rem. (240) qrs. or 5s.
10

20
20

(0)

Quest. 12. A Draper bought of a Merchant 50 pieces of Kerseys, each piece containing 34 Ells *Flemish*, (the Ell *Flemish* being 3 quarters of a yard) to pay him after the Rate of 8 *s.* 4 *d.* *per* Ell *English*, I demand how much the 50 pieces cost him at that rate?

First, Find how many Ells *Flemish* are in the 50 pieces, by multiplying 50 by 34, the product is 1700, which bring into quarters by 3, it makes 5100 quarters: then proceed, as in the last Question, and the Answer you will find to be 102000 pence, or 425 *l.* Behold the Operation, as followeth.

If

qrs. s. d. *qrs.*

If 5—8—4——5100 50

12 100 34

d.

110*d.* 5) 510000 (102000 200

150

5 1700 *Ells Flem.*

10 3

10

5100 *quarters*

(0) 2|0) *l.*

12) 102000 (8|50|0 (425

96 8

60 5

60 4

(0) 10

10

Facit 425 *pound* (0)

Queſt: 13. A Goldſmith bought a Wedge of Gold which weighed 14 *l.* 3 *oz.* 8 *p.w.* for the Sum of 514 *l.* 4 *s.* I demand what it ſtood him in *per* Ounce? Anſwer 60 ſhillings, or 3 *l.* See the Work.

lb. *oz.* *p.w.* *l.* *s.* *oz.*

If 14——3——8——514——4——1

12 20 *ſhillings* 20

31 10284 *ſhillings* 20*p.w.*

14 20 *p.w.*

2|0)

171 *oz.* 3428) 205680 (6|0 (3 *l.*

20 6

20568 *s.*

3428 *p.w.* (0) *facit* 60 or

(0) *Que*

Queſt. 14. A Grocer bought 4 *hhds* of Sugar, each ighing near 6 *C.* 2 *qrs.* 14 *l.* which coſt him 2 *l.* . 6 *d. per C.* I demand the value of the 4 *hhds* at at rate?

Firſt, Find the weight of the 4 *hhds*, which you may by reducing the weight of one of them into pounds d multiply them by 4 (the Number of *hhds*) and ey make 2968 *l.* then ſay, If 1 *C.* or 112. *l.* coſt . 8 *s.* 6 *d.* what will 29 68 *l.* coſt? *Facit* 64 *l.* 5 *s.* *d.* As by the Operation.

C.	*qrs.*	*l.*
6	2	14
4		
26		
28		
212		
53		

472 *l. in* 1 *hhd.*
4 *hogſheads*

2968 *l. in* 4 *hhds.*

l.	*l.*	*s.*	*d.*	*l.*
If 112	2	8	06	2968
20				582
48				5936
12				23744
102				14840
48				
582				

12) 2|0) *l.*

112) 1727376 (15423 (128| 5 (64

112	12	12
607	34	8
560	24	8
473	102	(05) *ſhillings*
448	96	
257	03	
224	60	
336	(3) *pence*	
336		
(0)		

l.	*s.*	*d*
Facit 64	5	3.

Queſt.

Queſt. 15. A Draper bought of a Merchant 8 pack of Cloth, each pack containing 4 parcels, and each parcel 10 pieces, and in each piece 25 yards, and gave after the *Rate* of 4 *l.* 16 *s.* for 6 yards, now I deſire to know how much he gave for the whole? *Anſwer*, 6656 *l.*

Firſt, Find out how many yards there were in the 8 packs, as by the following work you will find there are 8320 yards; then ſay if 6 yards coſt 4 *l.* 16 *s.* what will 8320 yards coſt, *&c.*

8 *packs*
4

32 *parcels*
10

320 *pieces*
26

1920
640

8320 *yds*

yds.	*l.*	*s.*	*yds.*
If 6	4	16	8320
20			96
96			49920
			74880
			2|0)
6)	798720	(	133|12|0(6656
	6		12
	19		13
	18		12
	18		11
	18		10
	07		12
	6		12
	12		(0)
	12		

Facit 6656 *l.*

(0)

By this time the Learner is (I suppose) well exercid in the Practick and Theorick of the Rule of Three irect, but at his leisure he may look over the follow- g Questions, whose Answers are given, but the ope- tion purposely omitted as a Touchstone for the earner, thereby to try his Ability in what hath been livered in the former Rules.

Quest. 16. If 24 *l.* of *Raisins* cost 6 *s.* 6 *d.* what will 3 Frails cost, each weighing Neat 3 *qrs.* 18 *l.* *Answer* 4 *l.* 17 *s.* 03 *d.*

Quest. 17. If an Ounce of *Silver* be worth 5 shil- ngs, what is the price of 14 Ingots, each Ingot eighing 7 *l.* 5 *oz.* 10. *p.w.*? *Answer* 313 *l.* 5 *s.*

Quest. 18. If a piece of Cloth cost 10 *l.* 16. *s.* 8 *d.* demand how many Ells *English* there are in the me, when the Ell at that rate is worth 8 *s.* 4 *d.* ? nsw. 26 Ells *English.*

Quest. 19. A Factor bought 84 pieces of Stuffs, hich cost him in all 537 *l.* 12 *s.* at 5 *s.* 4 *d. per* yar. demand how many Yards there were in all, and w many Ells *English* were contained in a piece of e same? *Answer* 2216 Yards in all, and $19\frac{1}{3}$ Ells *glish per* piece.

Quest. 20. A Draper bought 242 yards of Broad- oth, which cost him in all 254 *l.* 10 *s.* for 86 yards, which he gave after the rate of 21 *s.* 4 *d. per* yard, demand how many he gave *per* yard for the Remain- r? *Answ.* 20 *s.* 10 *d.* $\frac{64}{86}$ *per* yard.

Quest. 21. A Factor bought a certain quantity of rge and Shalloon, which together cost him 26 *l.* 14 *s.* *d.* the quantity of Serge he bought was 48 yards 3 *s.* 4 *d. per* yard, and for every two yards of Serge had 5 yards of Shalloon, I demand how many rds of Shalloon he had, and how much the Shalloon st him *per* yard? *Answ.* 120 yards of Shalloon at 1 *l.* 5 *s.* 05 $\frac{18}{20}$ *d. per* yard.

Quest. 22. An Oyl-man bought 3 Tun of Oyl, which st him 151 *l.* 34 *s.* and it so chanced that it leaked t 85 gallons, but he is minded to sell it again, so as at he may be no loser by it, I demand how he must

muſt ſell it *per* gallon? *Anſwer*, at 4 *s.* $6\frac{174}{671}$ *d.* *gallon.*

Queſt. 23. Bought 6 packs of Cloth, each pack co taining 12 Cloths, which at 8 *s.* 4 *d.* *per Ell Flem* coſt 1080 *l.* I demand how many yards there were each Cloth? *Anſwer* 27 yards in each Cloth.

Queſt. 24. A Gentleman hath 536 *l.* *per annum*, a his Expences are one day with another 18 *s.* 10 3 *qrs.* I deſire to know how much he layeth up the years end? *Anſwer* 191 *l.* 3 *s.* 0 *d.* 1 *qr.*

Queſt. 25. A Gentleman expendeth daily one d with another 27 *s.* $10\frac{1}{2}$ *d.* and at the years end la eth up 340 *l.* I demand how much is his yearly I come? *Anſwer* 848 *l.* 14 *s.* 4 *d.* $\frac{1}{2}$.

Queſt. 26. If I ſell 14 yards for 10 *l.* 10 *s.* 00 how many Ells *Flemiſh* ſhall I ſell for 283 *l.* 17 *s.* 6 at that rate? *Anſwer* $50\frac{2}{3}$ Ells *Flemiſh.*

Queſt. 27. If 100 *l.* in 12 Months gain 6 *l.* In reſt, how much will 75 *l.* gain in the ſame time, a at the ſame rate? *Anſwer* 4 *l.* 10 *s.*

Queſt. 28. If 100 *l.* in 12 Months gain 6 *l.* Im reſt, how much will it gain in 7 Months at that rat *Anſwer* 3 *l.* 10 *s.*

Queſt. 29. A certain Uſurer put out 75 *l.* for Months, and received Principal and Intereſt 81 *l* demand what rate *per Cent.* he received Intereſt? *ſwer*, 8 *l.* *per Cent.*

Queſt. 30. A Grocer bought 2 Cheſts of Sugar, one weighed neat 17 *C.* 3 *qrs.* 14. *l.* at 2 *l.* 6 *s.* 8 *per C.* the other weighed neat 18 *C.* 1 *qr.* 21 *l.* at $4\frac{1}{2}$ *per l.* which he mingleth together, now I deſire know how much a *C. weight* of this mixture is wort *Anſwer* 2 *l.* 4 *s.* 3 *d.* $2\frac{56}{40}\frac{59}{67}$ *qrs.*

Queſt. 31. Two men. *viz. A* and *B.* departed b from one place, the one goes Eaſt, and the other W the one travelleth 4 miles a day, the other 5 mile day, how far are they diſtant the 9*th.* day after th departure? *Anſwer* 81 *miles.*

Q

Queſt. 32. *A* flying every day 40 miles is purſued the 4*th* day after by *B*, poſting 50 miles a day, now the Queſtion is in how many days, and after how many miles Travel will *A* be overtaken ?

ore's Arithm. ap.8. Queſt.7.

ſwer, *B* overtakes him in 32 days, when they have velled 600 miles.

11. The general Effect of the Rule of Three Di-ct, is contained in the definition of the ſame, that is, find a fourth Number in proportion conſiſting of o equal Reaſons, as hath been fully ſhewn in all the regoing Examples.

The ſecond Effect is, by the price or value of one ng to find the price or value of many things of like nd.

The third Effect is, by the price or value of many ngs to find the price of one, or by the price of ny things (the ſaid price being 1) to find the price many things of like kind.

The fourth Effect is, by the price or value of many ings, to find the price or value of many things of e kind.

The fifth Effect is, thereby to reduce any Number Monys, Weight, or Meaſure, the one ſort into the ner, as in the Rules of *Reduction* contained in the ghth Chapter foregoing. Examples of its various fects have been already anſwered.

12. The Rule of 3 Direct is thus proved, *viz.* mul-ly the firſt Number by the fourth, l note the Product, then multi- the ſecond number by the third, l it this Product is equal to the oduct of the firſt and fourth, then work is rightly performed, otherwiſe it is erroneous. So the firſt Queſtion of this Chapter (whoſe An-er, or fourth number we found to be 18 *s.*) is thus ved, *viz.* the firſt number is 4, which multiplied 18 (the fourth) produceth 72. And the ſecond and rd numbers are 12 and 6, which multiplied toge-r produce 72, equal to the Product of the firſt and rth, and therefore I conclude the work to be right-performed.

The Proof of the Rule of Three Direct.

Always observing, that if any thing remain after you have divided the product of the second and third numbers, by the first, such remainder in proving the first must be added to the Product of the first and fourth *Numbers*, whose Sum will be equal to the Product of the second and third, (the second *number* being of the same denomination with the fourth, and the first of the same denomination of the third.)

So the Fourth Question of this Chapter [illegible] again repeated, *viz.* If 14 *l.* of Tobacco cost what will 478 *l.* cost at that Rate? The Answer (fourth *number*) was 46 *l.* 01 *s.* 10 *d.* 1 *qr.* $\frac{3}{7}$, which is thus proved, *viz.* bring the fourth *number* into *farthings*, and it makes 44249, which multiplyed by first *number* 14, produceth 619488 (the second which remaineth being added thereto) then (because I reduce my fourth *number* into *farthings*,) I reduce second (*viz.* 27 *s.*) into *farthings*, and they are which multiplyed by the third *number* 478, their duct is 619488 equal to the Product of the *first fourth Numbers*. Wherefore I conclude the Oper to be true. This is an infallible way to prove Rule of Three *Direct*, and it is deduced from the *Section* of the 9*th. Chapter* of this Book.

Thus much concerning the single Rule of *Direct*, and I question not but by this time the ner is sufficiently qualified to resolve any qu pertinent to this Rule, not relying upon *Fracti Geometrical Magnitudes*. Those that are desirous the Demonstration of this Rule, let them rea *sixth Chapter* of (the ingenious) Mr. *Kersey's* App to *Wingates* Arithmetick. Or the *sixth Chapter* *Oughtreds* (Incomparable) *Clavis Mathematicæ* both which Authors this Rule is largely demonst being grounded upon the 19*th. Prop.* of the 7*th.* the 19*th. Prop.* of the 9*th* of *Euclid. Elem.*

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CHAP. XI.

The Single Rule of Three Inverſe.

THE Golden Rule, or Rule of 3 Inverſe, is when there are 3 *Numbers* given to find a fourth, in proportion to the 3 given Numbers, ſo as the th proceeds from the ſecond, according to the Rate, Reaſon, or Proportion that the firſt pro- from the third, or the Proportion is, the third *number* is in propor- *Alſted. Math.* to the ſecond, ſo is the firſt to *lib. 2. cap.* 14. ourth.

if the 3 *numbers* given were 8, 12, and 16, and it required to find a fourth *number* in an inverted ortion to theſe, I ſay that as 16 (the third *Num-* is the double of the firſt *term* or *number* (8) ſo 12 (the ſecond *number*) be the double of the 1; ſo will you find the fourth *term* or *number* to And as in the Rule of 3 *Direct*, you multiply the d and third together, and divide their Product fourth *Proportional Number*.

In the Rule of 3 *Inverſe*, you muſt multiply the d *term* by the firſt (or firſt *term* by the ſecond) ivide the Product thereof by the third *term*, ſo the ent will give you the fourth *term* ſought in an In- l *Proportion*. The ſame order being obſerved in this as in the Rule of 3 *Direct*, for placing and di- g of the given *numbers*, and after your *numbers* aced in order, that you may know whether your ion be to be reſolved by the Rule *Direct* or *In-* obſerve the general Rule following.

When your Queſtion is ſtated, and your *numbers* y diſpoſed, Conſider in the firſt place whether urth *term* or *number* ſought, ought to be more than the ſecond *term*; which you may eaſily And if it is required to be more, or greater than cond *term*, then the leſſer *Extream* muſt be your r; but if it require leſs, then the biggeſt *Ex-*

tream must be your Divisor, (in this Case the fi
third *numbers* are called *Extreams* in respect of
cond,) and having found out your Divisor, yo
know whether your Question belong to the Rul
or *Inverse*; for if the third *term* be your Divisor
it is *Inverse*, but if the first *term* be your Divisor
it is a *Direct* Rule, As in the following Questi

Quest. 1. If 8 Labourers can do a ceartain p
work in 12 days, in how many days will 16
rers do the same? *Answer* in 6 days.

Having placed the *numbers* according to the
of the 10*th* Chapter, I consider
that if 8 Men can finish the
Work in 12 days, 16 Men will
do it in lesser (or fewer days,
than 12,) therefore the biggest
Extream must be the Divisor,
which is 16, and therefore it is the
Rule of 3 *Inverse*, wherefore I mul-
tiply the first and second *numbers*
together, *viz.* 8 by 12, and their
Product is 96, which divided by
16, Quotes 6 days for the *Answer*, and in
days will 16 Labourers perform a piece c
when 8 can do it in 12 days.

lab.	*days*
8	12
	8
	96
16)	96
	96
	(0)
Facit	6

Quest. 2. If when the measure (*viz.* a peck) c
cost 2 shillings, the penny Loaf weighed (acc
the Standard, Stature, or Law of *England*) 8
demand how much it will weigh when the
worth 1 *s.* 6 *d.* according to the same Rate o
tion? *Answer* 10 *oz.* 13 *p. w.* 8 *gr.*

Having placed and reduced the given *numb*
ding to the 6 and 9 Rules of the 10*th* Chapte
sider, that at 1 *s.* 6 *d. per* peck, the penny
weigh more than at 2 *s.* . *per* peck, for as
decreaseth, the weight increaseth, and as the
creaseth, so the weight diminisheth, wherefo
the first *term* requireth m re than the second
Extream must be the Divisor, 1 *s.* 6 *d.* or
having finished the work, I find the *Answer* t

w. 8 *gr.* and ſo much will the penny Loaf weigh, the peck of Wheat is worth 1 *s.* 6 *d.* according given rate of 8 ounces, when the peck is worth ings, the work is plain in the following operation.

		s.	*d.*
2	8	1	6
2	24	12	
	32	18	
	16		

oz. p. w. gr.

18) 192 (10—13—8

Rem. (12)

p.w.

18) 240 (13

18

60

54

(6)

24

gr.

18) 144 (8

144

(0)

ueſt. 3. How many pieces of Mony or Merchandiſe o *s. per* piece are to be given or received for 240 es, the value or price of every piece being 12 ſhil- ? *Anſwer*, 144. For if 12 *s.* require 240 pieces, 20 ſhillings will require leſs; therefore the big- *Extream* muſt be the Diviſor, which is the third ber, *&c.* See the Work.

s. pieces s.
If 12—240—20
12

480
240

2|0) 288|0 (144 *pieces at* 20 *s. per piece*
2

8
8

8
8

(0)

Queſt. 4. How many yards of 3 quarters broad required to double, or be equal in meaſure to 30 yards, that are 5 quarters broad? *Anſwer* 50 yards, For ſay, if 5 quarters wide require 30 yards long, what length will three quarters broad require? Here I conſider that 3 quarters broad will require more yards than 30, for the narrower the Cloath is, the more in length will go to make equal meaſure with a broader piece.

qrs.——*long*——
5 30
5

3) 150 (50
15

(0)

Queſt. 5. At the Requeſt of a Friend I lent hi 200 *l.* for 12 Months, promiſing to do me the l Courteſie at my Neceſſity; but when I came to queſt it of him, he could let me have but 150 *l.* n I deſire to know how long I may keep this Mo to make plenary ſatisfaction for my former kinds to my Friend? *Anſwer* 16 Months. I ſay, if 200 require 12 Months, what will 150 *l.* require? 150 will require more time than 12 Months, therefore t leſſer *Extream* (*viz.* 150) muſt be the Diviſor, Mul

P

and divide, and you will find the fourth inverted portional to be 16, and ſo many Months I ought to the 150 *l.* for ſatisfaction.

Queſt. 6. If for 24 *s.* I have 1200 *l.* weight carried miles how many miles, ſhall 1800 *l.* be carried the ſame Money? *Anſwer* 24 Miles.

Queſt. 7. If for 24 *s.* I have 1200 *l.* carried 36 s, how many pound weight ſhall I have carried miles for the ſame Money? *Anſwer* 1800 l. ght.

Queſt. 8. If a 100 Workmen in 12 days finiſh a piece work or ſervice, how many Workmen are ſufficient do the ſame in 3 days? *Anſwer* 400 Workmen.

Queſt. 9. A Colonel is beſieged in a Town in which 1000 Soldiers, with proviſion of Victuals only for months, the Queſtion is how many of his Soldiers ſt he diſmiſs, that his Victuals may laſt the remaing Soldiers 6 months? *Anſwer*, 500 he muſt keep, diſmiſs as many.

Queſt. 10. If Wine worth 20 *l.* is ſufficient for the linary of 100 Men, when the Tun is ſold for 30 *l.* w many Men will the ſame 20 pounds worth ſuffice, en the Tun is worth 24 *l.* *Anſwer*, 125 Men.

Queſt. 11. How much Pluſh is ſufficient to line a oak which hath in it 4 yards of 7 quarters wide, hen the Pluſh is but 3 quarters wide? *Anſwer*, $9\frac{1}{3}$ rds of Pluſh.

Queſt. 12. How many yards of Canvas that is Ell de, will be ſufficient to line 20 yards of Say, that 3 quarters wide? *Anſwer*, 12 yards.

Queſt. 13. How many yards of Matting that is two ot wide, will cover a Floor that is 24 Foot long, and Foot broad? *Anſwer*, 240 Foot.

Queſt. 14. A Reigment of Soldiers conſiſting of 00, are to have new Coats, and each Coat to contain 2 yards, 2 quarters of Cloth, that is 5 quarters ide, and they are to be lined with Shalloon that is quarters wide, I demand how many yards of Shalon will line them? *Anſwer*, $16666\frac{2}{3}$ quarters of rds, or $4166\frac{3}{4}$ yards.

Queſt. 15. A Meſſenger makes a Journey in 24 days when the day is 12 hours long, I deſire to know how many days he will go the ſame when the day is 16 hours long? *Anſwer*, in 18 days.

Queſt. 16. Borrowed of my Friend 64 *l.* for Months, and he hath occaſion another time for to borrow of me for 12 Months, I deſire to know how much I muſt lend to make good his former kindness to me? *Anſwer*, 42 *l.* 13 *s.* 04 *d.*

4. The general Effect of the Rule of 3 *Inverſe* is contained in the definition of the ſame, that is, to find a fourth *term* in a Reciprocal Proportion, inverted to the Proportion given.

The ſecond Effect, is by two prices, or values of two ſeveral pieces of Money or Merchandize known to find how many pieces of the one price is to be given for ſo many of the other. And conſequently to Reduce and Exchange one ſort of Money, or Merchandize, into another. Or contrariwiſe to find the price unknown of any piece given to Exchange in Reciprocal Proportion.

The third Effect, is, by two differing prices of a meaſure of Wheat bought or ſold, and the weight of the Loaf of Bread, made anſwerable to one of the prices of the meaſure given, to find out the weight of the ſame Loaf anſwerable to the other price of the ſaid meaſure given. Or Contrariwiſe by the two ſeveral weights of the ſame prized Loaf, and the price of the meaſure of Wheat anſwerable to one of thoſe Weights given, to find out the other price of the meaſure anſwerable to the other weight of the ſame **Loaf.**

The fourth Effect, is, by two lengths, and one breadth of two Rectangular Planes known, to find out another breadth unknown. Or by two bredths and one length given, to find out another length unknown in an inverted Proportion.

The fifth Effect, is, by double time and a capital Sum of Money borrowed or Lent, to find out another capital Sum anſwerable to one of the given Times

or

otherwiſe, by two Capital Sums, and a time anſwer-
le to one of them given to find out a time anſwer-
le to the other Capital Sum in Reciprocal Reaſon.

The ſixth Effect is, by two differing Weights of
arriage, and the diſtance of the places in Miles or in
eagues given, to find another diſtance in miles an-
verable to the ſame price of payment: Or otherwiſe
two diſtances in miles, and the weight anſwera-
e to one of the diſtances (being carried for a cer-
in price) to find out the weight anſwerable to the
ther diſtance for the ſame price.

The ſeventh Effect is by double Workmen, and the
me anſwerable to one of the *numbers* of Workmen gi-
en, to find out the time anſwerable to the other
mber of Workmen, in the performance of any work or
rvice. Or contrariwiſe, by double time and the Work-
en anſwerable to one of thoſe times given, to find
ut the *number* of Workmen anſwerable to the other
me, in the performance of any work or ſervice.

Alſo by a double price of Proviſion, and the *num-
r* of Men, or other Creatures nouriſhed for a cer-
in time, anſwerable to one of the prices of Proviſion
iven, to find out another Number of Men or other
reatures anſwerable to the other price of the Provi-
on for the ſame time. Or contrariwiſe by two *num-
rs* of Men or other Creatures nouriſhed, and one
rice of Proviſion anſwerable to one of the *numbers* of
reatures given, to find out the other price of the
me Proviſion anſwerable to the other *number* of Crea-
ures, both being ſuppoſed to be nouriſhed for the
me, *&c.* As in the foregoing Examples is fully de-
lared.

To prove the Operation of the Rule of 3 *Inverſe*,
ultiply the third and fourth *terms* together, and note
heir Product; and multiply the firſt and ſecond to-
ether, and if their Product is equal to the Product
f third and fourth, then is the Work truly wrought,
ut if it falleth out otherwiſe, then it is erroneous.

As in the firſt Queſtion of this Chapter, 16 (the
hird *number*) being multiplied by 6 (the fourth *number*)

the Product is 96, and the Product of 8 (the first number) multiplyed by 12 (the second number) is 96, equal to the first Product, which proves the work to be right.

And Note, that if in Division any thing remain, such Remainder must be added to the Product of the third and fourth terms, and if the Sum be equal to the Product of the first and second (the homogeneal terms being of one denomination) the work is right.

CHAP. XII.

The Double Rule of Three Direct.

WE have already delivered the Rules of *Single Proportion*, and we come now to lay down the Rules of *Plural Proportion*.

1. *Plural Proportion*, is when more Operations in the Rule of Three than one, are required before a Solution can be given to the Question propounded. Therefore in Questions that require Plurality in *Proportion* there are always given more than three *numbers*.

2. When there are given 5 *numbers*, and a sixth is required in *Proportion* thereunto, then this sixth *Proportion* is said to be found out by the double Rule of 3, as in the Question following, *viz.*

If 100 *l.* in 12 months gain 6 *l.* Interest, how much will 75 *l.* gain in 9 months?

3. Questions in the double Rule of 3 may be resolved either by two single Rules of Three, or by one single Rule of Three, compounded of the five given *Numbers*.

4. The double Rule of 3 is either *Direct*, or else *Inverse*.

5. The double Rule of 3 *Direct*, is when unto three given *Numbers* a sixth *proportional* may be found out by two single Rules of Three *Direct*.

6. The five given *Numbers* in the double Rule of Three

hree consists of 2 parts, *viz.* First, a Supposition, and econdly, of a Demand; the Supposition is contained n the *three first* of the *five* given *Numbers*, and the De- and lies in the two last; as in the Example of the econd Rule of this Chapter, *viz.* If 100 *l.* in 12 onths gain 6 *l.* Interest, what will 75 *l.* gain in 9 onths? Here the Supposition is expressed in 100, 12, nd 6; for it is said, if (or suppose) 100 *l.* in 12 onths gain 6 *l.* Interest, and the Demand lyeth in 5 and 9; for it is demanded how much 75 *l.* will in in 9 months?

7. When your Question is stated, the next thing will be to dispose of the given Numbers in due order nd place, as a Preparative for Resolution; which hat you may do, First, observe which of the given Numbers in the Supposition is of the same Denomination with the Number required; for that must be the econd number (in the first operation) of the single Rule f 3, and one of the other Numbers in the Supposition (it matters not which) must be the first Number, nd that Number in the Demand which is of the same Denomination with the first, must be the third number, which three Numbers being thus placed will make one erfect Question in the single Rule of Three, as in the forementioned Example: First, I consider that the *Number* required in the question is the Interest or Gain of 75 *l.* therefore that *Number* in the Supposition which hath the same name (*viz.* 6 *l.* which is the Interest or Gain of 100 *l.*) must be the econd *Number* in the first Operation, 100—6—75 nd either 100 or 12 (it matters not which) must be the first *Number*; but I will take 100, and then for the third *Number*, I put that *Number* in the Demand which hath the same Denomination with 100, which is 75, (for they both signifie pounds principal) and then the *Numbers* will stand as you see in the Margent.

But

But if I had for the first *Number* put the other *Number* in the Suppoſition, *viz.* 12, which ſignifieth 12 Months, then the third *number* muſt have been 9, which is that *Number* in the Demand which hath the ſame Denomination with the firſt, *viz.* 9 Months, and then they will ſtand in the Margent.

10	6	9

There yet remain two *Numbers* to be diſpoſed of and thoſe are, one in the Suppoſition, and another in the Demand; that which is of the Suppoſition, I place under the firſt of the three *Numbers*, and the other which is in the Demand I place under the third *number*, and then 2 of the *terms* in the ſuppoſition will ſtand (one over the other) in the firſt place, and the 2 *terms* in the Demand will ſtand (one over the other) in the third place, as in the Margent.

100	6	75
12		9

Or thus,

12	6	9
100		75

8. Having diſpoſed, or ordered the *numbers* given according to the laſt Rule, we may proceed to a Reſolution, and firſt I work with the three uppermoſt *Numbers*, which according to the firſt diſpoſition are 100, 6, and 75, which is as much as to ſay, If 100 *l.* require 6 *l.* (Intereſt) how much will 75 *l.* require? which by the third Rule of the eleventh Chapter I find to be *Di ect*, and by the 7 and 8 Rules of the tenth Chap. I find the fourth *Proportional number* to be 4 *l.* 10 *s.* ſo that by the foregoing ſingle Queſtion I have diſcovered how much Intereſt 75 *l.* will gain in 12 mon.; the operation whereof followeth on the left hand under the letter *A*; and having diſcovered how much 75 *l.* will gain in 12 Months, we may by another Queſtion eaſily diſcover how much it will gain in 9 months, for this fourth *number* (thus found) I put in the middle between the two loweſt *numbers* of the five after they are placed according to the ſeventh Rule of this Chapter; and then it will be a ſecond *number*, in another Queſtion in the Rule of Three:

m.	l.	s.	m.	
12	4	10	9	

the *numbers* being 12 4 10 9 the firſt and third *number*

Numbers being of one Denomination, *viz.* both Months, and may be thus expressed, if 12 months require 4 *l.* 10 *s.* Interest, what will 9 months require? And by the third Rule of the 11*th* Chapter I find it to be the *Direct* Rule, and by working according to the directions laid down in the 7, 8, and 9 Rules of the 10*th.* Chapter, I find the fourth *Proportional number* to the last single Question to be 3 *l.* 07 *s.* 06 *d.* which is the sixth *Proportional number* to the 5 given *numbers*, and is the answer to the general Question. The work of the last single Question is expressed on the Right side of the Page under the Letter *B*, as followeth,

100——6——75

A 12 9 B

l.	l.	l.
100	6	75

75

30

42

——l. s.

1|00) 4'50 (4--10

4

Rem. (50)

Mult. 20

1|00)10|00(10*s.*

l.	s.
Facit 4	10

Then say,

m.	l.	s.	m.
If 12	4	10	9

20

90 *shillings.*

12

180

90

1080 *pence*

——12) 2|0) l. s. d

9

12) 9720 (810(6|7(3--7--5

96 72

12 90

12 84

(0) (6) *pence*

l.	s.	d.
Facit 3	7	6

So

So that by the foregoing Operation I conclude that if 100 *l.* in 12 months gain 6 *l.* Interest, 75 *l.* will gain 3 *l.* 7 *s.* 6 *d.* in 9 months, after the same rate.

The Answer would have been the same, if the 3 given *Numbers* had been ordered according to the second Method, *viz.* as you see in the Margent.

12	6	9
100	75	

For first, I say, if 12 months gain 6 *l.* what will 9 months gain? This Question I find to be *Direct* by the 3*d.* Rule of the 11*th.* Chapter, and by the 7 and 8 Rules of the 10*th* Chapter, I find the fourth *Proportional Number* to these three to be 4 *l.* 10 *s.*

Thus have I found out what is the Interest of 100 *l.* for 9 months, and I am now to find the Interest of 75 *l.* for 9 months; to effect which, I make this 4*th Number* (found as before) to be my second *Number* in the next Question, and say, If 100 *l.* require 4 *l.* what will 75 require? This Question I find (by the said third Rule of the eleventh Chapter) to be *Direct*, and by the said 7*th*, 8*th*, and 9*th* Rules of the tenth Chapter, I find the Answer to be as before, *viz.* 3 *l.* 7 *s.* 6 *d.*

This Rule hath been sufficiently explained by the foregoing Example, so that the Learner may be able to resolve the following (or any other) Questions pertinent to the double Rule of 3 *Direct*, whose Answers are there given, but the Operation purposely omitted, to try the Learners ability in the knowledge of what hath been before delivered.

Quest. 2. A second Example in this Rule may be as followeth, *viz.* a Carrier receiving 42 shillings for the Carriage of 300 weight 150 Miles, I demand how much he ought to receive for the Carriage of 7 *C.* 3 *qrs.* 14 *l.* 50 miles at that rate? *Answer*, 36 *s.* 9 *d.*

Quest. 3. A Regiment of 936 Soldiers eat up 35 quarters of Wheat in 168 Days, I demand how many quarters of Wheat 11232 Soldiers will eat in 56 Days at that rate? *Answer*, 14 4 *qrs.*

Quest. 4. If 40 Acres of Grass be mowed by 8 men in 7 Days, how many Acres shall be mowed by 24 men in 28 days? *Answer*, 480 Acres.

Quest.

Queſt. 5. If 48 Buſhels of Corn (or other ſeed) yield 6 Buſhels in 1 Year, how much will 230 Buſhels ld in 6 years at that rate? That is to ſay, if there re ſowed 240 Buſhels every one of the 6 years? *ſwer*, 17280 Buſhels.

Queſt. 6. If 40 ſhillings is the Wages of 8 Men for days, what ſhall be the Wages of 32 men for 24 ys? *Anſwer*, 768 ſhillings, or 38 *l.* 8 *s.*

Queſt. 7. If 14 Horſes eat 56 Buſhels of Provender 16 Days, how many Buſhels will 20 Horſes eat in Days? *Anſwer*, 120 Buſhels.

Queſt. 8. If 8 Cannons in 1 Day ſpend 48 Barrels Powder, I demand how many Barrels 24 Cannons ll ſpend in 22 days at that rate? *Anſwer*, 1728 rrels.

Queſt. 9. If in a Family conſiſting of 7 Perſons re are drunk out 2 Kilderkins of Beer in 12 days, w many Kilderkins will there be drunk out in 8 days another Family conſiſting of 14 Perſons? *Anſwer*, Gallons, or 2 Kilderkins and 12 Gallons.

Queſt. 10. An *Uſurer* put 75*l.* out to receive Intereſt r the ſame, and when it had continued 9 Months, he ceived for Principal and Intereſt 78 *l.* 7 *s.* 6 *d.* I de- and at what rate *per Cent. per Annum*, he received tereſt? *Anſwer*, at 6 *l.* *per Cent. per Annum.*

CHAP. XIII.

The Double Rule of Three Inverſe.

THE Double Rule of 3 *Inverſe*, is, when a Queſtion in the Double Rule of 3 is reſolved by 2 Single ules of 3, and one of thoſe Single Rules falls out to *Inverſe*, or requires a fourth *number* in *Proportion Reprocal* (for both the Queſtions are never *Inverſe*.)

2. In all Queſtions of the Double Rule of 3 (as well *verſe* as *Direct*,) you are (in the diſpoſing of the 5 given

numbers) to obſerve the ſeventh Rule of the 12*th* Chapter, and in reſolving of it by two ſingle Rules, obſerve to make Choice of your *Numbers* for the firſt, and ſecond, ſingle Queſtions according to the directions given in the eighth Rule of the ſame Chapter, as in the Example following, *viz.*

Queſt. 1. If 100 *l.* Principal in 12 Months gain 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 months?

This Queſtion is an Inverſion of the firſt Queſtion of the 12*th* Chapter, and may ſerve for a proof thereof.

In order to a Reſolution, I diſpoſe of the 5 given *Numbers* according to the 7*th* Rule of the laſt Chapter, and being ſo diſpoſed, will ſtand as followeth,

12 ——— 100 ——— 9
6 l. s. d.
3—7—6

Or thus,

l. s. d.
6 ——— 100 ——— 3—7—6
12 9

Here obſerve, that according to the eighth Rule of the twelfth Chapter, the firſt Queſtion, if you take it from the 5 *Numbers*, (as they are ordered or placed firſt) will be, If 12 months require 100 *l.* Principal, what will 9 months require to make the ſame Intereſt? This (according to the third Rule of the 11 Chapter) is *Inverſe*, and the anſwer will be found (by the 2 Rule of the 11*th* Chapter) to be 133 *l.* 6 *s.* 8 *d.* the ſecond queſtion then will be, If 6 *l.* Intereſt, require 133 *l.* 6 *s.* 8 *d.* Principal, how much Principal will 3 *l.* 7 *s.* 6 *d.* require? This is a direct Rule, and the Anſwer in a direct *Proportion* is 75 *l.* See the Work.

Firſt

First I say,

m. l. m.
If 12 —— 100 —— 9

12

——— *l. s. d.*
9) 1200 (133—6—8
...

9 *l. s. d.*
——— *facit* 133—6—8

30
27
——
30
27
——
(3)
20
——
9) 60 (6 *s.*
54
——
(6)
12
——
9) 72 (8 *d.*
72
——
(0)

Then

Then I say,

l.	*l.*	*s.*	*d.*	*l.*	*s.*	*d.*
If 6	133	6	8	3	7	6
240	20		20			
1440 *d.*	2666		67			
	12		12			
	5340		140			
	2666		67			
	3200		810 *d.*			
	810					
	320000					
	256					

144|0) 2592000 (18000 *d.* or 75 *l.*

144

1152

1152

(0)

So that by the foregoing Work I find that if 6 *l.* Interest be gained by 100 *l.* in 12 months, 3 *l.* 7 *s.* 6 *d.* will be gained by 75 *l.* in nine months.

But if the resolution had been found out by these Numbers as they are ranked in the second place, then the second Question in the single Rule would have been *Inverse*, and the first Question *Direct*, and the conclusion the same with the first Method, *viz.* 75 *l.*

Quest. 2. If a Reigment consisting of 936 Soldiers can eat up 351 quarters of Wheat in 168 days, how many Soldiers will eat up 1404 quarters in 56 days at that rate? *Answer*, 11232 Soldiers.

Quest. 3. If 12 Students in 8 Weeks spend 48 *l.* I demand how many Students will spend 288 *l.* in 16 Weeks? *Answer*, 32 Students.

Quest

Queſt. 4. If 48 *l.* ſerve 12 Students 8 Week, how many Weeks will 288 *l.* ſerve 4 Students? *Anſwer* 144 Weeks.

Queſt. 5. If when the Buſhel of Wheat coſt 3 *s.* 4*d.* the peny Loaf weigheth 12 ounces, I demand the weight of the Loaf worth 9 *d.* when the Buſhel coſt 10 *s.* *Anſwer* 36 *ounces.*

Queſt. 6. If 48 Pioneers in 12 days caſt a Trench 144 *yards* long, how many Pioneers will caſt a Trench 168 *yards* long in 16 days? *Anſwer* 252 Pioneers.

Queſt. 7. If 12 *C.* weight being carried 100 mile coſt 5 *l.* 12 *s.* I deſire to know how many *C.* weight may be carried 150 miles for 12 *l.* 2 *s.* at that rate? *Anſwer*, 18 *C.*

Queſt. 8. If when Wine is worth 30 *l. per Tun*, 20 pounds worth is ſufficient for the ordinary of 100 men, how many men will 4 *l.* worth ſuffice when it is worth 24 *l. per Tun?* *Anſwer* 25 men.

Queſt. 9. If 6 men in 24 days mow 72 Acres, in how many days will 8 men mow 24 Acres? *Anſwer*, 6 days

Queſt. 10. If when the Tun of Wine is worth 30 *l.* 100 Men will be ſatisfied with 20 *l.* worth, I deſire to know what the Tun is worth, when 4 *l.* worth will ſatisfie 25 men at the ſame rate? *Anſwer*, 24 *l. per Tun.*

CHAP. XIV.

The Rule of Three compoſed of five Numbers.

1. THE Rule of Three Compoſed, is, when Queſtions (wherein there are 5 Numbers given to find a 6th in Proportion thereunto) are reſolved by one ſingle Rule of 3 compoſed of the 5 given Numbers.

2. When Queſtions may be performed by the double Rule of 3 Direct, and it is required to reſolve them by the Rule of 5 compoſed, (firſt order or rank your Numbers according to the 7th. Rule of the 12th Chapter, then)

The

The Rule is,

Multiply the Terms or (Numbers) that ſtand one over the other, in the firſt place, the one by the other, and make their Product the firſt Term in the Rule of Three Direct, then multiply the Terms that ſtand one over the other in the third place, and place their Product for the third Term in the Rule of Three Direct, and put the middle Term of the Three uppermoſt for a ſecond Term; then having found a fourth Proportional, direct to theſe Three, this fourth Proportional ſo found, ſhall be the Anſwer required.

So the firſt Queſtion of the 12*th* Chapter being propoſed, *viz.* If 100 *l.* in 12 Months gain 6 *l.* Intereſt, what will 75 *l.* gain in 9 Months? The Numbers being ranked (or placed) as is there directed and done.

Then I multiply the two firſt Terms, 100 and 12, the one by the other, and their Product is 1200 (for the firſt Term;) then I multiply the two laſt Terms 75 and 9 together, and their Product is 675 for the third Term. Then I ſay, as 1200 is to 6, ſo is 675 to the Anſwer, which by the Rule of Three Direct will be found to be 3*l.* 7*s.* 6*d.* as was before found.

3. But if the Queſtion be to be anſwered by the double Rule of Three Inverſe, then having (placed the five given Terms as before) multiply the lowermoſt Term of the firſt place, by the uppermoſt Term of the third place, and put the Product for the firſt Term; then multiply the uppermoſt Term of the firſt place, by the lowermoſt Term of the third place, and put the Product for the third time, and put the ſecond Term of the three higheſt Numbers for the middle Term to thoſe two, then if the Inverſe Proportion is found in the uppermoſt three numbers, the 4*th* Proportional Direct to theſe three ſhall be the anſwer; ſo the firſt Queſtion of the 13*th* Chapter being ſtated, *viz.* If a 100 *l.* Principal in 12 Months gain 6 *l* Intereſt, what Principal will gain 3 *l.* 7*s.* 6 *d.* in 9 Months? State the Numbers as is there directed in the firſt order, *viz.*

M.	*l.*	*M.*
12	100	9

l.	*l.*	*s.*	*d.*
6	3	7	6

then reduce the 6 *l.* and 3 *l.* 7 *s.* 6 *d.* into pence, the 6 *l.* is 1440 *d.* and 3 *l.* 7 *s.* 6 *d.* is 810 *d.* then multiply 1440 by 9, the Product is 12960 for the firſt Term in the Rule of Three Direct, and multiply 810 by 12, the Product is 9720 for the third Term, then I ſay, As 12960 is to 130 *l.* ſo is 9720 to the Anſwer, *viz.* 75 *l.* as before. But if the *terms* had been placed after the ſecond order, *viz.*

l.	*l.*	*l.*	*s.*	*d.*
6	100	3	7	6

M	*M.*
12	9

then the Inverſe Proportion is found in the loweſt Numbers, and having compoſed the Numbers for a ſingle Rule of Three as in the ſecond Rule foregoing, then the Anſwer muſt be found by a ſingle Rule of Three Inverſe, for here it falls out to multiply 810 by 12 for the firſt Number, and 1440 by 9 for the third Number, and then you muſt ſay, as 9720 is to 100 *l.* ſo is 12960 to the Anſwer, which by Inverſe Proportion will be found to be 75 *l.* as before.

The Queſtions in the 12*th* and 13*th* Chapters may ſerve for thy farther experience.

CHAP. XV.

Single Fellowſhip.

1. FELLOWSHIP is that Rule of Plural Proportion, whereby we ballance Accompts depending

pending between divers Perſons having put together a general Stock, ſo that they may every man have his Proportional part of Gain, or ſuſtain his Proportional part of Loſs.

2: The Rule of Fellowſhip is either ſingle, or it is double.

3. The ſingle Rule is when the Stocks propounded are ſingle Numbers without any reſpect or relation to time, each Partner continuing his Mony in Stock for the ſame time.

4. In the ſingle Rule of Fellowſhip, the Proportion is, as the whole Stock of all the Partners, is in Proportion to the total Gain or Loſs, ſo is each Mans particular ſhare in the Stock, to his particular ſhare in the Gain or Loſs. Therefore take the Total of all the Stocks for the firſt Term in the Rule of Three, and the whole Gain or Loſs for the ſecond Term, and the particular Stock of any one of the Partners for the third Term, then multiply and divide according to the 7th Rule of the 9th Chapter, and the 4th Proportional Number is the particular loſs or gain of him whoſe Stock you made your ſecond number, wherefore repeat the Rule of 3 as often as there are particular Stocks, or Partners in the queſtion, and the 4th Terms produced upon the ſeveral Operations are the reſpective Gain or Loſs of thoſe particular Stocks given, as in the Examples following.

Queſt. 1. Two Perſons, *viz.* A and B bought a Tun of Wine for 20 *l.* of which A paid 12 *l.* and B paid 8 *l.* and they gained in the Sale thereof 5 *l.* now I demand each Mans ſhare in the Gains according to his Stock?

Firſt, I find the Sum of their Stocks, by adding them together, *viz.* 12 *l.* and 8 *l.* which are 20 *l.* then according to this Rule I ſay firſt, If 20 *l.* (the Sum of their Stocks) Require 5 *l.* the total Gain, how much will 12 *l.* (the Stock of A) require? Multiply and Divide by the ſeventh Rule of the ninth Chapter, and the Anſwer is 3 *l.* for the ſhare of A in the gains;

12	
8	
20 *l.*	

gains; then again I say, If 20 *l.* require 5 *l.* what will 8 *l.* require? The Answer is 2 *l.* which is the *gain* of B. So I conclude that the share of A in the gain is 3 *l* and the share of B in the gain is 2 *l.* which in all is 5 *l.*

l. l. l.
If 20 —— 5 —— 12
12

20) 60 (3 l.
60

(0)

l. l. l.
If 20 —— 5 —— 8
8

20) 40 (2 l.

Quest. 2. Three Merchants, *viz.* A, B, and C, enter upon a joint Adventure, A put into the common stock 78 *l.* B put in 117 *l.* and C put in 234 *l.* and they find (when they make up their Accompts) that they have gained in all 264 *l.* now I desire to know each Mans particular share in the gains?

First I add their particular stocks together, and their Sum is 429 *l.* then say, If 429 *l.* gain 264 *l.* what will 78 *l.* gain? and what 117 *l.* and what will 234 *l.* (the Stocks of A, B, and C.) gain? Work by 3 several Rules of 3, and you will find that

	l.
78	
117	
234	
Sum 429	

			l
The Gain of	A	is	48
	B		72
	C		144
		Sum	264

Quest.

Queſt. 3. Four Partners, *viz.* A, B, C, and D, bee tween them built a Ship which coſt 1730 *l.* of whic A paid 346 *l.* B 519 *l.* C 692 *l.* and D 173 *l.* and hee Freight for a certain Voyage is 370 *l.* which is due t the owners, or Builders, I demand each Mans ſhar therein according to his Charge in Building her.

Anſwer,

	l.
A	74
B	111
C	148
D	37
Sum	370

Queſt. 4. A, B, and C, enter Partnerſhip for a cer tain time, A put into the common ſtock 364 *l.* B pu in 482 *l.* C put in 500 *l.* and they gained 867 *l.* noo I demand each mans ſhare in the gain Proportionabl to his Stock.

Anſwer,

	l.	s.	d.
A	284	09	$3\frac{354}{1346}$
B	310	09	$4\frac{62}{1346}$
C	322	01	$3\frac{930}{1346}$
Sum	867	00	0

5. To prove the Rule of *Single Fellowſhip*, add ea mans *Particular* gain or loſs toge- ther, and if the total Sum is equal to the general gain or loſs, then is the Work rightly performed, but otherwiſe it is erroneous. Example, in the firſt Queſtion of this Chapter, the *An ſwer* was that the gain of A was 3 *l.* and the gain of 2 *l.* which added together make 5 *l.* equal to the to gain given. *The Proof of th Rule of Sing Fellowſhip.*

If in finding out the *particular ſhares* of the ſeveral *rtners*, any thing remain after Diviſion is ended, h remainders muſt be added together, (they be- all Fractions of the ſame Denomination) and their n divided by the common Diviſor in each Queſtion z. the total ſtock) and the quotient add to the *par- ular gains*, and then if the total Sum is equal to the tal gain the work is right, otherwiſe not.

As in the fourth Queſtion, the Remainders were 4, 62, and 930, which added together make 1346, ich divided by 1346, (the Sum of their Stocks) Quotient is 1 *d.* which I add to the pence, *&c.* d the ſum of their ſhares is 867 *l.* equal to the total in; wherefore I conclude the work is right.

CHAP. XVI.

Double Fellowſhip.

DOUBLE Fellowſhip is when ſeveral Perſons enter into *Partnerſhip* for unequal time, that is en every Mans *particular* ſtock hath relation to a *rticular* time.

2. In the double Rule of Felloſhip, multiply each *rticular* ſtock by its reſpective time, and having ad- d the ſeveral products together make their ſum the t *number* (or *term*) in the Rule of 3, and the total n or loſs the ſecond number, and the product of any es particular ſtock by his time, the third *term*, and 4*th. number* in *Proportion* thereunto is his *particular* n or loſs, whoſe product of ſtock and time is your rd *number*.

Then repeat (as in Single Fellowſhip) the Rule of as often as there are Products or (Partners) and 4 *terms* thereby invented are the *numbers* required.

ample.

Queſt. 1. A and B enter *Partnerſhip*, A put in 40 *l.* 3 months, B put in 75 *l.* for 4 months, and they

gained 70 *l.* now I demand each mans ſhare in the gains, proportionable to his ſtock and time? *Anſwer* A 20 *l.* B. 50 *l.*

To reſolve this Queſtion, I firſt multiply the ſtock of A, (*viz.* 40 *l.*) by its time (3 months) and the product is 120, then I multiply the ſtock of B by its time (*viz.* 75 by 4) and it produceth 300, which I add to the Product of A his Stock and Time, and the ſum is 420. Then by the Rule of 3 Direct, I ſay; As 400 (the Sum of the products) is to 70 (the total gain) ſo is 120 (the Product of A his ſtock and time) to 20 *l.* (the *ſhare* of B in the gains.) And ſo much ought each to have for his ſhare.

	l.	l.
	40	75
	3	4
	A 120	B 300
		120
Sum		420

Queſt. 2. A, B, and C, make a Stock for 12 Months: A put in at firſt 364 *l.* and 4 Months after that he put in 40 *l.* B put in at firſt 408 *l.* and at the end of Months he took out 86 *l.* C put in at firſt 148 and 3 Months after he put in 86 *l.* more, and 5 months after that he put in 100 *l.* more, and at the end of 1 Months their gain is found to be 1436 *l.* I deſire to know each mans *ſhare* in the gains according to his ſtock and time?

Firſt, I conſider, that the whole time of their *Partnerſhip* is 12 Months. Then I proceed to find out the ſeveral products or ſtock and time as followeth.

A had at firſt 364 *l.* for 4 Months, wherefore their Product is	1456
Then he put in 40 *l.* which with the firſt Sum makes 404 *l.* which continued the remainder of the time, *viz.* 8 Months, and their Product is	3232
The Sum of the products of the ſtock and time of A is	4688

B ha

B had 408 l. in 7 months, whose roduct is — 2856

And then took out 86 l. therefore left in Stock 322 l. which conti-ed the reſt of the time, *viz.* five nths, whoſe product is — 1610

The ſum of the products of the ck and time of B is — 4466

C put in 148 l. for 3 months, whoſe oduct being multiplyed is — 444

Then he put in 86 l. which added the firſt (*viz.* 148) makes 234 l. ich lay in ſtock 5 Months their oduct is — 1170

Then he put in 100 l. more, ſo then had in ſtock 334 l. which continu-the Remainder of the time (*viz.* months) which multiplyed together duce — 1336

The Sum of the product of the mo-and time of C is — 2950

B 4466

A 4688

The Total Sum of all the product — 12104

Then I ſay, as 12104 is to 1436 (the total gain) ſo 2950, to the *ſhare* of A in the gains, *&c.* go on as he foregoing Examples, and you will find their es in the gain to be as followeth, *viz.*

Anſwer,

			l.	s.	d.
The ſhare of	A	is	556	03	$6\frac{6192}{12104}$
	B		529	16	$9\frac{5496}{12104}$
	C		349	19	$1\frac{4156}{12104}$
			1436	00	0

Queſt. 3. Three Graſiers, A, B, and C, take a piece of ground for 46 l. 10 s. in which A put in 12 Oxen for 8 Months, B put in 16 Oxen for 5 months, and C put 18 Oxen for 4 Months, now the queſtion is, what ſhall each man pay of the 46. l. 10 s. for his ſhare in that charge?

Anſwer,

		l.	s
A	ſhall pay	18	00
B		15	00
C		13	10
		46	10

3. The proof of this Rule is the ſame with that of *Single Fellowſhip*, laid down in the 5*th.* Rule of the 5*th* Chapter; and note that,

If a loſs be ſuſtained inſtead of gain amongſt *Partners*, every mans ſhare to be born in the loſs, is to be found after the ſame method as their gain, whether their Stocks be for equal or unequal time.

CHAP. XVII.

Alligation Medial.

1. THE Rule of Alligation is that Rule in plural proportion, by which we reſolve queſtions wherein is a compoſition or mixture of divers ſimples, as alſo it is uſeful in the compoſition of Medicines both for quantity, quality, and price. And its ſpecies are two, *viz.* Medial and Alternate.

2. Alligation Medial is when having the ſeveral quantities and prices of ſeveral ſimples propounded we diſcover the mean price or rate of any quantity of the mixture compounded of thoſe ſimples, and the proportion is,

As the ſum of the ſimples to be mingled is to the total value of all the ſimples, ſo is any part or quantity of the Compoſition or mixture, to its mean Rate or Price.

Queſt. 1. A Farmer mingleth 20 buſhels of VVheat at 5 *s. per* buſhel, and 36 buſhels of Rye at 3 *s. per* buſhel, with 40 buſhels of Barley, at 2 *s. per* buſhel, now I deſire to know what one buſhel of that mixture is worth?

To reſolve this Queſtion add together the given quantities and alſo their values, which is 96 buſhels, whoſe total value is 14 *l.* 8. *s.* as appeareth by the VVork following, for

buſh.		*l.*	*d.*
20 *of Wheat at*	5 s. per *Buſhel, is*	5	—0
36 *of Rye at*	3 s. per *Buſhel, is*	5	—3
40 *of Barley at*	2 s. per *Buſhel, is*	4	—0

The Sum of the given quantities is 96 *and their value is*——14—8

Then ſay by the Rule of 3 *Direct*, If 96 Buſhels coſt (or is worth) 14 *l.* 8 *s.* what is 1 *Buſhel* worth?

b.	l.	s.	b:
96	14	8	1
	20		

96) 288 (3 *s.*

288

(0)

facit 3 *s. per Buſhel*

Queſt. 2. A Vinter mingleth 15 Gallons of Canary at 8 *s. per* gallon, with 20 gallons of Malaga at 7 *s.* 4*d. per* gallon, with 10 gallons of Sherry at 6 *s.* 8*d. per* gallon, and 24 gallons of VVhite-wine at 4 *s. per* gallon, now I demand what a gallon of that Mixture is worth? work as in the laſt Queſtion, and you will find the Anſwer to be 6 *s.* 2 *d.* 2 *qurs.* $\frac{45}{69}$.

Queſt. 3. A Grocer hath mingled 3 C. of Sugar a 56 *s. per C.* with 3 *C.* of Sugar at 3 *l.* 14 *s.* 08 *d.* pe *C.* and with 6 C. at 1 *l.* 17 *s.* 04 *d. per C.* I defir to know the price of a hundred weight of that mix ture? *Anſwer* 2 *l.* 13 *s.* 1 *d.* $\frac{7}{12}$.

The Proof of Allig. Medial.

3. The proof of this operation is by the price o any quantity of the mixture to fin out the total value of the whole com poſition, and if it is equal to the total value of the ſeveral ſimples, the Work is right, otherwiſe not. As in the firſt Exam ple, the anſwer to the queſtion was that 3 *s.* is the price of one buſhel, wherefore I ſay by the Rule o Proportion, If 1 buſhel be 3 ſhillings, what is 96 buſhels *Anſwer* 14 *l.* 8 *s* which is the total value of the ſeve ral ſimples, wherefore the Work is right.

CHAP. XVIII.

Alligation Alternate.

1. ALligation Alternate is when there are given thee particular prices of ſeveral ſimples, and there by we diſcover ſuch quantities of thoſe ſimples, as be ing mingled together ſhall bear a certain rate pro pounded.

2. When ſuch a queſtion is ſtated, place the given prices of the ſimples one over the other, and the pro pounded price of the compoſition againſt them in ſuch ſort that it may repreſent a Root, and they ſo many branches ſpringing from it as in the following Example.

Queſt. 1. A certain Farmer is deſirous to mix 20 buſhels of Wheat at 5*s.* or 60 *d. per* buſhel, with Rye at 3 *s.* or 36 *d. per* buſhel, and with Barley at 2 *s.* or 24 *d. per* buſhel, and Oats at 1 *s.* 6 *d. per* buſhel, and deſireth to mix ſuch a quantity of Rye, Barly and Oats with the 20 buſhels of Wheat, as that the whole compoſition may be worth 2 *s.* 8 *d.* or 32 *d. per* buſhel.

The

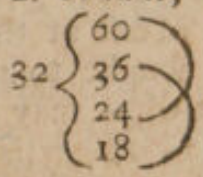
The prices of the ſimples being placed according to the laſt Rule, with the price of the compoſition propounded as a root to them will ſtand as followeth.

32 { 60 *pence*, 36, 24, 18

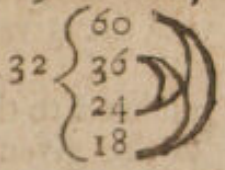
3. Having thus placed the given Numbers you are, to link or combine the ſeveral rates of the ſimples the one to the other, by certain Arches, in ſuch a ſort that one that is leſſer than the root (or mean rate) may be linked or coupled to another that is greater than the mean rate, ſo the queſtion laſt propounded will ſtand.

1. *Thus)*

2. *Or thus,*

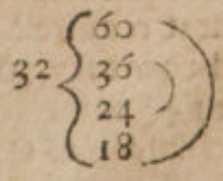


3. *Or thus,*



4. Then take the difference between the root and the ſeveral branches, and place the difference of each againſt the number or branch, with which it is coupled or linked, and having taken all the Differences and placed them as aforeſaid, then thoſe differences ſo placed will ſhew you the number of each ſimple to be taken to make a compoſition to bear the mean rate propounded.

So the branches of the laſt queſtion being linked together as in the firſt manner, I ſay the difference between 32 and 60, is 28, which I put againſt 18, becauſe 60 is linked with 18, then the difference between 32 and 36 is 4, which I



put againſt 24, becauſe 36 is linked or coupled wit 24, then I ſay the difference between 32 and 24 is which I place againſt 36 (for the reaſon aforeſaid then I ſay the difference between 32 and 18 is 1 which I place againſt 60; and then the Work wi ſtand as you ſee in the Margent.

So I conclude that a compoſition made of 14 buſhe of Wheat at 60 *d. per* buſhel, and 8 buſhels of Rye: 36 *d. per* buſhel, and 4 buſhels of Barley at 24 *d.* p buſhel, and 28 buſhels of Oats at 18 *d. per* buſhe will bear the mean price of 32 *d.* or 2 *s.* 8 *d.* pe buſhel. And here obſerve that in this compoſitio there is but 14 buſhels of Wheat; but I would mix gle 20 buſhels, and this kind (or rather caſe) of Allig gation Alternate, (*viz.*) when there is given a certai quantity of one of the ſimples, and the quantities c the reſt ſought to mingle with this given quantity (that the whole may bear a price propounded) is ca led Alternation partial.

And the proportion to find out the ſeveral quant ties to be mingled with the given quantity is as fol loweth, *viz.*

As the difference annexed to the branch that is th value of an Integer of the given quantity, is to th other particular Differences, ſo is the quantity give to the ſeveral quantities required.

So here, how to find out ſo much Rye, Barley an Oats muſt be mingled with the 20 buſhels of Wheat I ſay by the ſingle Rule of 3 Direct, If 14 buſhels o Wheat require 8 buſhels of Rye, what will 20 buſhel of Wheat require? *Anſwer*, 11 $\frac{6}{14}$ buſhels of Rye.

Again, if 14 buſhels of Wheat require 4 buſhels o Barley, what will 20 buſhels of Wheat require? *Anſwer* $5\frac{10}{14}$ buſhels of Barley. Again I ſay, if 14 buſhels o Wheat require 28 buſhels of Oats what will 20 buſhel of Wheat require? *Anſwer*, 40 buſhels of Oats.

And now I ſay, that 20 buſhels of Wheat mingle with 11 $\frac{6}{14}$ buſhels of Rye, and $5\frac{10}{14}$ buſhels of Barley and 40 buſhels of Oats, each bearing the Rates as afore ſaid, *will* make a compoſition or heap of Corn that may yield 32 *d. per* buſhel. But

But if the branches had been coupled according to the ſecond order, or manner, the differences would have been thus placed, *viz.* the differences between 32 and 60 is 28, which I ſet againſt 24, becauſe 60 is linked thereto; and the difference between 32 and 36 is 4, which I ſet againſt 18,

and the difference betwixt 32 and 24 is 8, which I ſet againſt 60; then the difference between 32 and 18 is 14, which I ſet againſt his yoke-fellow 36, and then I conclude that if you mix 8 buſhels of Wheat with 14 buſhels of Rye, 28 buſhels of Barley, and 4 buſhels of Oats, each bearing the foreſaid prices, the whole mixture may be ſold for 32 *d. per* buſhel, as by the work in the Margent.

You ſee by this work we have found how many buſhels of Rye, Barley and Oats, ought to be mixed with 8 buſhels of Wheat, and to find out how many of each ought to be mixt with 20 buſhels of Wheat, I ſay, as 8 is to 14, ſo is 20 to 35 buſhels of Rye. As 8 is to 28, ſo is 20 to 70 buſhels of Barley. As 8 is to 4, ſo is 20 to 10 buſhels of Oats, whereby I conclude, that if to 20 buſhels of Wheat I put 35 buſhels of Rye, 70 buſhels of Barley, and 10 buſhels of Oats, bearing each the foreſaid prices *per* buſhel, that then a buſhel of this mixture will be worth 32 *d.* or 2 *s.* 8 *d.*

And if the branches had been linked as you ſee in the third place, where each branch bigger than the root, is linked to two that are leſſer than the root, then in this caſe you muſt have placed the ſeveral differences between the root and branches, againſt thoſe two with which each is coupled, as firſt the difference between 32 and 60 is 28, which I put againſt 24 and 18 becauſe it is coupled,

with them both, then the difference between 32 and 36 is 4, which I ſet likewiſe againſt 24 and 18, becauſe 36 is linked to them both, then the difference between 32 and 24 is 8, which I put againſt 60 and 36, becauſe 24 is linked to them both, then the difference between 32 and 18 is 14, which I put againſt 60 and 36, the yoke-fellows of 18.

Laſtly, I draw a line behind the differences, and add differences which ſtand againſt each branch, and put the ſum behind the ſaid line againſt its proper branch as you ſee in the Margent.

And now by this work I find that 22 buſhels of thick Wheat mingled with 22 buſhels of Rye, and 32 buſhels of Early, and 32 buſhels of Oats, each bearing the ſaid price will make a mixture, bearing the mean rate of 32 *d. per* buſhel.

And to find how much of each of the reſt muſt be mingled with 20 buſhels of Wheat, I ſay,

As 22 is to 22, ſo is 20 to 20 buſhels of Rye. As 22 is to 32, ſo is 20 to $29\frac{3}{11}$ buſhels of Early. As 22 is to 23, ſo is 20 to $29\frac{3}{11}$ buſhels of Oats.

Whereby you ſee the queſtions of Alligation Alternate will admit of more true anſwers than one: for we have found three ſeveral anſwers to this firſt queſtion.

The Proof of Alternation partial.

Queſtions of Alternation partial are proved the ſame way with Queſtions in Alligation medial which you may ſee in the 3*d* Rule of the 17*th*. Chapter.

Queſt. 2. A Grocer hath 4 ſorts of Sugar, *viz.* of 12 *d. per l.* of 10 *d. per l.* of 6 *d. per l.* and of 4 *d. per l.* and he would have a compoſition worth 8 *d. per l.* the whole Quantity whereof ſhould contain 144 *l.* made of theſe 4 ſorts, I demand how much of each he muſt take?

Queſtions of this Nature are reſolved by that part of Alligation alternate called by Arithmeticians Alternation total, *viz.* where there is given the ſum, and the prices of ſeveral ſimples to find out how much of each ſimple ought to be taken to make the ſaid ſum or quantity,

quantity, ſo that it may bear a certain Rate propounded.

To reſolve this queſtion I place the ſeveral prices of the ſimples and mean rate propounded, and link them together, as is directed in the 2 and 3 Rules of this Chapter, and place the differences between the root and branches according to the 4*th*. Rule of this Chapter, which will then ſtand one of theſe three ways, *viz.*

First.

4
2
2
4

12

Second.

2
4
4
2

12

Third.

2,4	6
2,4	6
4,2	6
4,2	6

24

5. Then add the ſeveral differences together, which I have done, and the ſums of the firſt and ſecond order are 12 *l.* and of the third 24 *l.* as you may ſee above, but it is required that there ſhould be 144 *l.* of the compoſition, therefore to find the quantity of each ſimple, to make the whole compoſition 144 *l.* obſerve this general Rule, *viz.*

As the ſum of the differences is to the ſeveral differences, ſo is the total quantity of the compoſition to the quantity of each ſimple.

So to find how much of each ſort of Sugar I ought to take to make 144 *l.* at 8 *d. per. l.* I ſay,

l.

As 12 is to 4, ſo is 144 to 48 *l.* at 12 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 10 *d. per l.*
As 12 is to 2, ſo is 144 to 24 *l.* at 6 *d. per. l.*
As 12 is to 4, ſo is 144 to 58 *l.* at 4 *d. per. l.*

Whereby

Whereby I find that 48 *l.* at 12 *d. per l.* and 24 *l.* at 10 *d. per l.* and 24 *l.* at 6 *d. per l.* and 48 *l.* at 4 *d. per l.* will make a compoſition of Sugar containing 144 *l.* worth 8 *d. per l.*

But as the branches are linked in the ſecond order the anſwer will be 24 *l.* at 12 *d. per l.* and 48 *l.* at 10 *d. per l.* and 48 *l.* at 6 *d. per l.* and 24 *l.* at 4 *d. per l.* to make the ſaid quantity, and to bear the ſaid price.

And if you had worked as the Branches are linked after the third order, then you would have found the quantity of 36 *l.* of each.

Queſt. 3. A Vintner hath 4 ſorts of Wine, *viz.* Canary at 10 *s. per* Gallon, Malaga at 8 *s. per* gallon; Rheniſh-wine at 6 *s. per* gallon; and White-wine at 4 *s. per* gallon, and he is minded to make a Compoſition of them all of 60 gallons that may be worth 5 ſhillings *per* Gallon, I deſire to know how much of each he muſt have?

The numbers or terms being ranked according to the ſecond Rule of this Chapter, the branches will be linked as followeth, and will admit of no other manner of coupling, becauſe there is but one branch that is leſſer than the Root, therefore all the reſt muſt be linked unto it; and the differences between the Root and the three firſt branches, *viz.* 10, 8, and 6, which are 5, 3, and 1, muſt be ſet againſt 4 becauſe they are all coupled with it, and the difference between the Root (*viz.* 5.) and 4, which is 1, muſt be ſet againſt the 3 other, becauſe it is linked to them all; ſo I find 1 gall. of Canary, 1 gallon of Malaga, 1 gallon of Rheniſh Wine, and 9 gallons of White-wine, prized as above being mingled together, will be worth 5 *s. per* gallon, the Sum being 12 gallons, but there muſt be 60 gallons, wherefore I ſay,

10	1	
8	1	
5 { 6	1	
4	53,1.	9
		12

As 12 is to 1, ſo is 60 to 5 gallons of Canary.
As 12 is to 1, ſo is 60 to 5 gallons of Malaga.
As 12 is to 1, ſo is 60 to 5 gallons of Rheniſh.
As 12 is to 9, ſo is 60 to 45 gall. of White-wine.

So

So that 5 gallons of Canary, 5 gallons of Malaga, 5 gallons of Rheniſh, and 45 gallons of White-wine mingled together, will be in all 60 gallons, worth 5 *s.* per gallon, which was required.

Queſt. 4. A Goldſmith hath Gold of 4 ſeveral ſorts of fineneſs, *viz.* of 24 *Carects* fine, and of 22 *Carects* fine, of 20 *Carects* fine, and of 15 *Carects* fine. And he would mingle ſo much of each with alloy, that the whole Maſs of 18 ounces of Gold ſo mingled may bear 17 *Carects* fine. I demand how much of each he muſt take, the ſecond and third Rules of this Chapter being obſerved, (for inſtead of the alloy I put 0, becauſe it bears no fineneſs, but it makes a branch in the Operation) the terms may be alligated and the differences added any of theſe 4 ways following, *viz.*

Read Chap. 2. def. 2. of this Book.

Firſt thus,

24	17	17
22	2	2
20	1, 17	19
15	5, 3	8
0	7, 3	10

Sum 56

Secondly thus,

24	2	2
22	17	17
20	2, 17	19
15	7, 3,	10
0	5, 3,	8

Sum 56

Thirdly thus,

24	2,	2
22	2,	2
20	2, 17	19
15	7, 5, 3,	15
0	3,	3

Sum 41

Fourthly

Fourthly thus,

24	2,	17,	19
22	2,	17,	19
17 20	2,	17,	19
15	7,5	3	15
0	7,5	3	15

Sum 87

More ways may be given for the Alligatin or linking of the *Terms* in this Queſtion, but theſe a ſufficient for the induſtrious, and it ſhall alſo ſuffi to give an anſwer to the queſtion as the terms a link'd the firſt way, not doubting but the ingenio practitioner will be able at his leiſure to find Anſwe to the other 3 ways, *viz.*

	oz.	*p.w.*	*car.*
As 56 is to 17, ſo is 28 to	8-		-10 of 24
As 56 is to 2, ſo is 28 to	10-		-00 of 22
As 56 is to 19, ſo is 28 to	9-		-10 of 20
As 56 is to 18, ſo is 28 to	4-		-00 of 15
As 56 is to 10, ſo is 28 to	5-		-00 of allo

Thus much well practiſed and underſtood is ſuff cient for the underſtanding of Alligation.

The proof of Alternation Total.

In queſtions of Alternation Total, the Anſwer given is true, when the ſum of each of the quantity of ſimples found, agrees with the Sum or Quantity propounded; as in the laſt Queſtion, th Anſwer was 8 *oz.* 10 *p. w.* of 24 Carects fine, 10 o of 22 Carects fine, 9 *oz.* 10 *p. w.* of 20 Carects fin 4 *oz.* of 15 Carects fine, and 5 *oz.* of Alloy, which add toge ther make 28 *oz.* the quantity propounded.

CHAP. XIX.

Reduction of Vulgar Fractions.

1. WHat a Vulgar Fraction is, and its parts a ſeveral kinds, hath been already ſhewed the 19, 20, 21, 22, 23, 24, and 31 definitions of t fi

firſt Chapter of this Book, which the Learner is deſired diligently to obſerve before he proceeds.

2. To reduce a Vulgar Fraction (which diſcovereth the principal knowledge of Fractions, and therefore ought greatly to be regarded) we ſhall diſcover plainly under theſe eight ſeveral heads (or Rules) following, *viz.*

1. To reduce a mixt number into an improper Fraction.

2. To reduce a whole Number into an improper Fraction.

3. To reduce an improper Fraction into its equivalent whole (or mixt) number.

4. To reduce a Fraction into its loweſt terms equivalent to the Fraction given.

5. To find the value of a Fraction in the known parts of Coyn, Weight, Meaſure, *&c.*

6. To reduce a compound Fraction to a ſimple one of the ſame value.

7. To reduce divers Fractions having unequal denominators, to Fractions of the ſame value, having an equal Denominator.

8. To reduce a Fraction of one denomination to another of the ſame value.

I. *To reduce a mixt Number to an improper Fraction.*

The Rule is, *Vide Chap.* 1. *defin.* 31.

Multiply the Integral part (or whole Number) by the denominator of the Fraction, and to the Product add the Numerator, and that Sum place over the Denominator for a new Numerator; ſo this new Fraction ſhall be equal to the mixt Number given. As for Example.

1. Reduce $18\frac{3}{7}$ into an improper Fraction, multiply the whole number 18 by 7 the denominator, and to the Product add the numerator 3, the ſum is 129, which put over the denominator 7, and it makes $\frac{129}{7}$ for the anſwer as followeth.

$18\frac{3}{7}$

$18\frac{1}{7}$
7

129
facit 129

7

2. Reduce $183\frac{5}{21}$ to an improper *fraction*, *facit* $21\frac{0}{1}$
3. Reduce $56\frac{13}{22}$ to an improper *fraction*, *facit* $11\frac{8}{2}$

II. *To reduce a whole Number to an improper Fractio*

The Rule is,

Multiply the given *Number*, by the intended *denominator*, and place the product for a *numerator* over it. As for *Example*. *Vide Chap.* 11 *defin.* 23.

1. Let it be required to reduce 15 into a Fractio whose denominator ſhall be 12. To effect which, I multiply 15 by the intended denominator (12) the product is 180, which I place over 12 as a numerator, and it makes $\frac{180}{12}$ which is equal to 15, as was required; as *per* Margent. *facit* $\frac{180}{12}$

15
12
30
15
180

2. Reduce 36 into an improper Fraction whoſe denominator ſhall be 26, *facit* $\frac{936}{26}$.
3. Reduce 135 into an improper Fraction, whoſe denominator ſhall be 16, *facit* $\frac{2160}{16}$.

III. *To reduce an improper Fraction into its equivalent whole or mixt number.*

The Rule is,

Divide the Numerator by the Denominator, and the Quotient is the whole number equal to the fraction; and if any thing remain, put it for a Numerator over the Diviſor. Example, 1. Reduce

1. Reduce $43\frac{6}{8}$ into its equivalent mixt number, divide the Numerator 436 by the denominator 8, and the Quotient is 54, and 4 remains, which put for a Numerator over the Diviſor 8, the Anſwer is $54\frac{4}{8}$ as followeth.

8) 436 (54
40
facit $54\frac{4}{8}$ 36
32
4

2. Reduce $34\frac{7}{11}$ to a mixt number, *facit* $23\frac{1}{11}$
3. Reduce $15\frac{76}{136}$ to a mixt number *facit* $11\frac{72}{136}$.

IV. *To Reduce a Fraction into its loweſt terms equivalent to the Fraction given.*

The Rule is,

1. If the *numerator* and *denominator* are even *numbers*, take half of the one, and half of the other as often as may be, and when either of them falls out to be an odd number, then divide them by any number that you can diſcover will divide both *numerator* and *denominator* without any Remainder; and when you have thus proceeded as low as you can reduce them, then this new Fraction ſo found out ſhall be the *fraction* you deſire, and will be in value equal to the given Fraction.

Example.

1. Let it be required to reduce $\frac{192}{336}$ into its loweſt terms. Firſt, I take the half of the *Numerator* 192 and it is 96, then half of the *Denominator* and it is 168, ſo that now it is brought to $\frac{96}{168}$, and next to $\frac{48}{84}$, and by halfing ſtill to $\frac{24}{42}$, and their half is $\frac{12}{21}$, and now I can no longer half it, becauſe 21 is an odd *number*, wherefore I try to divide them by 3, 4, 5, 6, *&c.* and I find 3 divides them both without any remainder, and brings them to $\frac{4}{7}$ as *per* Margent.

192	96	48	24	12	4
336	168	84	42	21	6

So

So I conclude $\frac{4}{7}$ thus found to be equal in value t the given *fraction* $\frac{192}{336}$.

2. What is $\frac{1036}{1184}$ in its loweſt terms ? *Anſwer*

3. What is $\frac{1342}{1586}$ in its loweſt terms ? *Anſwer* $\frac{1}{1}$.

There is yet another way more excellent than th former to reduce a *fraction* into its loweſt terms, and that is by finding a common Meaſurer, *viz.* the greateſt *number* that will divide the *numerator* and *denominator* without any remainder, an by that means reduce a *fraction* to its loweſt terms a the firſt work ; and to find out this common meaſure divide the *denominator* by the *numerator*, and if an thing remains divide your Diviſor thereby ; and if an thing yet *remains*, then divide your laſt Diviſor by it do ſo until you find nothing *remains* ; then this la diviſor ſhall be the greateſt common meaſurer, whic will divide both *numerator* and *denominator*, and reduc them into their loweſt terms at one Work. *Vide Ought. Cl. Matth. Cap.* 7.

Example.

4. Reduce $\frac{228}{304}$ into its loweſt terms by a commo meaſurer. To effect which I divide the *denominat* 304 by the *numerator* 228 and there remains 76, the I divide 228 (the firſt Diviſor) by 76 (the *Remainde* and it quotes 3, and nothing *remains* ; wherefore th laſt Diviſor 76 is the common meaſurer, by which divide the *numerator* of the given *Fraction*, *viz.* 22 it quotes 3 for a new *numerator*, then I divide the *d nominator* 304 by 76 and it quotes 4 for a new *den minator*, that now I have found $\frac{3}{4}$ equal to $\frac{228}{304}$.

5. Reduce $\frac{6048}{7392}$ into its loweſt terms by a commo meaſurer, *facit* $\frac{9}{11}$.

6. Reduce $\frac{3081}{2038}$ into its loweſt terms by a com mon meaſurer, *facit* $\frac{13}{86}$.

A Compendium.

Note that if the *numerator* and *denominator* of a *fr ction*, and each with a Cypher or Cyphers, then cr off as many Cyphers from the one as from the othe and the *remaining* figures will be a *fraction* of the ſam value, *viz.* $\frac{3400}{7100}$ will be found to be reduced to $\frac{34}{71}$

t

cutting off the 2 Cyphers from the *numerator* and *nominator*, with a dash of the Pen, thus, $\frac{34|00}{71|00}$, d $\frac{460}{700}$, will be $\frac{46}{70}$ thus $\frac{46|0}{70|0}$, &c.

V. *To find the Value of a Fraction in the known parts of Coyn, Weight*, &c.

The Rule is,

Multiply the *numerator* by the parts of the next infe-ur *denomination* that are equal to to an Unit of the ne *denomination* with the *Fraction*, then divide that oduct by the *denominator*, and the quote gives you its lue in the same parts you multipled by, and if any ng remain multiply it by the parts of the next in-iour *denomination*, and divide as before, do so till u can bring it no lower, and the several quotients ll give you the value of the *fraction* as was required, d if any thing at last remain, place it for a *numerator* er the former *denominator*, some few Examples will ke the Rule plain.

1. What is the value of $\frac{27}{29}$ *l. Sterling?* To answer s Question I multiply the numerator 27 by 20 (the llings in a pound) the product is 540, which I di-le by 29 (the denominator) and the Quotient is *s.* and there remains 18 which I multiply by 12 nce, and the product (216) I divide by the denomi-or 29, the Quotient is 7 *d.* and 13 remains, which ultiply by 4 Farthings, the product is 52, which till divide by 29, the Quotient is 1 Farthing, and re remaineth 23, which I put for a Numerator r the denominator 29, so I find the value of $\frac{27}{29}$ *l.* be 18 *s.* 7 *d.* 1 *qr.* $\frac{23}{29}$, as by the following Opera-n, and after the same manner are the values of the ctions in the several examples following found out.

$\frac{27}{29}$ *l.*
27
Multiply 20

29) 540 (18 *s.*
29

250
232

Remains (18)
Multiply 12

36
18

29) 216 (7 *d.*
203

Remains (13)
Multiply 4

qr.
(29 52 (1$\frac{23}{29}$
29

Remains (23)

	s.	*d.*	*qr.*
Facit.	18	7	1$\frac{23}{29}$

2. VVhat is the value of $\frac{13}{15}$ *l. Sterling? facit* 14*s.* 1
3. VVhat is the Value of $\frac{28}{15}$ *l. Sterling? facit* 4 *l.* 1 *d.* $\frac{7}{15}$.
4. VVhat is $\frac{16}{22}$ *C.* weight *? facit* 3 *qrs.* 1 *l.* 5 *oz.*
5. VVhat is $\frac{13}{15}\frac{6}{1}$ *l. Troy* weight *? facit* 4 *oz. p.* 23 *gr.* $\frac{179}{271}$.
6. VVhat is $\frac{41}{50}$ of a year? *Answer,* 299 *da.* 7. 12 *min.*

VI. *To Reduce a compound Fraction to a ſimple one of the ſame value.*

What a compound Fraction is, hath been ſhewed in ap. 1. Definition 24, and to reduce it to a ſimple action of the ſame value.

The Rule is,

Multiply the Numerator continually, and place the t product for a new Numerator, then multiply the nominators continually, and place the laſt product a new denominator. So this ſingle Fraction ſhall be al to the compound Fraction given. Example.

1. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a ſimple Fraction.

Multiply the Numerators 2,3, and 5, together, they ke 30 for a new Numerator; then I multiply the nominators 3, 5, and 8 together, and their product 120 for a denominator, ſo the ſimple Fraction is $\frac{30}{120}$, and cutting off the Cyphers it is $\frac{3}{12}$ equal to $\frac{1}{4}$ the fourth Rule foregoing.

5	3
3	2
15	6
8	5
120	30

Facit $\frac{30}{120}$ or $\frac{3}{12}$ or $\frac{1}{8}$.

2. What is $\frac{7}{10}$ of $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$? *Anſwer* $\frac{154}{756}$ or $\frac{154}{756}$ $\frac{77}{378}$ in its leaſt terms.

3. What is $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$? *Anſwer,* $\frac{3003}{4872}$.

By this you may know how to find the value of a mpound Fraction, *viz.* firſt reduce it to a ſimple , and then find out his value by the 5*th*. Rule fore- ng.

Example.

Example.

What is the value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{10}$ of a pound? *Answer*, 11 *s.* 3 *d.*

VII. *To reduce Fractions of unequal Denominators to Fractions of the same value, having equal Denominators.*

The Rule is,

Multiply all the Denominators together, and the Product shall be the Common Denominator. Then multiply each Numerator into all the Denominators except its own, and the last Product put for a Numerator over the Denominator found out as before. So this new Fraction is equal to that Fraction, whose Numerator you multiplyed into the said Denominators. Do so by all the Numerators given, and you have your desire.

Example.

1. Reduce $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{7}{8}$ to a common Denominator. Multiply the Denominators 4, 5, 6, and 8, together continually, and the product is 960 for the common Denominator; then multiply the Numerator 3 into the Denominators, 5, 6, and 8, and the product is 720 which is a Numerator to 960 (found as before) so $\frac{720}{960}$ is equal to the first Fraction $\frac{3}{4}$, then I proceed to find a new Numerator to the second Fraction *viz.* $\frac{4}{5}$, and multiply 4 (into all the Denominators except its own *viz.*) into 4, 6, and 8, which produceth $\frac{768}{960}$ equal to $\frac{4}{5}$, then multiply the numerator 5 into the denominators 4, 5, and 8, the product is $\frac{800}{960}$ equal to $\frac{5}{6}$. Then multiply the numerator 7 into the Denominators 4, 5, and 6, the product is $\frac{840}{960}$ equal to $\frac{7}{8}$, and the work is done; so that for $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$ and $\frac{7}{8}$, I have $\frac{720}{960}$, $\frac{768}{960}$, $\frac{800}{960}$, $\frac{840}{960}$.

2. Reduce $\frac{11}{12}$, $\frac{14}{24}$, and $\frac{19}{24}$ into a common denominator, *faciunt* $\frac{5312}{5796}$, $\frac{3528}{5796}$, and $\frac{5244}{5796}$.

VIII. T

III. *To reduce a Fraction of one Denomination to another.*

1. This is eithe. Aſcending, or Deſcending. Aſnding when a Fraction of a ſmaller is brought to a eater Denomination, and Deſcending when a Fraction a greater Denomination is brought lower.

2. When a Fraction is to be brought from a leſſer to greater Denomination, then make of it a Compound action by comparing it with the intermediate Deminations between it, and that you would have it duced to, then (by the *6th* Rule foregoing) reduce ur Compound to a ſimple Fraction, and the Work done. Example.

Queſt. 1. It is required to know what part of a und *ſterling* $\frac{5}{7}$ of a peny is?

To reſolve this, I conſider that 1 *d.* is $\frac{1}{12}$ of a ſhilg, and a ſhilling is $\frac{1}{20}$ of a pound; wherefore $\frac{5}{7}$ *d.* is $\frac{1}{12}$ of $\frac{1}{20}$ of a pound, which by the ſaid *6th* Rule nd to be $\frac{5}{1680}$ of a *l. ſterling* of *Engliſh* Money.

Queſt. 2. What part of a pound *Troy* weight is $\frac{4}{5}$ of penny weight? *Anſwer*, $\frac{4}{5}$ of $\frac{1}{20}$ of $\frac{1}{12}$ *l.* equal to $\frac{4}{1200}$ *l. Troy.*

3. When a Fraction is to be brought from a greater a leſſer denomination, then multiply the Numerator the parts contained in the ſeveral denominations twixt it; and that you would reduce it to; then ce the laſt product over the denominator of the en Fraction. Example,

Queſt. 3. I would reduce $\frac{3}{5}$ *l.* to the Fraction of a ny; to do which I multiply the Numerator 3 by and 12, the product is 720, which I put over the nominator 5, it makes $\frac{720}{5}$ of a peny, equal to $\frac{3}{5}$ *l.*

Queſt. 4. What parts of an Ounce *Troy* is $\frac{5}{16}$ *l.*? wer, $\frac{5}{16}$ *oz.*

CHAP.

CHAP. XX.

Addition of Vulgar Fractions.

1. IF your Fractions to be added have a commo Denominator, then add all the Numerators to gether, and place their ſum for a Numerator to th common Denominator, which new Fraction is th Sum of all the given Fractions; and if it be impro per, reduce it to a whole or mixt Number, by th 3*d* Rule of the 19*th* Chapter.

Queſt. 1. What is the Sum of $\frac{1}{24}$, $\frac{7}{24}$, $\frac{16}{24}$, and $\frac{14}{24}$?

The Denominators are equal, *viz.* every one is 24 wherefore add the Numerators together, *viz.* 7, 16 and 14, their Sum is 46, which put over the De nominator 24, it makes $\frac{46}{24}$ the Sum of the given Fra ctions, which will be reduced to the mixt Numbe $1\frac{22}{24}$, or $1\frac{11}{12}$.

2. But if the Fractions to be added have unequa Denominators, then reduce them to a common De nominator by the 7*th* Rule of the 19*th* Chap. an then add the Numerators together, and put the Sum over the common Denominator, *&c.* as before in th laſt Example.

Queſt. 2. What is the Sum of $\frac{3}{5}$, $\frac{7}{8}$, $\frac{9}{10}$, and $\frac{11}{12}$?

The Fractions reduced to a common Denominat are $\frac{2880}{4800}$, $\frac{4200}{4800}$, $\frac{4320}{4800}$, and $\frac{4400}{4800}$, the Sum of the Numerators is 15800, which put over the commo Denominator, makes $\frac{15800}{4800}$ or $\frac{158}{48}$ equal to the mix number $3\frac{14}{48}$, or $3\frac{7}{24}$ for the Sum required.

Queſt. 3. What is the Sum of $\frac{13}{17}$, $\frac{21}{49}$, and $\frac{36}{47}$? *An ſwer*, $1\frac{375551}{391751}$.

3. If you are to add mixt numbers together, th add the fractional parts as before, and if their Sum an improper Fraction reduce it to a mixt numbe and add its Integral part to the Integral parts of th given mixt Numbers, and the Work is done.

Queſt. 4. What is the ſum of $13\frac{3}{4}$ and $24\frac{5}{8}$?

Fin

First add the fractions $\frac{3}{4}$ and $\frac{5}{8}$, the sum is $1\frac{11}{22}$, then dd this Integer 1, to 13 and 24, their sum is 38, nd put after it the fraction $\frac{11}{22}$ it is $38\frac{11}{33}$ for the *Answ.* r it is $38\frac{3}{8}$.

Queſt. 5. What is the Sum of $48\frac{3}{7}$, $64\frac{5}{8}$ and $130\frac{3}{4}$ *acit* $243\frac{180}{224}$, or $243\frac{45}{56}$.

4. If any of the Fractions to be added is a Compound Fraction, it muſt firſt be reduced to a ſimple raction by the *6th* Rule of Chapter 19, and then add to the reſt according to the *2d* Rule of this Chapter. xample,

Queſt. 6. What is the Sum of $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$? Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a ſimple fraction, and it is $\frac{105}{192}$, which reduced with the other two, and added e $1\frac{468}{560}$.

Queſt. 7. What is the Sum of $\frac{11}{12}$ and $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$? *nſwer*, $1\frac{5}{12}$.

5. If the fractions to be added are not of one demination, they muſt be ſo reduced, and then proed as before.

Queſt. 8. What is the Sum of $\frac{3}{4}$ *l.* and $\frac{5}{6}$ *s*?

Of the given fractions here, one is of a pound and e other the fraction of a ſhilling; and before you n add them together, you muſt reduce $\frac{5}{6}$ *s.* to the ction of a pound as the other is (by the *8th* le of Chapter 19) and it makes $\frac{5}{120}$ *l.* then $\frac{3}{4}$ *l.* and $\frac{5}{6}$ *l.* will be found to be $\frac{380}{480}$ *l.* or $\frac{38}{48}$ *l.* by the *7th* le of Chapter 19, and in its loweſt terms $\frac{19}{24}$ *l.* by *4th* Rule of Chapter 19.

It would have been the ſame, if (by the latter part the *8th* Rule of Chapter 19) you had reduced $\frac{3}{4}$ *l.* the *fraction* of a ſhilling, which you would have nd to have been $\frac{60}{4}$ *s.* which added to $\frac{5}{6}$ *s.* by the *17th* Rule of the laſt Chap. the Sum is $15s\ \frac{20}{24}$, ich is equal to the Sum found as before, *viz.* $\frac{19}{24}$ *l.* (by the *5th* Rule of Chapter 19) the value of $\frac{19}{24}$ *l.* be found to be 15 *s.* 10 *d.* and ſo will $15s.\frac{20}{24}$ be nd to be juſt as much.

Queſt. 9. What is the Sum of $\frac{2}{5}$ *l.* $\frac{3}{5}$ *s.* and $\frac{3}{5}$ *d.* *Answer* $\frac{379500}{600000}$ or $\frac{3795}{6000}$ or *l.* in its loweſt terms $\frac{253}{400}$ *l.*

CHAP. XXI.

Subſtraction of Vulgar Fractions.

1 THE Rules in Addition for reducing the given Fractions to one *denomination*, are here to be obſerved; for before *Subſtraction* can be made, the *fractions* muſt be reduced to a common *denominator*, then *ſubſtract* one *Numerator* from the other, and place the *remainder* over the common *denominator*, which *fraction* ſhall be the exceſs or difference between the given *fractions*. Example,

Queſt. 1. What is the difference between $\frac{3}{4}$ and $\frac{5}{8}$? The given *fractions* are reduced to $\frac{24}{32}$ and $\frac{20}{32}$, then *ſubſtract* the *numerator* 20 from the *numerator* 21, and there remains 1, which being put over the *denominator* 32 makes $\frac{1}{32}$ for the anſwer or difference between $\frac{3}{4}$ and $\frac{5}{8}$.

Queſt. 2. What is the difference between $\frac{5}{6}$ and $\frac{3}{5}$ of $\frac{5}{8}$?

Reduce the compound *fraction* $\frac{3}{5}$ of $\frac{5}{8}$ to a ſimple *fraction*, then proceed as before, and the anſwer $\frac{110}{240}$ equal to $\frac{11}{24}$.

2. When a *fraction* is given to be *ſubſtracted* from a whole *number*, *ſubſtract* the *numerator* from the *denominator*, and put the *remainder* for a *numerator* to the given *denominator*, and *ſubſtract* an Unit (for that you borrowed) from the whole number, and the remainder place before the *fraction* found as before, which mixt number is the remainder or difference ſought. Example,

Queſt. 3. *Subtract* $\frac{7}{10}$ from 48.

Anſw. 47 $\frac{3}{10}$; for if you *ſubtract* 7 (the *numerator*) from 10 (the *denominator*) there remains 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrowed) from 48 reſts 47 to which join $\frac{3}{10}$ and it makes 47 $\frac{3}{10}$ for the exceſs.

Queſt. 4. *Subtract* $\frac{13}{21}$ from 57, *remains* 56 $\frac{8}{21}$.

3.

3. If it is required to *ſubſtract* a *fraction* from a mixt number, or one mixt number from another, reduce the *fractions* to a common *denominator*, and if the *fraction* to be *ſubſtracted* be leſſer than the other, then *ſubſtract* the leſſer numerator from the greater, and that is a numerator for the common denominator; then *ſubſtract* the leſſer integral part from the greater, and the *remainder* with the remaining *fraction* thereto annexed, is the Difference required between the two given mixt numbers. Example,

Queſt. 5. *Subſtract* $26\frac{3}{5}$ from $54\frac{5}{8}$.

Firſt, *Subſtract* $\frac{3}{5}$, *viz.* $\frac{15}{40}$ from $\frac{5}{8}$, *viz.* $\frac{25}{40}$, the remainder is $\frac{17}{40}$, then 26 from 54 remaineth 28, to which annex $\frac{17}{40}$, it makes $28\frac{17}{40}$ for the *Anſwer.*

4. But if the *fraction* to be ſubſtracted is greater than the Fraction from whence you ſubſtract, then having firſt reduced the Fraction to a common denominator, take the numerator of the greater Fraction out of the denominator, and add the remainder to the numerator of the leſſer Fraction, and their Sum is a new numerator to the common denominator, which fraction note, then (for the 1 you borrowed) add 1 to the Integral part to be ſubſtracted, and ſubſtract it from the greater number, and to the remainder annex the fraction you noted before, ſo this new mixt number ſhall be the difference ſought. Example,

Queſt. 6. Subſtract $14\frac{3}{4}$ from $29\frac{4}{7}$.

The fractions reduced are, *viz.* $\frac{3}{4}$ equal to $\frac{21}{28}$, and equal to $\frac{16}{28}$, now I ſhould ſubſtract $\frac{21}{28}$ from $\frac{16}{28}$, but I cannot, therefore I ſubſtract 21 from 28 reſts 7, which added to 16 (the leſſer numerator) makes 23 for a numerator to 28; *viz.* $\frac{23}{28}$, then I come to the Integral parts 14 and 29, and ſay 1 that I borrowed and 14 is 15, which taken from 29 there reſts 14, to which annexing $\frac{23}{28}$ it is $14\frac{23}{28}$ for the remainder or difference between $14\frac{3}{4}$ and $29\frac{4}{7}$.

Queſt. 7. *Subſtract* $36\frac{9}{10}$ from $74\frac{4}{5}$ *facit* $37\frac{9}{10}$.

CHAP. XXII

Multiplication of Vulgar Fractions.

1. IF the Multiplicand and Multiplier are ſimple (or ſingle) Fractions, then multiply the numerators together for a new numerator, and the denominators for a new denominator, which new Fraction is the product required.

Queſt. 1. What is the product of $\frac{5}{7}$ by $\frac{9}{11}$? *facit* $\frac{45}{77}$.

For the numerators 5 and 9 being multiplyed make 45, and the denominators 7 and 11 being multiplyed make 77.

Queſt. 2. What is the product of $\frac{18}{25}$ by $\frac{21}{37}$? *fa.* $\frac{378}{925}$.

2. If the Fractions to be multiplyed are mixt numbers reduce them to improper Fractions by the 11th Rule of the 19*th* Chapter, then proceed as before.

Queſt. 3. What is the product of $48\frac{3}{5}$ by $13\frac{5}{8}$?

The given mixt numbers being reduced to improper fractions are $48\frac{3}{5}$ equal to $\frac{243}{5}$, and $13\frac{5}{8}$ equal to $\frac{83}{8}$; now $\frac{243}{5}$ multiplyed by $\frac{83}{8}$ according to the firſt Rule of this Chapter, produceth $\frac{20169}{40}$ or $672\frac{9}{40}$.

Queſt. 4. What is the product of $430\frac{6}{10}$ by $18\frac{3}{7}$? *facit* $\frac{55474}{70}$ or $7935\frac{24}{70}$.

3. If a compound Fraction is to be multiplied by a ſimple Fraction, firſt reduce the compound fraction into a ſimple fraction, then multiply the one by the other, as is taught above.

Queſt. 5. What is the product of $\frac{15}{21}$ by $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$? the Compound Fraction $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$ reduced is $\frac{60}{140}$ or $\frac{6}{14}$ which multiplyed by $\frac{15}{21}$ produceth $\frac{90}{294}$ which in its loweſt terms is $\frac{15}{49}$ for the Anſwer.

And if the Multiplicand and Multiplyer are both compound fractions, reduce them both to ſimple ones, then multiply theſe new fractions as before, ſo have you the product.

Queſt. 6. What is the product of $\frac{3}{4}$ of $\frac{2}{3}$ by $\frac{3}{5}$ of $\frac{1}{2}$?

Anſwer, $\frac{18}{120}$ in its loweſt terms $\frac{3}{20}$.

Queſt. 7. What is the product of $\frac{2}{3}$ of $\frac{3}{4}$ by $\frac{2}{5}$ of $\frac{5}{8}$?

Anſwer

Answ. $\frac{60}{360}$ or $\frac{6}{36}$, or in its least terms $\frac{1}{6}$.

4. If a Fraction be to be multiplyed by a whole number, put under the given whole number an Unit for a Denominator, whereby it will be an improper Fraction, then multiply these Fractions as before. Examp'e.

Quest. 8. What is the Product of 24 by $\frac{2}{3}$?

Answ. $\frac{48}{3}$, for 24 by putting an Unit under it will be $\frac{24}{1}$, and $\frac{24}{1}$ by $\frac{2}{3}$ produceth $\frac{48}{3}$ or 16.

Quest. 9. What is the Product of 36 by $\frac{9}{11}$? *Answer,* $\frac{324}{11}$ or $29\frac{5}{11}$

CHAP. XXIII.

Division of Vulgar Fractions.

IF the dividend and the Divisor are both of the Fractions, then multiply the numerator of the dividend into the denominator of the divisor, and the product is a new numerator, and multiply the denominator of the Dividend into the Numerator of the Divisor, and the product is a new Denominator, which new Fraction thus found, is the Quotient you desire. Example.

Quest. 1. What is the Quotient of $\frac{5}{8}$ divided by $\frac{3}{5}$?

Answ. $\frac{25}{24}$ or $1\frac{1}{24}$, for 1st I multiply (5) the Numerator of the Dividend into (5) the denominator of the Divisor, and the product (25) is

$$\frac{3}{5}\overline{)\frac{5}{8}}\left(\frac{25}{24}\right.$$

numerator for the Quotient, then I multiply (8) the denominator of the dividend into (3) the numerator of the Divisor, and the product (24) I put in the quotient for a denominator, so I find $\frac{25}{24}$ is the quotient sought.

Quest. 2. What is the quotient of $\frac{10}{21}$ divided by $\frac{2}{3}$?

Answ. $\frac{30}{42}$ equal to $\frac{5}{7}$ in its lowest terms.

2. But if you would divide a simple Fraction by a compound, or a compound by a simple, first reduce

such compound to a simple Fraction, then go on as before.

Queſt. 3. What is the quotient of $\frac{3}{10}$ divided by $\frac{3}{4}$ of $\frac{2}{3}$? *Anſwer* $\frac{36}{60}$ or $\frac{3}{5}$, firſt reduce $\frac{3}{4}$ of $\frac{2}{3}$ into a simple Fraction, and it is $\frac{6}{12}$, by which $\frac{3}{10}$ being divided the Quotient is $\frac{36}{60}$ equal in its leaſt terms to $\frac{3}{5}$. And if the Dividend and Diviſor be both compound Fractions, reduce them both to ſimple Fractions, then divide the one by the other as in Rule 1 beforegoing.

Queſt. 4. What is the quote of $\frac{2}{3}$ of $\frac{3}{4}$ divided by $\frac{3}{4}$ of $\frac{5}{6}$?

Anſw. $\frac{180}{120}$ or $\frac{18}{12}$ or $1\frac{6}{12}$ or $1\frac{1}{2}$ in its loweſt terms.

3. If the Dividend, or Diviſor, or both are mixt numbers, reduce them to improper Fractions, and perform Diviſion as you were taught before. Example.

Queſt. 5. What is the quote of $12\frac{3}{4}$ divided by $21\frac{4}{5}$?

Anſw. $\frac{255}{428}$, for $12\frac{3}{4}$ is equal to $\frac{51}{4}$ and $21\frac{4}{5}$ is equal to $\frac{109}{5}$, and the quote of $\frac{51}{4}$ divided by $\frac{109}{5}$ is as before $\frac{255}{428}$.

4. If you divide a Fraction by a whole number, or a whole number by a Fraction, make the whole number an improper Fraction by putting an Unit for a denominator to it as was taught in Rule 4 of Chap. 2: and then perform Diviſion as before was taught in Example.

Queſt. 6 What is the Quote of 8 divided by $\frac{3}{5}$?

Anſw. $\frac{40}{3}$ which is equal to $13\frac{1}{3}$ being reduced as is before directed. See the Work in the Margent.

$\frac{3}{5})\frac{8}{1}(\frac{40}{3}$ or $13\frac{1}{3}$

Queſt. 7 What is the Quotient of $\frac{3}{5}$ divided by 8? *Anſwer* $\frac{3}{40}$, as *per Margent.*

$\frac{8}{1})\frac{3}{5}(\frac{3}{40}$

$\frac{8}{1})\frac{3}{5}(\frac{3}{40}$

CHAP

CHAP. XXIV

The Rule of Three Direct in Vulgar Fractions.

1. AS in the *Rule of* 3 in whole *Numbers*, ſo likewiſe in *Fractions*, you muſt ſee that the *Fractions* of the firſt and third places be of the ſame denomination.

2. See that if any of the given *Fractions* be compound, that they be reduced to ſimple of the ſame value.

3. If there are given mixt numbers, reduce them to improper *Fractions* by the firſt Rule of Chap. 19.

4. If any of the three terms is a whole number, make it an improper *Fraction* by conſtituting a Unit for its *denominator*.

Having reduced your *Fraction* as is directed in the laſt *Rules*, then proceed to a Reſolution which is performed the ſame way as in whole numbers, reſpect being had to the Rules delivered for the working of *Fractions*, *viz.* multiply the 2*d* and 3*d Fractions* together, according to the 1 Rule of Chap. 22. and divide the product by the firſt *Fraction*, according to the Rule of Chap. 23. and the Quotient is the Anſwer.

Or (which is better)

5. Multiply the numerator of the firſt Fraction into the denominators of the ſecond and third, and the product is a new denominator, then multiply the denominator of the firſt Fraction into the numerators of the ſecond and third, and the product is a new numerator; which new Fraction is the 4*th* Proportional or anſwer, which (if it is an improper Fraction) muſt be reduced to a whole or mixt number by the third Rule of Chap. 19. Examples,

Queſt. 1. If $\frac{3}{4}$ yards of Cloth coſt $\frac{5}{8}$ *l.* what will $\frac{11}{12}$ *yds* coſt?

Having placed the given Fractions according to the Rule of Chap. 10. I proceed to the reſolution, and firſt I multiply the numerator of the firſt Fraction (3)

into 8 and 10, the denominators of the second and third fractions, and the product is 240 for a denominator, then I multiply 4 the denominator of the first fraction into 5 and 9 the Numerators of the second and third fractions the product is 180 for a Numerator, which Numerator 180 and denominator 240 make $\frac{180}{240}$ *l.* for the Answer, equal to $\frac{3}{4}$ *l.* or 15 *s.*

yds	*l.*	*yds.*	*l.*
3	5	9	180
4	8	10	240
	l.		*l.*
	facit 180	equal to	3
	240		4

Quest. 2. If $\frac{2}{3}$ *l.* buy $\frac{5}{6}$ *yds* of Cloth, what will $\frac{11}{12}$ *yds* cost at that rate?

Answer, $\frac{330}{180}$ *l.* equal to $\frac{11}{6}$ *l. or* 14 *s.* 8 *d.*

Quest. 3. If $\frac{7}{8}$ *l.* cost $\frac{3}{4}$ *s.* what will $\frac{3}{5}$ *s.* buy?

Answer, $\frac{252}{210}$ *l.* equal to $1\frac{1}{27}$ *l.*

Quest. 4. If $\frac{3}{5}$ of an Ell of Holland cost $\frac{1}{3}$ of a pound, how much will $12\frac{2}{3}$ ells cost at that rate?

Answer, $\frac{190}{27}$ equal to $7\frac{1}{27}$ *l.*

In resolving the last question, and the two next, observe the Third Rule of this Chapter foregoing.

Quest. 5. If $\frac{9}{10}$ of a *C.* cost 284 *s.* what will $7\frac{1}{2}$ *C.* cost at that rate?

Answer, 239 $\frac{7}{2}$ *s.* or 11 *l.* 19 *s.* 7 *d.*

Quest. 6. If $3\frac{1}{4}$ yards of Velvet cost $3\frac{5}{8}$ *l.* how much will $10\frac{1}{2}$ yards cost at that rate?

Answer, $11\frac{37}{52}$ *l.*

Quest. 7. If 3 *yds* of Broad Cloth cost $2\frac{4}{5}$ *l.* what will $14\frac{3}{7}$ yds cost?

Answer, 13 *l.* 9 *s.* 4 *d.*

In working the last question and the 4 next, observe the 4*th.* Rule of this Chap. foregoing.

Quest. 8. If 14 *l.* of Pepper cost 14 *s.* $6\frac{3}{5}$ *d.* I demand the price of $73\frac{3}{4}$ *l.*

Answer, 3 *l.* 16 *s.* $7\frac{43}{56}$ *d.*

Quest. 9. If 1 *l.* of Cochenele cost 1 *l.* 5 *s.* what will $36\frac{7}{10}$ *l.* cost?

Answer, 45 *l.* 17 *s.* 6 *d.*

Quest.

Queſt. 10. If one yard of broad-cloth coſt $15\frac{5}{8}$ *s.* what will 4 pieces, each containing $27\frac{1}{7}$ yards at that rate?

Anſwer, 85 *l.* 14 *s.* $3\frac{1}{7}$ *d.*

Queſt. 11. A Mercer bought $3\frac{1}{2}$ pcs of ſilk, each pc. $24\frac{3}{4}$ ells at 6 *s.* $0\frac{3}{4}$ *d. per* Ell, I demand the value of $\frac{1}{2}$ pcs at that rate?

Anſwer, 26 *l.* 3 *s.* $4\frac{3}{4}$ *d.*

In ſolving the 4 next queſtions obſerve the 8. Rule of Chap. 19.

Queſt. 12. If $\frac{3}{5}$ of an ounce of Silver coſt 2 *s.* I demand the price of $11\frac{1}{2}$ *l.* at that rate?

Anſwer, 35 *l.*

Queſt. 13. If $5\frac{1}{2}\frac{5}{7}$ *l.* of Gold is worth $61\frac{5}{7}$ *l. ſterling*, what is 1 grain worth at that rate?

Anſwer, $1\frac{1}{2}$ *d.*

Queſt. 14. If $\frac{3}{4}$ yds of Silk is worth $\frac{3}{4}$ of $\frac{5}{8}$ *l.* what the price of $15\frac{3}{5}$ Ells *Flemiſh*?

Anſwer, 9 *l.* 12 *s.* 6 *d.*

Queſt. 15. If $\frac{2}{3}$ of $\frac{3}{4}$ of a pound of Cloves coſt 6 *s.* 8 *d.* what coſt the *C.* weight at that rate?

Anſwer, 69 *l.* 6 *s.* 8 *d.*

Note that when the Anſwers to the Queſtions in this and the next Chap. are given in Fractions, they are given in their loweſt Terms.

CHAP. XXV.

The Rule of Three Inverſe in Fractions.

IT hath been already taught (in the third Rule of the 11*th* Chap.) how to diſcover when the 4*th* proportional number (to the 3 given numbers) is to be found out by a Rule of 3 Direct, and when by the Rule of Three Inverſe, to which Rule the Learner is now referred.

2 When (in Fractions) you find a queſtion to be reſolved by the Rule of 3 Inverſe, *viz.* when the third term is the Diviſor, then (having reduced the terms

exactly according to the Rules in Chap. 24) multiply the numerators of the 3 Fractions into the denominators of the second and first Fractions, and the product is a new Denominator, then multiply the denominator of the third Fraction into the numerators of second and first Fractions, and the product is a new numerator, which new fraction thus found is the answer to the question.

Quest. 1. If $\frac{3}{4}$ of a yard of Cloth that is 2 *yds* wide will make a Garment, how much of any other Drapery, that is $\frac{3}{5}$ of a yard wide will make the same Garment?

Answer, $2\frac{1}{2}$ *yds*.

Quest. 2. Lent my Friend 46 *l.* for $\frac{4}{5}$ of a year; how much ought he to lend me for $\frac{7}{12}$ of a year?

Answer, $63\frac{3}{5}$ *l.*

Quest. 3. If $\frac{2}{3}$ of a yard of Cloth that is $2\frac{1}{3}$ *yds* wide will make any Garment, what breadth is that Cloth, when $1\frac{3}{4}$ *yds* will make the same Garment?

Answer, $\frac{59}{63}$ of a *yd* wide.

Quest. 4. How many inches in length of a board that is 9 Inches broad will make a Foot square?

Answer, 16 inches in length.

Quest. 5. If when the bushel of Wheat cost $4\frac{3}{4}$ *s.* the penny Loaf weigheth $10\frac{2}{3}$ Ounces, what will it weigh when the bushel cost $8\frac{9}{10}$ *s.*?

Answer, $5\frac{1}{2}\frac{8}{67}$ Ounces.

Quest. 6. If 12 Men can mow $24\frac{1}{2}$ Acres in $10\frac{2}{3}$ days, in how many days will 6 Men do the same?

Answer, In $21\frac{1}{3}$ days.

CHAP. XXVI.

Rules of Practice.

1. IN the single Rule of 3, when the first of the 3 Numbers in the Question (after they are disposed according to the 6*th*. Rule of Chap. 10) happeth to

o be an Unit (or 1) that Queſtion many times may e reſolved far more ſpeedily than by the Rule of 3, which kind of Operation is commonly called Practice, and indeed it is of excellent uſe amongſt Merchants, Tradeſmen and others, by reaſon of its ſpeedineſs in finding a reſolution to ſuch kind of Queſtions.

2. The chiefeſt Queſtion reſolvable by theſe brief Rules may be comprehended under the ſeveral general heads or caſes following, *viz.*

When the given Price of the Integer conſiſts,

1 *Of farthings under* 4
2 *Of pence under* 12
3 *Of pence and farthings*
4 *Of ſhillings under* 20
5 *Of ſhillings, pence and farthings*
6 *Of Pounds*
7 *Of pounds, ſhillings, pence and farthings.*

It would be very convenient for the Practical Arithmetician to have by heart the ſeveral products o the Nine Digits multiplyed by 12, for his ſpeedy reducing pence into ſhillings, or ſhillings into pence, which he may gain by the following Table.

12 Times

1	12
2	24
3	36
4	48
5	60
6	72
7	84
8	96
9	108

3. Shillings are practically reduced into pounds thus, *viz.* cut off the figure ſtanding in the place of Units with a daſh of the pen and note it for ſhillings, then draw a line under the given Number, and take half

half of the remaining figures (after the first is cut off) and set them under the line, and they are so many pounds, but if the last figure is odd, then take the lesser half, and add 10 to the figure so cut off (as before) for shillings, as if I were to reduce 43658 shillings into pounds, first I cut off the last figure (8) for shillings, then I take half of the remaining figures (4365) thus half of 4 is 2, which I put under the line, then $\frac{1}{2}$ of 3 is 1, and because 3 is an odd number, I make the next figure 6 to be 16, and I go on, saying, $\frac{1}{2}$ of 16 is 8, and then $\frac{1}{2}$ of 5 is 2, which is the last figure, wherefore because 5 is an odd number, I add 10 to the 8 I cut off, and it makes 18 *s.* so that I find it to be 2182 *l.* 18 *s.* as *per Margent.*

4365|8	
l.	s.
2182	18

4. It is likewise convenient that the Learner be acquainted with the practical Tables following, the first containing the Aliquot (or even) parts of a shilling, the second containing the Aliquot parts of a pound.

The even Parts of a shilling.

d.	*s.*
6	$\frac{1}{2}$
4	$\frac{1}{3}$
3	$\frac{1}{4}$
2	$\frac{1}{6}$
$1\frac{1}{2}$	$\frac{1}{8}$
1	$\frac{1}{12}$

The even parts of a pound

s.	*d.*	*l.*
10	00	$\frac{1}{2}$
6	08	$\frac{1}{3}$
5	00	$\frac{1}{4}$
4	00	$\frac{1}{5}$
3	04	$\frac{1}{6}$
2	06	$\frac{1}{8}$
2	00	$\frac{1}{10}$
1	08	$\frac{1}{12}$
1	00	$\frac{1}{20}$

Case 1.

Case 1.

5. When the price of the Intege. is a Farthing, then take the ſixth Part of the given Number, which will be ſo many three half-pences, and if any thing Remains it is Farthings, by the 7*th* Rule of Chap. 9. then conſider that three half-pence is $\frac{1}{8}$ of a ſhilling, wherefore take the eighth part of them for ſhillings, and if any thing remain they are ſo many 3 half-pence, which reduce into pounds by the Third Rule foregoing. Example, What comes 67486 *l.* to at a Farthing *per l.* Firſt, I take $\frac{1}{6}$ of 67486 and it is 11247 three half-pence and 4 farthings, or one peny; then $\frac{1}{8}$ of 11247 is 1405 *s.* and 7 remains, which is 7 three half-pence, or $10\frac{1}{2}$ *d.* which with the 4 farthings before make $11\frac{1}{2}$ *d.* and 1405 ſhillings, which by the 3 Rule is 70 *l.* 5 *s.* In all 70 *l.* 5 *s.* $11\frac{1}{2}$ *d.* for the *Anſwer.* See the Work following.

		d.
$\frac{1}{6}$	67486	at $\frac{1}{4}$ per *l.*
		d.
$\frac{1}{8}$	11247	--1
$\frac{1}{20}$	1405	—$10\frac{1}{2}$
	l.	*s.* *d.*
	70	—5—$11\frac{1}{2}$ *facit*

Other Examples follow.

$\frac{1}{6}$	8576 *l.* at 1 *qr.*	
$\frac{1}{8}$	1429	— 2 *qrs.*
$\frac{1}{20}$	1718	— 8 *d.*
	l. s. d.	
	8—18—8	*facit*

$\frac{1}{6}$	6380 *l.* at 1 *qr.*	
$\frac{1}{8}$	1063	— 2 *qrs.*
$\frac{1}{20}$	1312	— 11 *d.*
	l. s. d.	
	6—12—11	*facit*

6. When

6. When the price of the Integer is 2 farthings, then take the third part of the given Number for so many three-half-pences, and the Remainder (if any) is half pence, then take the eighth part of that for shillings, as before, *&c.*

Examples.

$\frac{1}{3}$	7368 *l.* at 2 *qrs.*	
$\frac{1}{8}$	2456	
$\frac{1}{2\,0}$	3017	
	l. s.	
	15 7 *facit*	

$\frac{1}{3}$	8347 *l.* at 2 *qrs.*
$\frac{1}{8}$	2782 —— 2 *qrs.*
$\frac{1}{2\,0}$	3417 —— 9 *d.* $\frac{1}{2}$
	l. s. d.
	17—7—9 *facit*

7. When the price of the Integer is 3 farthings, then take half the given Number for three half-pence, (and if any thing remain it is 3 farthings) then take the eighth of that for shillings as before, *&c.*

Examples.

$\frac{1}{2}$	4736 *l.* at 3 *qrs.*	
$\frac{1}{8}$	2368	
$\frac{1}{2\,0}$	2916	
	l. s.	
	14—16 *facit*	

$\frac{1}{2}$	5425 *l.* at 3 *qrs.*
$\frac{1}{8}$	2712 —— 3 *qrs.*
$\frac{1}{2\,0}$	3316
	l. s. d. qrs.
	16—19-0—3 *fa.*

Case 2.

8. When the given price of the Integer, is a part, or parts of a shilling (*viz.* pence) divide the given Number of Integers (whose value is sought) by the Denominator, of the fraction representing the even part, and the quote is shillings, (always minding the *7th.* Rule of the *9th.* Chap.) and those shillings may be reduced into *l.* by the *3d.* Rule of this Chapter. Examp. Let it be required to find the value of

438 *l.*

438 *l.* at 3 *d. per l.* I conſider 3 *d.* is $\frac{1}{4}$ of a ſhilling, and 438 *l.* will coſt ſo many 3 pences, wherefore I divide 438 by 4 the denominator of $\frac{1}{4}$, and the quote is 109 ſhillings, and 2 remains, which is 2 three pences or 6 *d.* the whole value is 5 *l.* 9 *s.* 6 *d.* as by the following work appeareth.

$\frac{1}{4}$	438 *l.* at 3 *d.*
$\frac{1}{20}$	109——6

	l.	s.	d.
facit	5	9	6

More Examples follow.

	l. d.
$\frac{1}{2}$	3574 at 6 *per l.*
$\frac{1}{20}$	1787

facit 89 *l.* 7 *s.*

	l. d.
	5316 at 2 *per l.*
$\frac{1}{20}$	886

facit 44 *l.* 6 *s.*

	l. d.
$\frac{1}{4}$	438 at 4 *per l.*
$\frac{1}{20}$	146

facit 7 *l.* 6 *s.*

	l. d.
$\frac{1}{8}$	6389 at $1\frac{1}{2}$ *per l.*
$\frac{1}{20}$	798——7 *d.* $\frac{1}{2}$

facit 39 *l.* 18 *s.* 7 *d.* $\frac{1}{2}$

	l. d.
$\frac{1}{4}$	879 at 3 *per l.*
$\frac{1}{20}$	219— 9 *d.*

facit 10 *l.* 19 *s.* 9 *d.*

	l. d.
$\frac{1}{12}$	88 at 1 *per l.*
$\frac{1}{20}$	6 8 —— 2 *d.*

facit 3 *l.* 8 *s.* 2 *d.*

9 If the price of the Integer be pence under 12, and yet not an even part, then it may be divided into even parts, and ſo the parts of the given Number taken

ken accordingly, and added together, as if it were 5 *d.* which is 3 *d.* and 2 *d. viz.* $\frac{1}{4}$ and $\frac{1}{6}$ of a ſhilling, firſt take $\frac{1}{4}$ of the given number, and then $\frac{1}{6}$ thereof and add them together, and their Sum is the Anſwer in ſhillings, ſtill obſerving Rule 7. of Chap. 9. for the remainders, (if any be) then bring the ſhillings into pounds by the 3 Rule foregoing. Likewiſe 7 *d.* is $\frac{1}{3}$ and $\frac{1}{4}$, ſo 9 *d.* is $\frac{1}{2}$ and $\frac{1}{4}$, and 10 *d.* is $\frac{1}{4}$ and $\frac{1}{6}$, and 11 *d.* is $\frac{1}{3}$ and $\frac{1}{3}$ and $\frac{1}{4}$ of a ſhilling or elſe many times your work may be ſhortned thus, *viz.* when the ſaid given price is to be divided into even parts of a ſhilling or of a pound, after you have taken the firſt even part, the other may be an even part of that part, as in the next Example, where is given 439 *l.* at 5 *d. per l.* now I may divide it thus, *viz.* into 4 *d.* and 1 *d.* and 4 *d.* being $\frac{1}{3}$ of a ſhilling, and 1 *d.* being $\frac{1}{4}$ of 4 *d.* I firſt take $\frac{1}{3}$ of 439 *l.* and it gives 146 *s.* 4 *d.* and for the 1 *d.* I take $\frac{1}{4}$ of 146 *s.* 4 *d.* which is 36 *s.* 7 *d.* which in all comes to 9 *l.* 2 *s.* 11 *d.* Examples follow.

	l.	d.
	439 *at* 5 *per l.*	
$\frac{1}{3}$	146	4
$\frac{1}{4}$	36	7
	18|2	11
	9 *l.* 2 *s.* 11 *d. facit*	

	ells	d.
	587 *at* 7 *per Ell*	
$\frac{1}{3}$	195	8
4	146	9
	34|2	5
	17 *l.* 2 *s.* 5 *d. facit*	

	yds.	d.
	417 *at* 9 *per yd*	
$\frac{1}{2}$	208	6
$\frac{1}{2}$	104	3
	31|2	9
	15 *l.* 12 *s.* 9 *d. facit*	

	ells	d.
	386 *at* 10	
$\frac{1}{2}$	193	
$\frac{1}{3}$	128	8
	32|1	8
	16 *l.* 1 *s.* 8 *d. facit*	

	yds.	d.
	836	*at* 8 *per yd*
⅓	278	—— 8
⅓	278	—— 8
	5517	—— 4
	27*l.* 17*s.* 4*d.*	*facit*

	l.	d.
	534	*at* 11
⅔	178	
⅓	178	
¼	133	—— 6
	4819	—— 6
	24*l.* 9*s.* 6*d.*	*facit*

Case 3.

10. When the price of the Integer is pence and rthings, if it make an even part of a ſhilling, work before, but if they are uneven, as penny farthing, enny three farthings, 2 *d.* 1 *qr.* or 2 *d.* 3 *qrs.* 3 *d.* *qrs.* or the like, then firſt work for ſome even part, d then conſider what part the reſt is of that even art, and divide that quotient thereby, then add em together, and reduce them o pounds as before, Example, 3470 *l.* at 1 *d.* 1 *qr.* *per l.* firſt I ork for the penny by dividing 470 by 12, for 1 *d.* is $\frac{1}{12}$ of a illing, and the quote is 289 *s.* *d.* then I conceive that one rthing is the ¼ of a peny, and he value at one farthing, will e ¼ of the value at 1 peny, and herefore I take ¼ of 289*s.* 2 *d.* hich is 72 *s.* 3 *d.* 2 *qrs.* and ld them together, and they are 8*l.* 1*s.* 5*d.* 2 *qrs.* as by the Margent. Other Examples of the ſame nature follow.

l.	*qrs.*
3470 *at*	5
289 ——	2
72 ——	3 —— 2
3611 ——	5 —— 2

l.	*s.*	*d.*	*qrs.*
18 —	1 —	5 —	2

	l.	d.
1/12	4360 *at*	1 1/4
1/4	363	4
	90	10
	45|4	2
	l.	*s.* *d.*
	22	14 2 *facit*

	yds	d.
1/8	573 *at*	1 3/4
1/6	71	7 1/2 *d.*
	11	11 1/4
	8|3	6 3/4
	l.	*s.* *d.*
facit	4	3 6 3/4

1/8	485 *l. at*	2 3/4 *d.*
1/8	80	10 *d.*
	10	1 1/4
	910	11 3/4
	4 *l.* 10 *s.*	11 1/4 *d.*

1/2	520 *yds at*	7 1/2
1/4	260	
	65	
	2|25	
	16 *l.* 5 *s.*	*facit*

1/6	654 *l.* at	2 1/2 *d.*
1/4	109	
	27	3 *d.*
	1316	3
	6 *l.* 16 *s.*	3 *d.*

	137 *yds* at	10 1/2
1/2	68	6 *d.*
1/2 1/8	34	3
	17	1 1/2
	1119	10 1/2 *d.*
	5 *l.* 19 *s.*	10 1/2 *facit*

Case 4.

11. When the price of the Integer is 2 *s.* then cut off the figure in the place of Units of the given number, and double it for ſhillings, and the figures on the other hand are pounds. Example 436 *yds* at 2 *s. per yd*, cut off the laſt figure 6 and double it, it makes 12 ſhill. and the other 2 figures, *viz.* 43 are ſo many pounds, ſo that their value is 43 *l.* 12 *s.* as *per Margent.*

4316

43 *l.* 12 *s.*

12. Hence

12. Hence it is evident that when the given price f an Integer is an even number of ſhillings, then if ou take half of that even number of ſhillings, and ultiply the given number of Integers thereby, dou- ing the firſt figure of the product, and ſetting it part for ſhill. the reſt of the product will be pounds, hich pounds and ſhill. is the value ſought. Example, *What coſt 526 yds at 8 s. per yd?* To reſolve which, take $\frac{1}{2}$ of 8 *s.* (the price of a *yd*) which is 4, and ultiply 536 thereby, ſaying, 4 mes 6 is 24, then I double the rſt figure 4 makes 8 for ſhill. nd carry 2 to the next product, *&c.* I find the reſt of the pro- uct to be 214 which I note for pounds, ſo the value f 536 *yds* at 8 *s. per yd* is 214 *l.* 8 *s.* as *per* Margent. lore Examples follow.

546 *yds* at 8 *s.*

214 *l.* 8 *s.*

6 yds at 6 s. per yd	420 yds at 12 s. per yd
16 l. 16 s. *facit*	252 l. *facit*
23 yds at 4 s. per yd	326 yds at 14 s. per yd
24 l. 12 s. *facit*	228 l. 4 s. *facit*
8 ells at 8 s. per ell	48 yds at 16 s. per yd
19 l. 4 s. *facit*	38 l. 8 s. *facit*
4 yds at 10 s. per yd	52 yds at 18 s. per yd
42 l. *facit*	46 l. 16 s. *facit*

13. If the given price of the Integer is an odd umber of ſhillings, then work firſt for the even number f ſhillings by the laſt Rule, and for the odd ſhilling take $\frac{1}{20}$ of the given Number of Integers according to the Rule of this Chap. and add them together, and you ave your deſire. Examples follow.

yds	*s.*			*ells*	*s.*		
422	at	3	*per yard*	431	at	13	
l.	*s.*			*l.*	*s.*		
42	——	4		258	——	12	
21	——	2		21	——	11	
63	——	6	*facit*	280	——	03	*facit*

ells	*s.*			*ells*	*s.*		
516	at	7	*per ell*	324	at	17	*per ell*
l.	*s.*			*l.*	*s.*		
154	——	16		259	——	4	
25	——	16		16	——	4	
180	——	12	*facit*	275	——	8	*facit*

14. Except when the given price of the Integer is 5 *s.* for then it is sooner answered by taking $\frac{1}{4}$ of the given Number whose value is sought, as in the following Example.

	yds	*s.*			*ells*	*s.*		
$\frac{1}{4}$	436	at	5	*per yard*	206	at	5	*per ell*
	109 *l.*	*facit*			51 *l.*	10 *s.*	*facit*	

Case 5.

15. When the given price of an Integer is shillings and pence, or shillings, pence and farthings; then if the shillings and pence be an even part of a pound, divide the given number of Integers, whose value you seek by the denominator of that Fraction representing that even part. As for Example, what is the price of 384 *yds* at 6 *s.* 8 *d.* *per yd?* Here I consider that 6 *s.* 8 *d.* is $\frac{1}{3}$ of a pound, wherefore

erefore I divide 384 by 3, and
e quore is the Answer, *viz.* 128 *l.*
tha 384 *yds* at 6 *s.* 8 *d.* *per yd*
ounts to 128 *l.* as *per margent*, still
ferving the 7*th* Rule of the 9*th*
apter.

$\frac{1}{3}$	384
	128 *l. facit*

More Examples follow.

	438 *ells at* 6 *s.* 8 *d.*
	146 *l. facit*
	525 at 3 *s.* 4 *d.*
	87 *l.* 10 *s. facit*
$\frac{3}{8}$	443 *yds at* 2 *s.* 6 *d.*
	55 *l.* 7 *s.* 6 *d. facit*
$\frac{1}{12}$	726 *yds at* 1 *s.* 8 *d.*
	60 *l.* 10 *s. facit*

16. When the given value of the Integer is ſhillings
d pence, and not an even part of a pound, yet ma-
times it may be divided into parts (*viz.* 6 *s.* 6 *d.* is
. and 2 *s.* 6 *d.* for the 4 *s.* work according to the
Rule foregoing, and for the 2 *s.* 6 *d.* take the
hth part of the given Number and add them to-
her, then their ſum is the value required.)
So 8 *s.* 6 *d.* will be divided into 6 *s.* and 2 *s.* 6 *d.*
d the price of the given Number may be found
t as before, *&c.* Examples follow.

	yds s. d.
	386 *at* 8—8
$\frac{1}{3}$	128 *l.*—13—4
10	38 —12—0
	167 *l.* 5 *s.* 4 *d. facit*

	tells s. d.
s.	540 *at* 5—4
2	54 *l.*—0 *s.*
$\frac{1}{6}$	90—0
	144 *l.* 0 *s. facit*

	ells s. d.
s.	427 *at* 8—6
6	128 *l.*—2—0
$\frac{1}{8}$	53—7—6
	181 *l.* 9 *s.* 6 *d. facit*

	yds s. d.
s.	386 *at* 14—8
8	154 *l.*— 8—0
$\frac{1}{3}$	128—13—4
	283 *l.* 1 *s.* 4 *d. facit*

17. When

17. When the given price of the Integer is ſhillings and pence, and you cannot readily divide them according to the laſt Rule, then multiply the given number whoſe value you ſeek by the number of ſhillings in the price of the Integer, and then for the pence work by the *8th* Rule foregoing, then add the Numbers together, and their Sum is the value ſought in ſhillings; as for Example, what is the value of 392 *yds* at 6 *s.* 9 *d. per yard.* Here 6 *s.* 9 *d.* cannot be madd any even part, nor indeed can it be divided into even parts of a pound, wherefore I multiply the given number of *yards* 392 by 6, for the 6 *s.* the product is 2352 ſhillings, then for the 9 *d.* I divide it into 6 *d* and 3 *d.* and work for them by the *8th* Rule foregoing, and at laſt add the ſhillings together, they make 2646 *s.* and by the 3 Rule they are reduced to 132 *l.* 6 *s.* the value of 392 *yds* at 6 *s.* 9 *d. per yard* Seet he work following.

	Lps	*s.*	*d.*
	392 *at*	6	9
	2352		
½	196		
¼	98		
	26416		
	1132 *l.* 6 *s. facit*		

Other Examples follow.

s.	*l.*	*s.*	*d.*
	480 *at*	4	10
4	1920		
½	240		
⅓	160		
	23210		
	116 *l. facit.*		

s.	*ells.*	*s.*	*d.*
	732 *at*	12	7
12			
½	8784		
¼	244		
	183		
	92111		
	460 *l.* 11 *s. facit.*		

18. When

18. When the given price of the Integer is ſhillings, pence and farthings, then multiply the given number of Integers by the number of ſhillings contained in the value of the Integer, and for the pence and farthings follow the 10*th* Rule of this Chapter.

Examples.

	yds.	*s.*	*d.*
s.	438 *at*	8	—— 6 ¾.
8	3504		
½	219		
⅛	27	—— 4 ½ *d.*	
	2751	0 —— 4 ½	
	fac. 187 *l.* 10 *s.* 4½ *d.*		

	ells	*s.*	*d.*
	370 *at*	14	—— 2¾
	1480		
s.	370		
14	5180		*d.*
⅙	61	——	8
¼	15	——	5
½	7	——	8½
	5261	4 ——	9½
	fac. 263 *l.* 4 *s.* 9 *d* ½.		

	ells	*s.*	*d.*
.	136 *at*	9	—— 2½
9	1224	——	0
⅙	22	——	8
¼	5	——	8
	1251	2 ——	4
	fac. 62 *l.* 12 *s.* 4 *d.*		

	ells	*s.*	*d.*
s.	431 *at*	2	—— 4½
2	862		
¼	107	——	9 *d.*
⅛	53	——	10½.
	1021	3 ——	7½
	facit 51 *l.* 3 *s.* 7½ *d.*		

Caſe

Case 6.

19. When the given value of the Integer is pounds then multiply the Number of Integers whose value is sought by the price of the Integer, and the product is the answer in pounds.

Examples.

C.	*l.*		*C.*	*l.*
42	*at* 2 *per C.*		13	*at* 8 *per C.*
84 *l. facit*			104 *l. facit*	
C.	*l.*		*C.*	*l.*
30	*at* 3 *per C.*		48	*at* 12 *per C.*
90 *l. facit*			576 *l. facit*	

Case 7.

20. If the price of the Integer is pounds and shillings, then for the pounds work as in the last Rule, and for the shillings as in the 12 and 13 Rules before going; then add the Numbers produced from them both, and the Sum is the Value sought.

Examples.

	C.	*l.*	*s.*		*grofs*	*l.*	*s.*
	46	*at* 2	—4		82	*at* 4	—10
2 *l.*	92		*s.*	4 *l.*	328		
4 *s.*	9		—4	10 *s.*	41		
	101 *l.* 4 *s. facit.*				369 *l. facit*		

	grofs	*l.*	*d.*		*grofs*	*l.*	*s.*
	58	*at* 3	—7		26	*at* 3	—15
3 *l.*	174		*s.*	3 *l.*	78		
6 *s.*	17		—8	14 *s.*	18		—4
1 *s.*	2		—18	1 *s.*	1		—6
	194 *l.* 6 *s. facit*				97 *l.* 10 *s. facit*		

21. When

21. When the given price of an Integer consists of pounds, shillings, and pence, with farthings, then work for the shillings, pence, and farthings, first according to the 18 Rule of this Chapter, and find the total value of the given Number, as if there were no pounds, then work with the pounds according to the 1 Rule of this Chapter, and add the Numbers thus found, and their Sum is the total value required.

Examples of this Rule follow.

C.	l.	s.	d.
213	at 1	—13	—4½
639			
213			
2769			d.
53			3
26			7½
284	8		10½
142 *l.* 08 *s.* 10½ *d.*			
213			
355 *l.* 8*s.* 10½ *d. facit*			

C.	l.	s.	d.
37	at 3	—8	—10½
296	*d.*		8 *s.*
18	—6		6 *d.*
9	—3—		3 *d.*
4	—7½		1½ *d.*
32	8	—4½	*d.*
16 *l.* 8 *s*			4½ *d*
111			3 *l.*
127 *l.* 8 *s.* 4½ *d. fac.*			

gross	l.	s.	d.
416	at 3	—9	—3¾
3744			
104			
26			
38714			
193 *l.* 14 *s.*			
832			
1025 *l.* 14 *s. facit*			

gross	l.	s.	d.
48	at 3	—15	—11½
240			
48			
720			15 *s.*
24			6 *d.*
16			4 *d.*
6			1½ *d.*
7616			
38—6			
144			3 *l.*
182 *l.* 6 *s. facit*			

22. When there is given the value of an Integer and it is required to know the value of many succ Integers together, with $\frac{1}{4}$ or $\frac{1}{2}$ or $\frac{3}{4}$ of an integer then first (by the former rules) find out the Valu of the given number of Integers, and then for $\frac{1}{4}$ t an integer take $\frac{1}{4}$ of the given value of the Integer or for $\frac{1}{2}$ take $\frac{1}{2}$ of the given value of the integer, and fo $\frac{3}{4}$ first take the $\frac{1}{2}$ of the given value, and then $\frac{1}{2}$ of tha $\frac{1}{2}$, setting each part under the precedent, then addin them together, their Sum will be the required valu of the Integers and their parts. Example; what is th value of 116$\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard*? To give an Answer, first I work for the value of 116 *yds.* by the 15*th.* Rule foregoing, and then for the $\frac{1}{2}$ *yd.* I take $\frac{1}{2}$ of 4 *s.* 6 *d.* which is 2 *s.* 3 *d.* and add to the reſt found as before, then is that Sum the total value of 116$\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard*, which I find to amount to 26 *l.* 4 *s.* 3 *d.* as by the work in the Margent

yds.	*s.*	*d.*
116$\frac{1}{2}$ *at* 4	——	6.
11 *l.* 12 *s.*		2 *s.*
14 — 10 *d.*		2 *s.* 6 *d.*
2 — 3		$\frac{1}{2}$ *yd.*
26 — 4 — 3 *facit*		

Other Examples follow.

320$\frac{1}{4}$ *yds. at* 4 *s.* 10 *d.*	
1296 ——	4 *s.*
162 ——	6 *d.*
108 ——	4 *d.*
1 — 2$\frac{1}{2}$ *d.*	$\frac{1}{4}$ *yd.*
1501 7 *s.*	2$\frac{1}{2}$ *d.*
78 *l.* 7 *s.* 2$\frac{1}{2}$ *d. facit*	

720$\frac{1}{2}$ *yds. at* 6 *s.* 8 *d.*
240 *l.* 3 *s.* 4 *d. facit*

228$\frac{3}{4}$ *ells at* 12 *s.* 11 *d.*	
2736 ——	12 *s.*
76 ——	4 *d.*
76 ——	4 *d.*
57 ——	3 *d.*
6 — 5$\frac{1}{2}$ *d.*	$\frac{1}{2}$ *ell.*
3 — 2$\frac{3}{4}$ *d.*	$\frac{1}{4}$ *ell.*
2951 4 — 2$\frac{1}{4}$ *d.*	
147 6 14 *s.* 8$\frac{1}{4}$ *d facit*	

C. qrs. l.	*l.*	*s. C*
28 — 3 — 14 *at* 1	—	10
28 *l.* ——		1 *l.*
14 *l.* ——		10 *s.*
00 — 15 *s.*		$\frac{1}{2}$ *C.*
7 *s.* 6 *d.*		$\frac{1}{4}$ *C.*
3 *s.* 9 *d.*		14 *l.*
43 *l.* 6 *s.* 3 *d. facit*		

Many

Many more queſtions may be ſtated, and ſeveral her Rules of Practice may be ſhewn according to the ethod of divers Authors, but what have been de- ered here are ſufficient for the practical Arithme- ian in all Caſes whatſoever.

CHAP. XXVII.

The Rule of Barter.

BArter is a Rule amongſt Merchants, which (in the Exchanging of one Commodity for ano- r) informs them ſo to proportion their Rates as t neither may ſuſtain loſs.

2. To reſolve Queſtions in Barter, it will not be ficult to him that is acquainted with the Golden le, or Rule of 3, it being altogether uſed in reſol- g ſuch Queſtions.

Queſt. 1. Two Merchants, (*viz.* A and B) *Barter*, A h 13, C. 3 *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s.* *per* C. B hath Cotton at 9 *d.* *per l.* I demand how much ton B muſt give A for his Pepper?

Anſwer. 9 C. 1 *qrs.*

Firſt, find by the Rule of 3, or, the Rules of *Pra-* e foregoing, how much the *Pepper* is worth, ng,

f 1 *C.* coſt 2 *l.* 16 *s.* what will 13 *C.* 3 *qrs.* 14 *l* ?

Anſwer, 38 *l.* 17 *s.*

econdly, By the Rule of 3 ſay, if 9 *d.* buy 1 *l.* Cotton, how much will 38 *l.* 17 *s.* buy?

Anſwer, $9\frac{1}{4}$ *C.* and ſo much Cotton muſt B give to A 13 *C.* 3 *qrs.* 14 *l.* of *Pepper* at 2 *l.* 16 *s.* *per Cent.* n the Cotton is worth 9 *d.* *per l.*

Queſt. 2. Two Merchants (A and B) *barter*, A hath Ginger worth 1 *l.* 17 *s.* 4 *d. per C.* but in *barter* he will have 2 *l.* 16 *s. per C.* B hath Nutgmegs worth 5 *l.* 12 *s. per C.* now I demand how B muſt rate his Nutmegs *per C.* to make his gain in *barter* equal to that of A?

Anſwer, 8 *l.* 8 *s.*

Say, By the Rule of 3, If 1 *l.* 17 *s.* 4 *d.* require 2 *l.* 16 *s.* in *barter*, what will 5 *l.* 12 *s.* require in *barter*?

Facit 8 *l.* 8 *s.*

Queſt. 3. A and B *barter*, A hath 120 yards of Broad-cloth worth 6 *s. per yd.* but in *barter* he will have 8 *s. per yd.* B hath Shalloon worth 4 *s. per yd.* Now I demand how many *yds* of Shalloon B muſt give A for his Broad-cloth, making his gain in *barter* equal to that of A?

Anſwer, 180 *yds* of Shalloon.

Firſt (as in the laſt queſtion) find out how B ought to ſell his Shallon in *barter*, *viz.* ſay if 6 *s.* require 8 *s.* what will 4 *s.* require?

Anſwer, 5 *s.* 4 *d.*

Thus you ſee that B muſt ſell his ſhalloon in *barter* at 5 *s.* 4 *d.* if A ſell his Broad-cloth at 8 *s. per yd.*

It remaineth now to find out how much Shalloon B muſt give for 120 yards of broad-cloth, which after the ſame method uſed to reſolve the firſt Queſtion of this Chapter is found to be 180, and ſo many *yds* of Shalloon muſt B give A for the 120 *yds.* of broad-cloth.

Queſt. 4 A and B *bartered*, A had 14 *C.* of Sugar worth 6 *d. per l.* for which B gave him 1 *C.* 3 *qrs.* of Cinnamon, I demand how B rated his Cinnamon *per l.*

Anſwer, 4 *s. per* pound.

Queſt. 5. A and B *barter*, A hath 4 Tun of Brandy worth 37 *l.* 16 *s.* ready mony, but in *barter* he hath 50 l. 8 *s. per* Tun, and A giveth B 21 *C.* 2 *qrs.* 11$\frac{1}{3}$ of Ginger for his 4 Tun of Brandy, I deſire to know how B ſold his Ginger in *barter per C.* and how much it was worth in ready mony

Anſwe

Anſwer, For 9 *l.* 6 *s.* and 8 *d.* in Barter, and it was orth 7 *l. per Cent.* in ready money.

Queſt. 6. A and B *barter*, A hath 320 dozen of Candles at 4 *s.* 6 *d. per* dozen, for which B giveth him 30 *l.* in money, and the reſt in Cotten at 8 *d. per l.* demand how much Cotten he muſt give him more than the 30 *l.*

Anſwer, 11 *C. qr.*

Queſt. 7. A and B *bartr*, A hath 608 yards of broad loth worth 14 *s. per yd.* for which B giveth him 25 l. 12 s. ready money, and 85 *C.* 2 *qrs.* 24 l. of ees Wax, now I deſire to know how he reckoned is Wax *per. C.*

Anſwer 3 l. 10 s. *per. C.*

CHAP. XXVIII.

Queſtions in Loſs and Gain.

Queſt. 1. A Merchant bought 436 yards of broadcloth for 8 s. 6 d. *per* yard, and ſelleth t again at 10 *s.* 4. d. *per* yd. now I deſire to know ow much he gained in the Sale of the 463 yards?

Anſwer, 39 l. 19 s. 4 d.

Firſt find out by the Rule of Three, or by practice ow much the Cloth coſt him at 8 *s.* 6 d. *per yd.* which find to be 185. l. 6 s. then by the ſame Rule find ut how much he ſold it for, *viz.* 225 l. 5 s. 4 d. hen ſubſtract 185 *l.* 6 s. which it coſt him, from 225 l. 5 s. 4 d. which he ſold it for, and their remaineth 39 l. 19 s. 4 d. for his gain in the Sale thereof.

Otherwiſe it may ſooner be reſolved thus, firſt find ut how much he gained *per yd. viz.* ſubſtract 8 s. 6 d. which he gave *per yd.* from 10 s. 4 d. which he ſold it for *per yd.* the remainder is 1 s. 10 d. for his gains *per yd.* Then ſay,

If 1 *yd.* gain 1 *s.* 10 *d.* what will 436 *yds.* gain? thee *Answ.* by Practice, or the Rule of Three is 39 *l.* 19 *s.* 4 *d.* as was found before.

Quest. 2. A Draper bought 124 *yds.* of Holland cloth, for which he gave 31 *l.* I desire to know how he must sell it *per yd.* to gain 10 *l.* 6 *s.* 8 *d.* in the whole Sale of the 124 *yds?* Answer, at 6 *s.* 8 *d.* *per yd.*

And the price which it cost him, (*viz.* 31 *l.*) to his intended gain, (*viz.* 10 *l.* 6 *s.* 8 *d.*) the sum is 41 *l.* 6 *s.* 8 *d.* then say,

If 124 *yds.* require 41 *l.* 6 *s.* 8 *d.* what will 1 *yd.* require? by the Rule of Three I find the Answer 6 *s.* 8 *d.*

Quest. A Grocer bought 3 *C.* 1 *qr.* 14 *l.* of Cloves, which cost him 2 *s.* 4 *d.* *per l.* and sold them for 52 *l.* 14 *s.* I desire to know how much he gained in the whole? Answer 8 *l.* 12 *s.*

Quest. 4. A *Draper* bought 86 Kerseys for 129 *l.* I demand how he must sell them *per* piece to gain 15 *l.* in laying out 100 *l.* at the rate? Answer 1 *l.* 14 *s.* 6 *d.* *per* piece; for,

As 100 *l.* is to 115 *l.* so is 129 *l.* to 148 *l.* 7 *s.*

So that by the proportion above, I have found how much he must receive for the 86 Kerseys to gain after the rate of 15 *l.* *per C.* then to find how he must sell them *per* piece. I say,

As 86 pieces are to 148 *l.* 7 *s.* so is 1 piece to 1 *l.* 14 *s.* 4 *d.* which is the number sought.

Quest. 6. A *Grocer* bought 4¼ *C.* of Pepper for 25 *l.* 17 *s.* 4 *d.* and (it proving to be damnified) is willing to lose 12 *l.* 10 *s.* *per Cent.* I demand how he must sell it *per l.* Answer 7 *d.* *per l.*

Substract 12 *l.* 10 *s.* the loss of 100 *l.* from 100 *l.* and there remains 87 *l.* 10 *s.* then say,

As 100 *l.* is to 87 *l.* 10 *s.* so is 15 *l.* 17 *s.* 4 *d.* to 13 *l.* 17 *s.* 8 *d.* so much as he must sell it all for to lose after the rate propounded, then to know how he must sell it *per l.* I say,

As 13 *l.* 17 *s.* 6 *d.* is to 4¼ *C.* so is 1 *l.* to 7 *d.*

Quest.

Quest. 6. A *Plummer* sold 10 Fodder of Lead (the *Fodder* containing $19\frac{1}{2}$ *C.*) for 204 *l.* 15. *s.* and gained after the rate of 12 *l.* 10 *s. per* 100 *l.* I demand how much it cost him *per C*? Answer 18 *s.* 8 *d.*

To resolve this Question add 12 *l.* 10 *s.* (the Gain *per Cent.*) to 100 *l.* and it makes 112 *l.* 10 *s.* then say,

As 112 *l.* 10 *s.* is to 100 *l.* so is 204 *l.* 15 *s.* to 128 *l.*

Which 128 *l.* is the Sum it cost him in all, then reduce your 10 *fodders* to half hundreds and it makes 390, then say,

As 390 half hundreds is to 128 *l.* so is 2 half hundreds to 18 *s.* 8 *d.* the price of 2 half hundreds, or one *C.* weight, and so much it stood him in *per C.* weight.

Quest. 7. A *Merchant* bought 8 Tuns of Wine, which being sophisticated, he selleth for 400 *l.* and loseth after the rate of 12 *l.* in receiving a 100 *l.* now I demand how much it cost him *per Tun*? and how he selleth it *per gallon* to lose after the said rate? *Answ.* it cost 56 *l. per tun*, and he must sell it at 3 *s.* 11 *d.* $2\frac{10}{21}$ *qrs. per gallon* to lose 12 *l.* in receiving 100 *l.*

To resolve this question I consider in the first place, that in receiving 100 *l.* he loseth 12 *l.* therefore 100 *l.* comes in for 112 *l.* laid out, wherefore to find how much he laid out for the whole, I say,

As 100 *l.* is to 112 *l.* so is 400 *l.* to 448 *l.* and so much the 8 Tun cost him, then to find how much it cost *per tun*, I say,

As 8 is to 448 *l.* so is 1 to 56 *l.* the price it cost *per Tun.*

Now to find how he must sell it *per* gall. reduce the 8 Tuns into Gallons, they make 2016, then say,

As 2016 Gallons is to 400 *l.* so is 1 Gall. to 3 *s.* 11 *d.* $2\frac{10}{21}$ *qrs.* the price he must sell it at *per* Gall. to lose as aforesaid.

Quest. 8. A Merchant bought 8 Tuns of Wine, which being sophisticated, he is willing to sell for 400 *l.* and loseth at that rate 12 *l.* in laying out 100 *l.* upon the same, now I demand how much it cost him *per* Tun ??

Here I consider that for 100 *l.* laid out, he receiveth but 88 *l.* therefore to find what the 8 Tuns cost him, I say,

As 88 *l.* is to 100 *l.* so is 400 *l.* to $454\frac{6}{11}$ the price it all cost him, then to find how much *per Tun*, I say,

As 8 is to $454\frac{6}{11}$ *l.* so is 1 to $56\frac{7}{11}$, or 56 *l.* 16 *s.* 4 *d.* $1\frac{7}{11}$ *qr. per Tun.*

CHAP. XXIX.

Equation of Payments.

1. EQuation of Payments, it that Rule amongst Merchants whereby we reduce the times for payment of several Sums of Money, to an equated time for the payment of the whole Debt, without Damage to Debtor or Creditor, and

The Rule is,

2. Multiply the Sums of each particular payment by its respective Time, then add the several products together, and their Sum divide by the total debt, and the quotient thence arising is the equated Time for the payment of the whole debt. Example

Quest. 1. A is indebted to B in the Sum of 130 *l.* whereof 50 *l.* is to be paid at 2 months, and 50 *l.* at 4 months, and the rest at 6 months, now they agree to make one payment of the total Sum, the question is what the equated time for payment without Damage to Debtor or Creditor?

To

To resolve this Question I multiply each payment by its time, *viz.*

50 *l.* *multiplyed by* 2 *mon.* *produceth*	100
50 *l.* *multiplyed by* 4 *mon.* *produceth*	200
30 *l.* *multiplyed by* 6 *mon.* *produceth*	180
The Sum of the Product is	480

Then I divide 480 (the Sum of the Products) by 130 (the total Debt) and the Quotient is $3\frac{9}{13}$ months for the time of paying the whole Debt.

Quest. 2. A Merchant hath owing him 1000 l. to be paid as followeth, *viz.* 600 l. at 4 months, 200 l. at 6 months, and the rest (which is 200 *l.*) at 12 months, and he agreeth with his Debtor to make one payment of the whole, I demand the time of Payment without Damage to Debtor or Creditor ?

600 *l.* *multiplyed by* 4 *months is*	2400
200 *l.* *multiplyed by* 6 *months is*	1200
200 *l.* *multiplyed by* 12 *months is*	2400
The Sum of the Product is	6000

And the Sum of the products (6000) being divided by the whole Debt (1000 *l.*) quotes 6 months for the time of payment of the whole Debt.

3. The truth of this Rule is thus manifest, if the Interest of that Money which is paid (by the equated time) after it is due, be equal to the interest of that money which (by the equated time) is paid so much sooner than it is due at any rate *per C.* then the Operation is true, otherwise not. Example,

The Proof of the Rule of Equation of Payments.

In the last Quest. 600 *l.* should have been paid at 4 months, but it is not discharged till 6 months (that is 2 months after it is due) wherefore its interest for 2 months at 6 *per C. per Annum* is 6 *l.* and then

200 l. was to be paid at 6 months, which is the equated time for its payment, therefore no intereſt is reckoned for it, but 200 l. ſhould have been paid at 12 months, but it is to be paid at 6 months, which is 6 months ſooner than it ought, wherefore the intereſt of 200 l. for 6 months is 6 l. (accompting 6 l. *per Cent. per Annum*) which is equal to the intereſt of 600 l. for 2 months, wherefore the work is right.

Queſt. 3. A *Merchant* hath owing him a certain ſum to be diſcharged at 3 equal payments, *viz.* $\frac{1}{3}$ at two months, $\frac{1}{3}$ at four months and $\frac{1}{3}$ at 8 months, the queſtion is, what is the equated time for the payment off the whole Debt?

In queſtions of this nature, (*viz.* where the Debt is divided into equal or unequal parts) each of the parts is to be multiplyed by its time, and the ſum of the product is the Anſwer,

$\frac{1}{3}$ *multiplyed by* 2 *mon. produceth* $\frac{2}{3}$
$\frac{1}{3}$ *multiplyed by* 4 *mon. produceth* $1\frac{1}{3}$
$\frac{1}{3}$ *multiplyed by* 8 *mon. produceth* $2\frac{1}{3}$

The Sum of the Product is $4\frac{2}{3}$

which is $4\frac{2}{3}$ months for the equated time of payment.

If inſtead of the *fractions* (repreſenting the parts) you had wrought by the numbers themſelves (repreſented by thoſe parts) according to the firſt and ſecond Examples, it would have been the ſame Anſwer, as ſuppoſe the Debt had been 90 *l.* then $\frac{1}{3}$ of it is 30 *l.* for each payment, *viz.* at 2, 4, and 8 months, then

30 *l. multiplyed by* 2 *mon. produceth* 60
30 *l. multiplyed by* 4 *mon. produceth* 120
30 *l. multiplyed by* 8 *mon. produceth* 240

The Sum of the product is 240

which divided by 90 (the whole debt) quoteth $4\frac{60}{90}$ or $4\frac{2}{3}$ months as before.

Queſt. 4.

Quest. 4. A Merchant oweth a Sum of Money to be paid $\frac{1}{2}$ at 5 Months, and $\frac{1}{4}$ at 8 Months, and $\frac{1}{4}$ at 10 Months, and he agreeth with his Creditor to make one total payment; I demand the time, without damage to Debtor or Creditor? Work as in the last Question, and you will find the Answer to be 7 Months.

Quest. 5. *A* is indebted to *B* 800 *l.* Whereof he is to pay 40 *l.* present Money, and 350 *l.* at 3 Months, and the rest (*viz.* 250 *l.*) at 8 Months, and they agree, to make an Equated time for the whole Payment; now I demand the time?

In questions of this Nature, (*viz.* where there is ready money paid) you are (in Multiplying) to neglect the Money that is to be paid present, and work with the rest as is before directed, and divide the Sum of the products by the whole Debt, and the Quote is the Answer: For here 40 *l.* is to be paid present, and hath no time allowed, and according to the Rule it should be multiplied by its time, which is (0) therefore 40 times 0 is 0, which neither augmenteth nor diminisheth the Dividend; wherefore (to proceed according to direction) I say,

350 *by* 3 *Months produceth*	1050
250 *by* 8 *Months produceth*	2000
The Sum of the product is	3050

which divided by 640, the whole Debt, the Quote is $4\frac{42}{64}$ Months, the time of Payment.

Quest. 6. *A* is indebted to *B* in a certain Sum, $\frac{1}{2}$ whereof is to be paid present Money, $\frac{1}{3}$ at 6 Months, and the rest at 8 Months; now I demand the Equated time for the payment of it all?

Answer, $3\frac{1}{7}$ Months is the time of payment.

Quest. 7. *A* is indebted to *B* 120 *l.* whereof $\frac{1}{2}$ is to be paid at 3 months, $\frac{1}{4}$ at 6 months, and the rest at 9 months; what is the Equated time for the payment of the whole Sum?

Answer,

Answer, At 6 ¼ months.

Quest. 8 A is indebted to B 420 *l.* which is due at the end of 6 months, but A is willing to pay him 140 *l.* present, provided he can have the remainder forborn so much the longer to make satisfaction for his kindness, which is agreed upon, I desire to know what time ought to be allotted for the payment of the 280 *l.* remaining?

To resolve this Question, first, find out what is the interest, of 140 *l.* for the time it was paid before it was due, at 6 *per Cent.* (or any other rate) (*viz.* 6. months)) and you will find it to be 4 *l.* 4 *s.* Then it is evident that the remaining 280 *l.* must be detained so much longer than 6 months as the while it may eat out that interest, *viz.* 4 *l.* 4 *s.* which is thus found out, *viz.* First, see what is the Interest of 280 *l.* for a month, or any other time; but here we will take one month, and its Interest, for one month is 28 *s.*

Then by the Rule of Three, say,

As 28 *s.* is to 1 month; so is 84 *s.* to 3 months; so that the 280 *l.* remaining must be kept 3 months, beyond its first time of pryment, (*viz.* 6 months) which added thereto, makes 9 months, at the end of which time A ought to make payment of the remainder.

CHAP. XXX.

EXCHANGE.

1. THE Rule of Exchange informeth Merchants how to exchange Moneys, Weights, or Measures of one Country into (or for) the Moneys, Weights, or Measures of another Country and when the Rate, Reason, or proportion betwixt the Money, Weights, or Measures of different Countryes is known, it will not be difficult for the practitioner that is well acquainted with the Rule of proportion (or Rule of Three) to resolve any Question wherein it is required

to

to Exchange a given quantity of the one kind into the same value of another kind.

2. In Questions of Exchange there is always a comparison made between the Coyns, *&c.* of two Countries (or kinds) or of more.

3. In Questions where there is a comparison made between two things, (whether they be Moneys, Weights, *&c.*) of different kinds or (Countries) there may be a solution found by a single Rule of Three, as may appear by the following Example.

Quest. 1. A Merchant at *London* delivered 370 *l. Sterling*, to receive the same at *Paris* in *French* Crowns; the Exchange $3\frac{1}{3}$ *French* Crowns *per* pound *Sterling*. I demand how many *French* Crowns ought he to receive?

In placing the numbers observe the 6 Rule of the 10 Chapter, which being done, the given numbers will stand thus,

l.	*Crowns*	*l.*
1	$3\frac{1}{3}$	370

and being reduced according to the Rules of the 24 Chapter, will stand thus;

l.	*Crowns*	*l.*	*Crowns*
As $\frac{1}{1}$	is to $\frac{10}{3}$	so is $\frac{370}{1}$	to $1233\frac{1}{3}$

So that I conclude he ought to receive $1233\frac{1}{3}$ *French* Crowns at *Paris* for 370 *l.* delivered at *London*.

Quest. 2. A Merchant delivered at *Amsterdam* 587 *l. Flemish* to receive the value thereof at *Naples* in Ducats the Exchange $4\frac{4}{5}$ Ducats *per l. Flemish*. I demand how many Ducats he ought to receive?

The proportion is as followeth.

l.	*Ducats*	*l.*	*Ducats*
As $\frac{1}{1}$	is to $\frac{24}{5}$	so is $\frac{587}{1}$	to $2817\frac{3}{5}$

So I find he ought to receive $2817\frac{3}{5}$ Ducats at *Naples* for the 587 *l. Flemish* delivered at *Amsterdam*.

Quest. 3. A Merchant at *Florence* delivereth 3478 Ducatoons, to receive the value at *London* in pence, the Exchange $53\frac{1}{2}$ pence *Sterling per* Ducatoon; I demand how much *Sterling* he ought to receive?

The

The Proportion for Resolution is,

As $\frac{1}{1}$ Duc. is to $10\frac{7}{2}$ d. so is $34\frac{8}{1}$ Duc. to 18607 d.

which is equal to 7751. $6\frac{1}{1}\frac{1}{2}$ for the Answer.

I might here (according to the Custom of Arithmetical Writers) lay down Tables for the Reduction of Foreign Coyns to *English*; but by Reason of their Instability (for they continue not at a constant standard, as our *Sterling* Money doth, but are sometimes raised, and sometimes depressed) I shall forbear.

4. When there is a Comparison made between more than two different Coyns, Weights, or Measures, there ariseth ordinarily two different cases from such a Comparison.

1. When it is required to know how many pieces of the first Coyn, Weight, or Measure are equal in value to a known number of Pieces of the last Coyn, Weight, or Measure.

2. When it is required to find out how many Pieces of the last Coyn, Weight, or Measure are equal in Value to a given Number of the first sort of Coyn, Weight, or Measure.

An Example of the first Case may be this, VIZ.

Quest. 4. If 150pence at *London* are equal to 3 Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Brussels*, then how many pence at *London* are equal to 138 Shillings at *Brussels*? *Facit* 960 d.

This Question may be resolved at two single Rules of Three; for first I say,

If $\frac{3}{1}$ Ducats at *Naples* make 150 Pence *London*, how many Pence will $4\frac{4}{5}$ Ducats make?

Answer, 240 Pence.

By the foregoing Proportion, we have discovered that $4\frac{4}{5}$ Ducats at *Naples* make 240 Pence at *London*!

London: And by the Tenour of the Question we see that $4\frac{4}{5}$ Ducats at *Venice* make $34\frac{1}{2}$ shillings at *Brussels*, therefore 240 *d.* at *London.* are equal to $34\frac{1}{2}$ *s.* at *Brussels*, (for the things that are equal to one and the same thing are also equal to one another) wherefore we have a way laid open to give a solution to this Question by another Single Rule of Three, whose proportion is,

As $34\frac{1}{2}$ shillings at *Brussils* is to 240 pence at *London*, so is 138 shill. at *Brussels* to 960 pence at *London*, which is the Answer to the Question.

An Example of the second Case may be thus, VIZ.

Quest. 5. If 40 *l. Averdupois* weight at *London* is equal to 36 *l.* weight at *Amsterdam*, and 90 *l.* at *Amsterdam* makes 116 *l.* at *Dantzick* then how many pounds at *Dantzick* are equal to 112 *l.* of *Averdupois* weight at *London*?

Answer, $129\frac{2}{5}$ pounds at *Dantzick*.

This Question is likewise answered at two single Rules of Three, *viz.* First, I say,

As 36 *l.* at *Amsterdam* is to 40 *l.* at *Lond.*

So is 90 *l.* at *Amsterdam* to 100 *l.* at *Lond.*

And by the Question you find that 90 *l.* at *Amsterdam* is 116 *l.* at *Dantzick*, and therefore 100 *l.* at *London* is likewise equal thereunto, wherefore again, I say,

As 100 *l.* at *London* is to 116 *l.* at *Dantzick*,

So is 112 *l.* at *Lond.* to $129\frac{2}{5}$ *l.* at *Dantzick*.

By which I find that $112\frac{2}{5}$ *l.* at *Dantzick* are equal to 112 *l. Averdupois* weight at *Lond.*

5. There is a more speedy way to resolve such Questions as are contained under the two Cases before-mentioned, laid down by Mr. *Kersey* in the third Chapter of his Appendix to Mr. *Wingate's* Arithmetick, where he hath given two Rules for the Resolution of the Questions pertinent to the two said Cases.

6. But I shall lay down a general Rule for the solution of both Cases; and first, let the Learner observe the following Directions in placing of the given terms, *viz.*

7. Let.

7. Let there be made two Columns, and in these Columns so place the given terms one over the other, as that in the same Column there may not be found two terms of the same kind one with the other.

Having thus placed the Terms, the General Rule is,

Observe which of the said Columns hath the most Terms placed in it, and multiply all the Terms therein continually, and place the last product for a Dividend; then multiply the Terms in the other Column continually, and let the last product be a Divisor, then divide the said Divided by the said Divisor, and the Quotient then arising is the Answer to the Question.

So the Example of the first of the said Cases being again repeated, *viz.* if 150 pence at *London* make 3 Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ shill. at *Bruſſels*, then how many pence at *London* are equal to 138 shillings at *Bruſſels*?

The terms being placed according to the *7th.* Rule will stand as followeth.

	A	B	
Pence at Lond.	150	3	*Ducats at Na-*
Ducats at Na-	$4\frac{4}{5}$	$34\frac{1}{2}$	*Shill. at Bruſſ.*
Shill. at Bruſſ.	138		

having thus placed the Terms that in either Column there is two Terms of one kind, then observe that the Column under A hath most terms in it, therefore they must be multiplyed together for a Dividend; viz. 150 mult. by $4\frac{4}{5}$ produceth $360\frac{0}{5}$ which multiplyed by 138 produceth $49680\frac{0}{5}$ for a Dividend, then in the Column under B there are 3 and $34\frac{1}{2}$ which multiplyed together, produce $207\frac{0}{2}$ for a Divisor; then having divided $49600\frac{0}{5}$ by $207\frac{0}{2}$, the Quotient is 960 pence for the answer as before.

Again, let the Example of the second case be again repeated, *viz.* If 40 *l.* Averdupois weight at *London* make 61 *l.* weight at *Amsterdam*, and 90 *l.* at *Amsterdam* make 116 *l.* at *Dantzick*, then how many pounds at *Dantzick* are equal to 112 *l.* *Averdupois* weight at *London*,

The

The terms being disposed according to the *7th.* Rule foregoing will stand thus,

	A	B	
l. at Lond.	40	36	*l. at Amsterdam*
l. at Amst.	90	116	*l. at Dantzick*
		112	*l. at London.*

whereby I find that the Terms under *B* multiplyed together produce 467712 for a dividend, and the Terms under *A*, *viz.* 40 and 90 produce 3600 for a Divisor, and Division being finished, the quotient gieth $129\frac{3312}{3600}$ pounds at *Dantzick* for the Answer.

CHAP. XXXI.

Single Position.

1. NEgative Arithmetick, called the Rule of False, is that by which we find out a truth, by numbers invented or supposed, and this is either single or double.

2. The Rule of Single Position is when at once, *viz.* by one False position, or feigned number, we find out the true Number sought.

3. In the single Rule of False, when you have made made choice of your position, work it according to the tenour of the question, as if it were the true number sought, and if by the ordering your position you find the result either too much or too little you may then find out the number sought by this proportion following, *viz.*

As the result of your position is to the position, so is the given number to the number sought.

Example.

Quest. 1. A Person having about him a certain number of Crowns, said if the fourth and third and sixth of them were added together, they would make just 45, now I demand the number of Crowns he had about him? ? *Answer*, 60 Crowns.

To

To resolve this question I suppose he had 24 Crown (or any other number that will admit of the like di vision) now the fourth of 24 is 6, and the third is 8 and the sixth is 4, all which parts (*viz.* 6, 8 and 4, being added together make but 18, but it should be 45, wherefore I say by the Rule of Three,

As 18, the sum of the parts is to the position 24 so is 45 the given number to 60 the true numbe sought.

For the fourth of 60 is 15, and the third of 60 i 20, and the sixth of 60 is 10, which added togethe make 45.

Quest. 2. Three Persons, *viz.* A. B, C, thus diss course together concerning their Age, quoth B to A I am as old, and half as old again as you, then quoth C to B I am twice as old as you, then quoth A to them and I am sure the Sum of all our Ages is 165, now demand each mans Age? *Answer*, A 30, B 45, C 90 years of Age, which added together, make 165.

CHAP. XXII.

Double Position.

1. THE Rule of Double Position is when 2 false positions are assumed to give a Resolution to the question propounded.

2. When any Question is stated in double position make such a Cross as followeth.

3. Then make choice of any number you think may be convenient for your working, which call your first Position, and place it at that end of the Cross a 2, then work with this position (as if it were the tru numbe

umber ſought) according to the nature of your que-
tion, then having found out your errour, either too
uch or too little, place it on that ſide the Croſs *d*,
hen make choice of another number of the ſame de-
omination with the firſt poſition (which call your ſe-
ond poſition) and place it on that ſide of the Croſs
b, then work with this poſition as with the former,
nd having found out your error, either too much
r too little, place it on that ſide of the Croſs at *c*,
nd then the poſitions will ſtand at the top of the
roſs, and the errors at the bottom, each under his
orreſpondent poſition, and then multiply the errors
to the poſitions croſs-wiſe, that is to ſay, multiply
e firſt poſition by the ſecond error, and the ſecond
oſition by the firſt error, and put each product over
s poſition.

4. Having proceeded ſo far, then conſider whe-
er the errors were both alike, that is, whe-
er they were both too much, or both too little, and
they are alike, then ſubſtract the leſſer product from
e greater, and ſet the remainder for a dividend, then
bſtract the leſſer Error from the greater, and let the
mainder be a diviſor, then the quotient ariſing by
is Diviſion is the anſwer to the queſtion.

5. But if the errors are unlike, that is one too
uch and the other too little, then add the products
the poſitions and errors together, and their Sum
all be a dividend, then add the errors together, and
eir Sum ſhall be a Diviſor, and the Quotient ariſing
nce is the Anſwer; which two laſt Rules may be
pt in memory by this Verſe following, *viz.*

When Errors are of unlike kinds
Addition *doth ceaſe,*
But if a like Subſtraction *finds*
Dividing work for you.

Queſt. 1. A, B, and C build a Houſe which coſt
l. of which A paid a certain Sum unknown,
B paid

B paid as much as A, and 10 *l.* over, and C paid as much as A and B, now I desire to know each man's Share in that Charge?

Having made a Cross according to the 2 Rule, I come according to the third Rule to make choice of my first position, and here I suppose A paid 6 *l.* which I put upon the Cross as you see, then B paid 16 *l.* (for it is said he had paid 10 *l.* more than A) and C paid 22 *l.* for 'tis said he paid as much as A and B, then I add their parts.

l.		*l.*
9		A 6
19		B 16
28	120 168 288	C 22
56	6 9 12) X (14 32 20 12	*Sum* 44
76		76
56		44
20		*error* 32

and they amount to 44, but it is said they paid 76 *l.* wherefore it is 32 too little, which I note down at the bottom of the Cross under its position for the first error.

Secondly, I suppose A paid 9 *l.* then B paid 19 *l.* and C 28 *l.* all which added together, make 56, but they should make 76, wherefore the error of this position is 20, which I put at the bottom of the Cross under his position for the second *Error*, then I multiply the *Errors* and the *Positions* Cross-wise, *viz.* 32 (the *Error* of the first *position*) by 9 (the second *position*,) and the product is 288. Then I multiply 20 (the *Error* of the second *position*) by 6 (the first *position*) and the product is 120.

Then (according to the 4*th.* Rule) I subtract the lesser Product from the greater, (*viz.* 120 from 288) because the *Errors* are both alike, *viz.* too little

and

nd there remaineth 168 for a Dividend, then I ubſtract 20, (the leſſer *Error*) from 32 (the greater *Error*) and the Remainder is 12, for a Diviſor, then ivide 168 by 12, and the Quotient is 14 for the Anwer, which is the ſhare of A in the Payment.

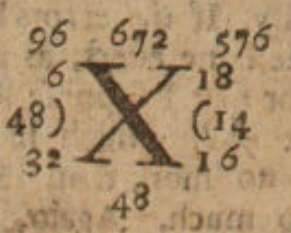
6. Again Secondly, If the errors had been both too ig it had had the ſame effect, as appeareth by the llowing work; for firſt I ſuppoſe A paid 20 *l.* then paid 30 *l.* and *C.* 50 *l.* which in all is 100, but it hould have been no more than 76, wherefore the irſt Error is 24 too much. Again, I ſuppoſe A paid 8 *l.* then B muſt pay 28 *l.* and *C.* muſt pay 46 *l.* which in all

20 A				A 18
30 B				B 28
50 C	320	112	432	C 46
	20	X	18	
100 *ſum*	8)		(14 *facit*	*ſum* 92
76 *ſubtr.*	24		16	*ſubtr.* 76
		8		
24 *error*				*error* 16

s 92 *l.* but it ſhould have been but 76 *l.* wherefore he ſecond *Error* is 16 too much; then I multiply 20 (the firſt *Poſition*) by 16 (the ſecond *Error*) and he product is 320, again I multiply 18, the (ſecond *Poſition*) by 24 (the firſt Error) and the product is 432. Then becauſe the Errors are both too much, I ſubſtract 320 (the leſſer product) from 432 (the greater product,) and there remaineth 112 for a Dividend, likewiſe I ſubſtract (16 the leſſer Error) (from 24 the greater Error,) and the difference is 8 for a Diviſor, then perform Diviſion, and the Quotient is 14, (as before) for the anſwer.

Again Thirdly, If the Errors had been the one too big, and the other too little, Reſpect being had to the 5*th.* Rule foregoing, the Anſwer would have been the ſame; as thus, I take for my firſt *Poſition* 6, and then the Error is 32 too little, then I take

take for my second Position 18, and then the error is 16 too much, then I multiply the Positions and errors Cross-wise, and the products are 96 and 576, and because the errors are unlike,



(*viz.*) one too big, and another too little, I add the products 96 and 576 together, and their Sum is 672 for a Dividend, I likewise add the errors 32 and 16 together, and their Sum is 48 for a Divisor, then having finished Division, I find the Quotient to be 14, which is the answer as was found out at the 2 several Tryals before.

For proof of the Work I say,

	l.
If A *paid*	14
Then B *paid* 14 *and* 10 (*that is*)	24
Then C *paid* 14 *and* 24 (*that is*)	38
The Sum of all is	76

which is the total value of the building and equal to the given Number.

Those who desire to see the demonstration of this Rule, let them read the 7*th.* Chap. of Mr. *Kersey's* Appendix to *Wingates* Arithmetick, *Fetiscus* in the 5*th.* Book of *Trigonometria.* Or Mr. *Oughtred* in his *Clavis Mathematica.*

Quest. 2. Three Persons, A, B, C, thus discoursed together concerning their Age; quoth A I am 18 years of Age, quoth B I am as old as A and $\frac{1}{2}$ C; and quoth C I am as old as you both, if your years were added together. Now I desire to know the Age of each Person? Answer A is 18, B is 54, and C is 72 years of Age.

Quest. 3.

Quest. 3. A Father lying at the point of Death, left to his 3 Sons, *viz.* A, B, C, all his Estate in Money, and divideth it as followeth, *viz.* to A he gave $\frac{1}{2}$ wanting 44 *l.* to B he gave $\frac{1}{3}$ and 14 *l.* over, and to C he gave the Remainder, which was 82 *l.* less than the share of B, now I demand what was the Sum left, and each mans part? Answer, The Sum bequeathed was 588 *l* and whereof A had 250 *l.* B had 210 *l.* and C had 128 *l.*

Quest. 4. Two persons, *viz.* A and B had each in their hands a certain number of Crowns, and A said to B, if you give me 1 of your Crowns I shall have 5 times as many as you, and said B to him again, if you give me one of yours, then we shall each of us have an equal number; now I demand how many Crowns had each Person? Answer, A had 4, and B had 2 Crowns.

Quest. 5, What number is that unto which if I add $\frac{1}{4}$ of it self, and from the Sum subtract $\frac{1}{8}$ of it self, the Remainder will be 210? *Answer*, 192.

Many more questions may be added, but these well understood, will be sufficient, (even for the meanest capacity) for the Resolution of any other question pertinent to this Rule.

There may be an objection made because we have not treated particularly upon Interest and Rebate, but the operation of such Questions being more applicable to Decimals, are omitted, till we come to acquaint the learner therewith.

192
423
11
12

Laus Deo Soli.

192
46

240
30

210

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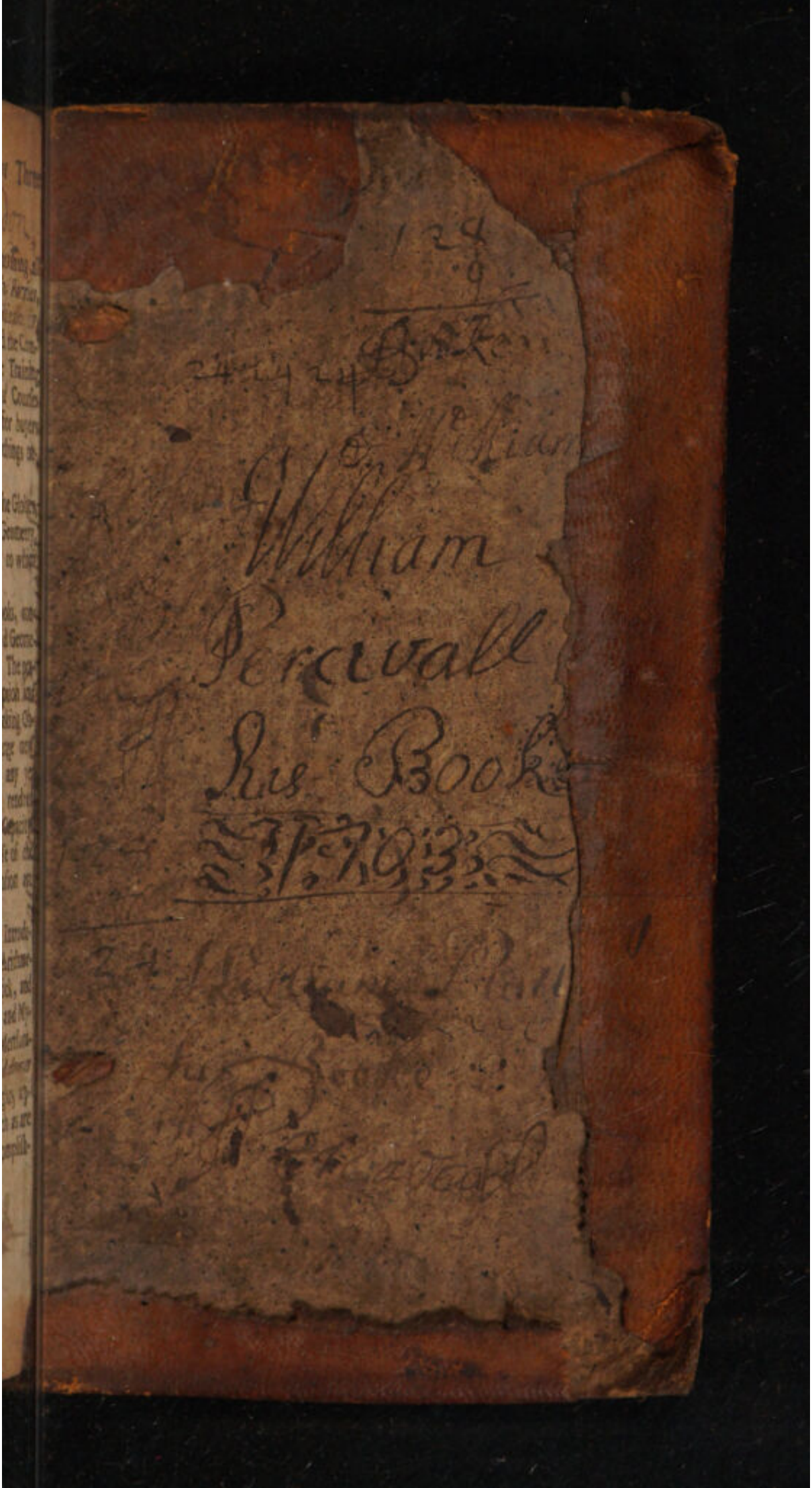
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9
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Percivall
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1703