Leybourn, William:

The Art of Numbring by Speaking - Rods, Vulgarly termed Nepeirs Bones.

London 1685

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The *ART* of NUMBRING

BY

SPEAKING-RODS:

Vulgarly termed

Nepeirs Bones.

By which

The most difficult Parts of

ARITHMETICK,

As *Multiplication*, *Division*, and *Extracting of Roots* both Square and Cube,

Are performed with incredible Celerity and Exactness (without any charge to the Memory) by *Addition* and *Substraction* only.

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THE

ARGUMENT

TO THE

READER.

THe *Right Honourable* John *Lord* Nepeir, *Baron of* Merchiston *in* Scotland; *In the Composure of those ever to be admired* Tables *of his Invention called* Logarithms, *finding his Calculations so laborious in long and tedious Multiplicati-*

ons, Divisions, and Extracting of Roots, that his Invention to him must needs render it self very unpleasant, had he not known that the Labour when finished will crown both Him and his Work. He advised with divers Learned men studious in the Sciences Mathematical, and to them (and amongst them) especially to Mr. Henry Briggs, *who (by a Learned and able Divine) was styled (and not without due respect) our* English Archimedes, *to him, I say, this honourable Lord imparted his* Invention, *who joyning issue with him in this* Herculean Labour, *brought them to that perfection to which they are now (to the admiration of all* Europe) *arrived.*

In the tedious calculation of these, Numbers, the Author finding his Work to go on but very slowly, at length studying out for some help by Art to assist him in this his Noble Enterprise, thinking upon several helps; at last (by the blessing of God) he hapned to find out this which I here intend to describe and shew the use of, with some Additions and variation, from what he hath himself done in his Treatise *in* Latine, *Published and Printed at* Edinburgh *in* Scotland, *in* Anno 1617, *Entituled* Rabdologiæ seu Numerationis per Virgulas. *The uses whereof I shall in the following* Tractate *endeavour to render so plain and easie, that he that can but Add and Substract shall be made able in a days time and less to Multiply and Divide any great Numbers, nay, and*

and to Extract *both the Square and Cube Roots:*

I have begun this Treatise *with the* Frabrick *and* Inscription *of these* Rods *according to the* Authors *Description, which being not so convenient either for Portability or Practice, as some others which I have seen and used, I have described them (I think) in the best manner they possibly can be contrived.*

For their Use, I am sure I have done more than hitherto I have seen done, and (if I mistake not) to as good and effectual purpose. I do not publish it as a Novelty, neither do I attribute much in it to my self, besides the Method, for had I not been desired, I should hardly have thought upon it; however it being done, Accept it and Use it, till I direct something else to thee, which may be more acceptable, till when, I bid thee heartily

Farewell.

CHAP.

CHAP. I.

Concerning the *Fabrick* and *Inscription* Of these

RODS.

IN the foregoing Argument I told you, That the Author and Inventer of this kind of Instrument, of which I intend to shew the Use, called it *RABDOLOGIA*, and the Word he thus defines:

RABDOLOGIA est Ars Computandi per Virgulas numeratrices. That is, *RABDOLOGIE* is the Art of Counting by Numbering Rods.

I. *Of the Fabrick of theſe Rods, according to the Inventors Deſcription of them.*

Theſe Rods may be made either of *Silver, Braſs, Box, Ebony, or Ivory*, of which laſt ſubſtance I ſuppoſe they were at firſt made, for that they are (for the moſt part) by all that know or uſe them, called *NEPAIRS-BONES*.

But let the matter of which they are made be what it will, their form (according to this deſcription) is exactly a ſquare Parallelepipedon, the length being about three Inches, and the breadth of them about One tenth part of the length. But the length of theſe Rods are not confined to three Inches, but let the length be what it will, the breadth muſt be a tenth part thereof, but that may be accounted a competent breadth that

is

is capable of receiving of two numerical Figures, for there is never upon one Rod required more to be ſet on the breadth thereof.

The breadth of theſe Rods being exactly One tenth part of the length thereof, when 10 of theſe are laid together they do exactly make a Geometrical ſquare, and if 20 of them be tabulated or laid together, they will make a right-angled Parallelogram, whoſe length is double to its breadth. If 30 be tabulated, the Figure will be ſtill a Parallelogram, whoſe length will be three times the breadth, and ſo if 40, four times the length-·65, *ſic* 650. ?

The Rods being thus prepared of exact length and breadth, let each of them be divided into 10 equal parts, with this *Proviſo*, that Nine of the Ten parts ſtand in the middle of each Rod, and the other tenth part muſt be divided into two parts, half

whereof

whereof muſt be ſet at the one end, and the other half at the other end of the ſame Rod. Then from ſide to ſide draw right Lines from diviſion to diviſion, ſo is your Rod divided into Squares on every ſide thereof. Laſtly, from corner to corner of every of theſe Squares draw a Diagonal Line, and that will divide every Square into two Triangles. The Rods being thus prepared and lined firſt into Squares, and then into Triangles, they are then fit to be numbred.

Figure 1

The Figure I, at the beginning of the Book ſhews the Form of one of theſe Rods lined as it ought to be.

CHAP.

CHAP. II.

How theſe Rods are to be Numbred?

IN the two half Squares which are at the ends of each Rod on every ſide, there are ſet one ſingle Figure, on each ſide of every Rod one, in the diviſion at the end thereof, ſo every Rod containing four ſides, Ten Rods will contain 40 ſides, and ſo conſequently will have 40 ſingle Figures at the ends of every of them; that is, there will be upon the ten Rods amongſt them four Figures of each kind, that is, four Ones, 1111. four twos, 2222. four threes, 3333. four fours, 4444. four fives, 5555. four ſixes, 6666. four ſevens, 7777. four eights, 8888. four nines, 9999. four Cyphers, 0000.

And

And here it is to be noted, That what Figure ſoever it be that ſtandeth at the top of the Rod alone, the Figure that ſtandeth alone on the other ſide of the ſame Rod, maketh that figure up the number 9. As for example; If 1 ſtand on one ſide, 8 will ſtand on the other ſide, ſo 2 and 7 ~~be~~: As in this Table, where,

	1		8	
	2		7	
	3	ſtands alone	6	
	4	at the top of	5	ſtandeth on
If	5	any ſide of	4	the other
	6	any of the	3	ſide of the
	7	Rods, then	2	ſame Rod.
	8		1	
	9		9	
	0			

This alſo is to be obſerved in the figuring of every Rod, that what figure ſoever

ſoever ſtandeth alone at the top or ſuperior part of the Rod, the figure or figures that ſtand in the two Triangles next underneath it, is double to the figure which ſtandeth at the top. And the figures which ſtand in the next two Triangles below, that is three times as much as the figure above. And that in the fourth place, or Triangles, is four times as much as the figure above 1~~650~~, till you come to the loweſt Triangles in that Rod, and then the figure or figures that ſtand in thoſe Triangles are nine times as much as the figure which ſtandeth at the top of the Rod.

So if a Rod have 4 at the top thereof, in the two Triangles which are juſt and next under it, hath only 4 in them, which is equal to 4; in the next two Triangles below, there is 8, which is double to 4; in the two Triangles below them, is 1, and 2, which together make 12, which is

three

three times as much as the 4 at the top; the next Triangles have in them 16, which is four times as much; the next 20, which is five times as much; the fixth hath 24, which is fix times as much. The next Triangles have in them 28, which is feven times 4; the next hath 32, which is eight times as much: And the laft Triangles at the bottom they have 36 in them, which is nine times as much. All which is vifible by the Figure 2 at the beginning of the Book.

And is evident enough by this little Table following, which is the Table of Multiplication, commonly called *Pythagoras* his Table.

The figures in the	0	1	2	3	4	5	6	7	8	9	Times as much as the Figure at the top.
First	0	1	2	3	4	5	6	7	8	9	1
Second	0	2	4	6	8	10	12	14	16	18	2
Third	0	3	6	9	12	15	18	21	24	27	3
Fourth	0	4	8	12	16	20	24	28	32	36	4
Fifth	0	5	10	15	20	25	30	35	40	45	5
Sixth	0	6	12	18	24	30	36	42	48	54	6
Seventh	0	7	14	21	28	35	42	49	56	63	7
Eighth	0	8	16	24	32	40	48	56	64	72	8
Ninth	0	9	18	27	36	45	54	63	72	81	9

Figure at the top of each Rod.

Square which are

Thus have you the *Fabrick*, *Inſcription and Numbering* of theſe Rods, according to the Inventors contrivance of them: He makes mention of Ten of them, and hath in his Book ſet the figure of the ſaid Ten, of one of which Ten I have given you a Scheme at the beginning of the Book, which is Figure 2.. I will now proceed to give you the deſcription of theſe Rods in another more commodious form.

CHAP. III.

A Decription of theſe Rods according to their beſt and lateſt Contrivance.

THe Deſcription which I ſhall here give of theſe Rods, varies not at all from that before delivered in

in the matter of which they are made, for theſe may be made either in Silver, Braſs, Wood, Ivory, &c. Neither do they differ in their dividing nor yet in their numbering: Only whereas my Lord *Nepair* maketh them ſquare, each Rod to contain four ſides, theſe are made flat, conſiſting each Rod but of two ſides, and contain in length about: 2 Inches 2/10
and in breadth 1/2 of an Inch.
and in thickneſs 1/12 of an Inch.

One ſet of theſe Rods conſiſteth of five pieces, and therefore hath but ten Faces or ſides, whereas thoſe of the Lord *Nepairs* conſiſted of 40 Plains or ſides.

Upon one of theſe five pieces (a Figure whereof is at the beginning of the Book, noted with Figure 3) you have a Cypher at the head of the firſt piece, and 9 at the bottom thereof. Upon the ſecond of them you have 1 at the head, and 8 at the bottom: upon

upon the third you have 2 at the head and 7 at the bottom; upon the fourth 3 a top and 6 at bottom; and upon the fifth you have 4 at the top, and 5 at the bottom. Every of the two Figures at the top and bottom together make 9; as 0 and 9 is 9, 1 and 8, 2 and 7, 3 and 6, 4 and 5. And here obſerve, that the Figures 9 8 7 6 5, which ſtand at the bottom of the Scheme ſtand with their heels upwards, in this manner, 6 8 L 9 S, ſo do all the other figures under them, till you come to the double Line which is in the middle of the Scheme, noted with *A* and *B*, at which Line if the Scheme were cut into two pieces, and folded or paſted on the backſide of the other half, ſo that the 9 at the bottom were placed upon the Cypher at the top, and ſo 8 upon 1 7 upon 2, 6 upon 3, and 5 upon 4, and then the Scheme cut again into five little ſlippets by the down-right Lines;

Lines; theſe five ſlippets would exactly repreſent one ſet of theſe Rods, for upon one ſide of one of theſe pieces, you ſhould have a Cypher upon one ſide, and 9 on the other: Upon the next 1 and 8, upon another 2 and 7, on another 3 and 6, and on the other 5 and 4; both the Figures on either ſide making 9, as before was deſcribed.

Theſe five ſlippets do now contain the whole Table of *Pythagoras* before mentioned, but ſo few are not of ſufficient uſe, neither are the Ten before mentioned of the Lord *Nepair*'s order; for there can be but four Figures of one kind, which in all caſes is not ſufficient.

Therefore as theſe Rods are made now a days, they do commonly make ſix ſets of them, that is, 30 pieces, which contain 60 faces, and theſe will be of good uſe, and there will ſeldom be found a want, which in thoſe of of the Inventors there will often be; except you have a great quantity, which will be far more cumberſom than theſe here deſcribed, for there is required as much Metal or Wood in one of his as in four of theſe, and then for his Four ſides we have here Eight.

Concerning a Caſe *for theſe Rods.*

For the orderly keeping and ready finding of theſe Rods, I have often (for my ſelf and others) had a Box made of Walnut-tree, or Pear-tree, with five partitions in it, each partition to hold five or ſix ſets of theſe Rods, or more if more Rods were required. Every of theſe partitions being figured one the ſide thereof next the Eye, with ſuch figures as the Rods in ſuch a partition had figures at the top, ſo that the party that was to uſe

uſe them, could take them as readily out of his partition, as a Printer can take his Letters out of his reſpective Boxes to make any Word.

In this Box there is alſo convenient room made for one other Rod, double in breadth to theſe here deſcribed; but of the ſame length and thickneſs; upon the one ſide whereof there is a Table or Plate uſeful in the Extracting of the Square Root, and on the other ſide another for the Extracting of the Cube Root, the Figure whereof is at the beginning of the Book, noted with ~~Figure~~. *Square Cube*

But I ſhall forbear to ſay any thing of them, till I come to ſhew you how to Extract the Square and Cube Roots by the help of them and the Rods.

Of

Of a Board with a Frame, upon which to lay your Rods, when any Operation is to be wrought by them, known by the name of a TABULAT.

In the uſing of theſe Rods, care is to be had firſt of the orderly laying of them, and then ſecondly, for the keeping of them in that poſition till your work be ended. For the effecting whereof, both neatly and certainly, there is a little Table or Frame contrived, containing in breath $\frac{1}{20}$ of an Inch more than the length of the Rods, and in length at pleaſure, but it may well be about once and a half the length of the breadth.

It ought to be made of a thin piece of Pear or Walnut-tree, or of ſuch matter as your Box or Caſe is made of, and it may very commodiouſly be contrived to be put into the Box

Box as I ever had them made to do, for that I found it inconvenient to carry looſe.

Upon the Superficies of this Board, cloſe to one of the edges thereof, muſt be glewed, or otherwiſe faſtned, with Pins, a ſmall piece of the ſame matter and alſo of the ſame length, breadth, and thickneſs of one of your Rods, which muſt be divided into 9 equal parts, and Lines drawn croſs the piece, ſo will there be 9 Squares, in which you muſt grave or ſtamp the nine Digits, beginning with 1 at the top, and ſo deſcending by 2 3 4 to 9 at the bottom thereof: And it were neceſſary that theſe Figures (as alſo thoſe which are at the head of every of your Rods) were graven or ſtamped of ſomething a bigger Figure then the other figures of your Rods are.

Under the end of this ledge beginning at the ~~Figure,~~ and ſo continuing

Figures

nuing the whole length of the Board, must another ledge of the same mater and thickness as the other, be glewed or pined, and then is your *Tabulat* finished. A Figure whereof you have at the beginning of the Book, noted with Figure 4, it is called a *Tabulat*, for that when the Rods are laid thereon, for any Operation to be wrought by them, we usually say, the Rods are Tabulated.

Being thus prepared with Rods and Tabulat, you are ready for the work intended by them, and for which chiefly they were invented.

Thus much for the Fabrick, Inscription, and Numbering of these Rods; let us now come to shew the Uses of them.

CHAP.

CHAP. IV.

To what Use these Rods generally serve.

THe cheif Uses to which these small Rods serve unto, I in part intimated at the beginning, to which effect I shall repeat it again—for by them all manner of Multiplications and Divisions, as also of the Extraction of both the Roots either Square or Cube, are so facilly and expeditiously performed, and that by the help of Addition and Substraction only, that it is (as I may well say) inconceivable, for here is no charge at all required of the Memory, and you shall assuredly take your Quotient Figure in Division always certain; neither too great nor too little, an inconvenience so prejudicial, that I leave it to the censure of such as have

have found it, to their great loſs of time, and other vexation which it hath put them to. But ceaſing to ſay more of their properties, I will now come to ſhew their Uſe.

CHAP. V.

How to apply or lay down any Numbers by the Rods.

PROP. I.

Any Number being given, how to Tabulate or lay down the ſame by the Rods.

LEt it be required to Tabulate or lay down this Number 3 4 9 6.

Firſt, From among your Sets of Rods, (or out of your Caſe) take four of them, of which let one of them have the Figure 3 at the top thereof, and

and lay it upon your Tabulat cloſe to the edge thereof then,

Secondly, Take another Rod from your Caſe, which hath the Figure 4 at the top of it, and lay that alſo upon your Tabulat cloſe by the ſide of the other.

Thirdly, Take another Rod which hath the Figure 9 at the top of it, and lay that upon your Tabulat cloſe by the other two.

And laſtly, take a fourth Rod, having the figure 6 at the head thereof, and lay that alſo upon your Tabulat cloſe by the reſt.

Theſe four Rods thus taken, and laid upon the Tabulat you ſhall ſee in the uppermoſt Row (which ſtandeth againſt the Figure 1 on the ſide of your Tabulat) theſe four Figures, 3 4 9 6, that is 3 4 9 6, equal to your given Number. In the ſecond Row (againſt the figure 2 of your Tabulat) you ſhall find the double thereof of. In the third (against the figures 3) you shall find the triple thereof. In the fourth the Quadruple thereof. In the fifth the Quintuple; and so on to the ninth and last, in which you shall find the Noncuple of the Number given.

PROP. II.

How these Rods will appear when Tabulated, and being Tabulated, how to read the Multiplication, of that Number so Tabulated, by any of the Nine Digits?

The Four Rods being Tabulated according to the Precepts delivered in the preceding *Proposition*, they will appear exactly as they are represented in *Figure* 4 at the beginning of the Book, which Figure lively represents the four Rods lying upon the Tabulat, which mind well, for upon the true tabulating, and right reading

reading of the Rods so tabulated, depends the whole Work.

The Rods thus Tabulated, and as you see them in the *Figure* 4, do to the eye appear in the form of a Glass-window, every Pane thereof representing a Rhomboyades or Diamond form: In the reading of the Figures which are in these several Rhomboyades or Diamond form, observe these few Directions following, which will fully illustrate the whole business intended, and therefore especially to be minded.

Note,

I. *That the Figures upon the Rods are to be read beginning at the right hand and reading towards the left*; which is contrary to our common course of reading and writing, which is from the left hand towards the right.

II. *That*

II. *That in every Rhomboyades or Diamond, there are either One Figure, or Two Figures, but never more then Two.*

III. *If there be but one Figure in a Rhombus, then that Figure is the Figure to be ſet down alone* (be it either a Figure or a Cypher) *but if there be two Figures in a Rhomboyades* (as for the moſt part there is) *then add them two Figures together, and ſet down their ſum in one Figure.*

IV. *But if the ſum of the two Figures in one Rhomboyades or Diamond do exceed Ten, then you muſt ſet down the overplus above Ten, and keep One in mind, which One you muſt carry to the next Rhomboyades.*

V. *Note that the firſt towards your right hand, and the laſt towards your left hand are but half Rhomboyades or Diamonds, and never have in them more then one Figure only, but all between them are whole ones, and for the muſt part have two Figures in them.*

VI. *If in either Rhomboyades or half Rhomboyades, you find no Figures but Cyphers, you muſt not negleſt but ſet them down as if they were Figures.*

¶ Theſe Rules being rightly underſtood, all that follows will be familiar and eaſie, and theſe I ſhall explain by Example following.

Example.

For the illuſtration of the preceding Rules, we will make uſe of thoſe Rods which were before tabulated

lated, therefore have recourſe to *Figures* 4 at the beginning of the Book, where this Number 3496 is tabulated.

The Figures at the top of the Four Rods are theſe 3, 4, 9, 6. which ſignifie the former given number 3496, and this number ſtands againſt the figure 1 on the ſide of the Tabulat. Then I ſay, that the figures in the next row ſtanding againſt the figure 2 of the Tabulat are double thereunto, which I thus prove.

Repair to the Rods as they lie upon the Tabulat, and in that row which lieth againſt the figure 2, you ſhall find in the firſt half Rhomboyades towards your right hand (where *by Rule* 1 you muſt begin) the figure 2, wherefore ſet down with your Pen upon Paper the figure 2. In the next Rhomboyades, in the ſame row you ſhall find 8 and 1, which added make 9, ſet down 9 on the left hand of

of 2: In the next Rhombus you ſhall find 8 and 1 again, which is 9 alſo, ſet down 9 on the left hand of the other, and in the laſt Rhomboyades you ſhall find only 6, wherefore ſet down 6 on the left hand of 9, ſo have you in all 6992, which is double to 3496.

Again, the figures in the row which ſtands againſt the figure 3 in the Tabulat, are triple to 3496; for in the firſt half Rhomboyades towards your right hand, you have 8, ſet down 8.-- In the next Rhom. you have 7 and 1, which is 8, ſet down 8 again.-- In the next you have 2 and 2, which is 4, ſet down 4.—In the next Rhom. you have 9 and 1, which makes 10, ſet down 0 and carry 1, but it is the laſt Rhom. and becauſe there is never another to carry the 1 unto, you muſt therefore ſet it down, ſo have you this number 10488, which is triple to 3496.

 Again,

Again, the figures ſtanding againſt 4 in the Tabulat, are Quadruple to 3496, --- for in the half Rhom, you have 4, ſet it down: in the next 6 and 2, which is 8, ſet that down. In the next 6 and 3 which is 9, ſet that down: In the next 2 and 1, which is 3, ſet that down: and in the laſt half Rhom, you have 1, which alſo ſet down: ſo have you 13984 which is Quadruple to 3496.

Alſo, the figures againſt 5 in the Tabulat: the firſt is a Cypher therefore put down 0; the next is 5 and 3 which is 8, ſet down 8; the next is 0 and 4, ſet down 4; the next is 5 and 2, that is 7, ſet down 7; and the laſt is 1, therefore ſet down 1, ſo have you in all 17480, which is Quintuple to 3496.

Againſt 6 in the Tabulat, you have in the firſt place 6, ſet it down; then in the next 4 and 3, that is 7, ſet that down; in the next 4 and 5, that is

is 9, ſet 9 down; in the next you have 8 and 2, that is 10, ſet down 0 and carry 1 to the next Rhom. where you find only 1, to which add the 1, which you carried from the Rhom. before, and it makes 2, ſet down 2: ſo have you 20976, which is ſix times 3496.

Againſt 7 in the Tabulat, you have firſt 2, ſet it down; then 3 and 4, which is 7, ſet 7 down; in the next 8 and 6, which is 14, which being above 10, ſet down 4, and carry 1 to the next Rhom, where you have 2 and 1, which is 3, and 1, which you carried makes 4, ſet down 4; then in the laſt place you have only 2, which ſet down, ſo have you in all 24472, which is Septuble to 3496, or ſeven times as much.

Againſt 8 in the Tabulat, you have firſt 8, which ſet down; then 2 and 4, which is 6, ſet 6 down; then 2 and 7, which is 9, ſet 9 down; then 4 and 3, which is 7, ſet 7 down; and laſtly 2, ſet that down, ſo have you 27968, which is Octuple to 3496, or eight times as much.

Laſtly, againſt 9 in the Tabulat, you have in the firſt place 4, ſet that down; in the next you have 1 and 5, which is 6, ſet 6 down; in the next place you have 6 and 8, which is 14, ſet down 4, and carry 1 to the next Rhom. where you find 7 and 5, that is 10, which with 1 which you carried makes 11, ſet down 1, and carry 1 to the next Rhom. where you find only 2 and the 1 carried makes 3, therefore ſet down 3, and ſo you have 31464, which is Noncuple to 3496, or nine times as much as the tabulated number.

Thus have I given you Examples, in ſhewing you how the Numbers upon the Rods are to be read and written down, and in the delivery of this Example, I have made the whole work

work which is to follow ſo plain and eaſie, that the meaneſt capacity (I think) if he can but tell his figures, and add any two figures together, he may by this here delivered, read or write down any number that can be tabulated; and that you may throughly underſtand this Chapter before you proceed further, I will give you the Products of 7009078 multiplied by all the nine Digits which I would have your ſelf to tabulate, and ſee if you find your working by your Rods to agree with thoſe which are here written, which numbers if they do, you need not ſcruple at the moſt difficult that can be propoſed to you, therefore ſtudy it, and try it.

			7009078
	2	Produceth	14018156
	3		21027234
	4		28036312
7009078	5		35045390
being mul-	6		42054468
tiplied by	7		49063546
	8		56072624
	9		63081702

Thus have I sufficiently described these Rods and the manner of Numbring upon them; and now I think it time to apply them to that use for which they were intended, namely, the more difficult parts of Arithmetick, as Multiplication, Division, and Extraction of Roots, but first let me give you,

An Admonition concerning Addition and Substraction.

Whereas it was the difficult operatations of *Arithmetick*, which by the benefit of these Rods, the Inventor chiefly aimed at (of which kind he esteemed *Multiplication*, *Division*, and *Extraction of the Square and Cube Roots*) he omitted to say any thing concerning *Addition* and *Substraction* as things obvious to every *Tyro*, he therefore omitting them, begins to shew the use of his Rods in *Multiplication*, whose Method I shall here follow.

CHAP. VI.

Multiplication by the Rods.

IN Multiplying by the Rods, you are to consider (as in vulgar Arithmetick) three Terms, Things, or Numbers, *viz.*

1. The *Multiplicand*, which is the Number to be multiplied.

2. The *Multiplier*, which is the Number by which the *Multiplicand* is multiplied.

3. The *Product*, which is the ſum produced by the multiplying of the two former together.

And here note, that the *Product* doth contain the *Multiplicand*, ſo many times as there be *Unites* in the *Multiplier*.

Thus for the definition of *Multiplication*, now for the working thereof by the Rods, for which this is

THE RULE:

Firſt, *Set down upon your Paper the Multiplicand*, *and orderly under it the* **Multiplier*. It matters not greatly which of the two given Numbers be made *Multiplicand* or *Multiplier*, but it is uſual and beſt to make the greateſt Number *Multiplicand*, and the leſſer *Multiplier*: *Then draw*

draw a Line with your Pen under them, and having Tabulated you Multiplicand (or greater number) look what Numbers in your Rods ſtand againſt the firſt Figure towards your right hand, and that number which you ſhall find upon your Rods ſtanding againſt that firſt Figure found in your Tabulat, ſet down under your Line which you formerly drew under your Multiplcand and Multiplier: And having ſo done with the firſt Figu. of you Multiplier do ſo with the reſt, ſetting them down one under another, removing every Figure one place more toward the left hand, then that which went before it, as is done in common Multiplication, and as you ſee in the following Example.

Example 1. *Let it be required to multiply* 3496, by 489. As if it were required to know how much 489 times 3496 would amount unto.

Firſt, Set down your given Number

bers 3496, and 489, one under another, and draw you Line under them, as here you ſee done.

Secondly, 3496 your Multiplicand being Tabulated, and 9 being the firſt Figure to the right hand in your Multiplier, look upon your Rods, what ſum

3496	Multiplicand,
489	Multiplier,
31464	
27968	
13984	
1709544	Product.
	&c.

there ſtands againſt 9 in the ſide of your Tabulate, and you ſhall find (as by the Rules in the the ſecond Prop.of the Fifth Chap. you were directed) 31464, which is the Product of 3496 multiplied by 9, wherefore ſet down this number 31464 under your Line, as you ſee in the Example.

Thirdly, Look what ſum upon the Rods ſtands againſt 8, which is the ſecond Figure of your Multiplier, and you

you ſhall find 27968, ſet this number under the former, moving it one place forward towards the left hand.

Fourthly, Look what ſum upon the Rods ſtands againſt 4 which is the Third Figure in your Multiplier, and you ſhall find 13984, which ſet down under the other, one place more to the left hand.

Laſtly, under theſe three Sums draw a Line and add the three ſums together, and they make 1709544, which is the Product of 3496 multiplied by 489, and this 1709544 the Product, contains 3496 the Multiplicand, 489 times.

Practiſe well this firſt Example, and compare it with the Rods as they are Tabulated in Figure 4 at the beginning of the Book, as alſo with the Rules in the Fifth Chapter, and you may perform any Multiplication. However I will give you one or two more

more Examples, and ſome other ways of *Multiplication.*

Example 2. *Let it be required to multiply the ſame ſum* 3496 by 261.

3496
261
———
3496
20976
6992
———
912456

Set the Numbers down as here is done, then look upon the Rods for the Product of 3496 by 1, and you ſhall find it to be the ſame, wherefore ſet down 3496 under the Line—— then look upon the Rods for the Product of 3496 by 6, and you ſhall find it to be 20976, which ſet down under the other number one place more towards the left hand.——Again, look in the Rods for the Product of 3496 multiplied by 2, and you ſhall find it to be 6992, which ſet down under the other two.

Laſtly, Draw a Line under them, and add the three numbers together in order as they ſtand, and the ſum of

of them will be 912456, which is the Product of 3496 multiplied by 261.

Example 3. *Let it be required to multiply the ſame number* 3496 by 520.

Set down your Numbers as here you ſee done---- Then becauſe the firſt Figure of your Multiplier towards your right hand is a Cypher, wholly omit it, and multiply 3496 by 52 only, ſo ſhall you find the Product of 3496 by 2 to be 6992, which ſet down: Alſo the Product by 5 will be 17480, which ſet down under the other one place further, Then draw a Line —- and add theſe two ſums together, and they make 181792, to the which if you add a Cypher for the Cypher which you omitted in your Multiplier, the ſum will be 1817920, which is the Product of 3496 by 520.

3496
520
———
6992
17480
———
1817920

Example 4. *Let it be required to multiply*

multiply the ſame 3496 by 7003——
Set down your Numbers as before and as you ſee here done, Then having Tabulated 3496, ſee what the Product thereof is upon the Rods being multiplied by 3 the firſt Figure in your Multiplier, and you ſhall find it to be 10488, which ſet down under the Line——Then the two next places of your Multiplier being Cyphers, make two pricks under the former number, one under 8, the other under 4, as you ſee in the Example, or inſtead of 2 pricks you may make two Cyphers, --- Then look in the Rods for the Product of 3496 by 7, and you ſhall find it to be 24472, which ſet down under the other ſum, beginning your number at the fourth place, or beyond the two Pricks or Cyphers. Laſtly, draw a Line and add theſe two ſums together,

```
    3496
    7003
   10488
 24472··
--------
24482488
```


and their ſum is 24482488, which is the Product of 3496 multiplied by 7003.

Thus have you four Examples in *Multiplication*, in which are included all the Varieties that may at any time happen in that Rule, *viz.* Two where the Multiplier conſiſted all of Figures, as in the firſt and ſecond Example they did. — Another where the latter place of the Multiplier conſiſted of a Cypher.— And this laſt Example where Cyphers were intermixed among the Figures.

And thus much for this kind of Multiplication, but before I leave, I will ſhew you

Another Form of

MULTIPLICATION.

Whereas in the foregoing Form of Multiplication, which is the beſt and moſt

moſt uſual, (only I inſert this following for variety.) You began (your Rods being Tabulated) with that Figure of your Multiplier which ſtands next your right hand, but there is no neceſſity for that, for you may begin with that Figure which ſtandeth next to your left hand, and by ſo doing, and placing your ſeveral Products one place more to the right hand, as you did before place them to the left hand, thoſe Products added together in the Form they then ſtand, ſhall produce a Product equal to the former.

Example, For our example we will take the firſt Example before-going at the beginning of this Chapter, where *it was required to multiply* 3496 by 489. Set the Numbers down as before in that firſt Example, and as you ſee here done——


```
  3496
   489
 -----
 13984
  27968
   31464
 -------
 1709544
```

Then 3496 being Tabulated, look upon your Rods for the Product thereof multiplied by 4, (which is the firſt Figure of your Multiplier towards your left hand) and you ſhall find the Product thereof to be 13984, which ſet down. ---- Secondly, look the Product of 3496 by 8 (your ſecond Figure) and you ſhall find it to be 27968, which muſt not be ſet down as in the other firſt Example but as you ſee it in this, 8 the firſt Figure thereof muſt be ſet one place forwards towards the right hand, as in the other it was ſet a place backward towards the left. --- Laſtly, ſeek in your Rods for the Product of 3496 by 9 your laſt Figure, and you ſhall find it to be 31464, which ſet under the other two Numbers yet one place more to the right hand.---So a Line being drawn under, and theſe three

Numbers added together produce 1709544 equal to that in the first Example: And that you may the better see the difference of the work, I have set them one by the other.

As in the first Example,	As in this Example,
3496	3496
489	489
31464	13984
27968	27968
13984	3146:
170944	1709544

One Example more in Multiplication, which shall be for Advertisement and direction, I will give, and so conclude Multiplication.

I said in the general Rule for working of *Mulplication* (at the beginning of this Chapter) that it mattered not which of your Nnmbers were

were made the Multiplicand, or which the multiplier, of which I will here give you a President where the lesser Number shall be Tabulated, and the greater Number only set down; and I will work it here according to this last way of Multiplication, and the Example shall be as followeth.

Example, *Let it be required to multiply* 868437 by 3496, and let 3496 (the lesser Number) be Tabulated.

Let the Numbers be set as you here see, then 3496 being Tabulated, begin with the first Figure towards the left hand of your Multiplier, which here is 8, and upon your Rods find the Product of 3496 multiplied by 8, which is 27968, set that down under the Line

3496
868437
27968
20976
27968
13984
10488
24472
3036055752

Line---- then find the Product of 3496 by 6 the second Figure of your Multiplier, and you shall find that to be 20976, set this number under the former one place more towards the right hand.——Again the third Figure of your Product is 8 whose Product is 27968 as before, set that under the other still one place more to the right hand.——In this manner do with the other Figures of the Multiplier, as 4 the next Figure, whose Product is 13984, which also set down a place forward.——So also the Product of 3 which is 10488, which set down.——And lastly, of 7, which is 24472.——All these Products being set down in the order as you see them in the Margent, if you add them together, the sum of them will be 3036055752, which is the Product of 3496 multiplied by 868437, the lesser number being Tabulated.

Other ways of Multiplication I could have add.d, but these I esteem sufficient.

CHAP. VII.

DIVISION

By the Rods.

AS in Multiplication, so in Division there are three Numbers, Terms, or Things required, *viz.*

1. The *Dividend* or Number to be divided.

2. The *Divisor* or Number by which the Dividend is divided, and,

3. The *Quotient*, which is the Number issuing from the Dividends being divided by the Divisor; And this *Quotient* doth always consist of so many *Unites* as the *Divisor* is

times contained in the *Dividend.*

Thus much for the *Definition* of *Division*, now let us come to the *Practice* of it by the *Rods*, to perform which, this is

THE RULE.

Tabulate the Divisor, (which is always the lesser Number of the two given) and set down the Dividend, and set the Divisor on the left hand, and draw a crooked Line on the right hand for your Quotient, as in common Arithmetick. Then look upon your Tabulated Rods (always) for the Number, less then the Number in the first Figures of your Dividend, and what Figure stands against that Number on the edge of your Tabulat must be the Figure you must put in you Quotient, and that Number you must always substract from the Figures of your Dividend, and to the remainder add ano-

ther Figure, so proceeding from Figure to Figure till your Division be wholly ended.

Example, *Let it be required to divide* 1709544, by 3496. Having tabulated 3496 set down your Dividend, your Divisor on the left hand thereof, and a crooked Line for the Quotient on the right hand thereof, as by the Rule preceding you were directed, and as you see done in the Example adjoyning.

And because at your first setting down of your Divisor 3496, it would reach (if it were set under your Dividend 1709544) as far as the Figure 5, therefore under the Figure 5 make a Prick to intimate how far you are gone on in your work, and under this Prick draw a Line quite under your Dividend, then is your Sum set down ready for work, and will appear as here you see;

3496) 1709544 (

Your Sum thus prepared, ask how often can you have 3496 in 17095, look in your Tabulated Rods for 17095, which you cannot there find, but the neareſt number thereunto amongſt the Rods, which is leſs then 17095 (for you muſt always take a leſs number) is 13984, which number ſtands againſt the Figure 4 in the Tabulat, wherefore ſet 4 in your Quotient, and 13984 under the Line, and ſubſtract 13984 from 17095, and there will remain 3111, ſo is the firſt part of your Diviſion ended and your work will ſtand thus;

3111
3496) 1709544 (4

13984

Then make another Prick under 4 the next Figure of your Dividend, ſo will

will the remaining number be 31114, —Then look among your Rods for the number 31114 (or the neareſt leſs then it) and the neareſt leſs you ſhall find to be 27968, which ſtands againſt 8 in your Tabulat, put 8 in your Quotient, and ſet 27968 under 31114, and ſubſtract 27968 from 31114, ſo will there remain 3146, which ſet over head, ſo is the ſecond part of your Diviſion ended, any your work will appear thus,

3146
3111
3496) 1709544 (48

13984
27968

Laſtly, Make another Prick under the next Figure of your Dividend, which is 4 alſo, making the remaining number to be 31464, ſeek a

mong

mong your Tabulated Rods for this number (or the nearest less) but looking you shall find the very number, against which stands on your Tabulat the Figure 9, set 9 in the Quotient, and the number 31464 under the Line, and Substract it from 31464 the remainder which stands above the Line, and nothing remains, and being there is never another Figure in your Dividend, your Division is ended, and your work will stand thus, and 3496 is contained in 1709544 489 times.

```
             00000
             31464
             3111
Divisor,  ) 1709544 ( Quotient
  3496    )         ( 489
           ---------
           13984
            27968
             31464
```


Another Example, and by another way of Division.

Let it be required to divide 912456 by 3496, set down your Dividend and Divisor, draw a crooked Line for your Quotient, and also make a Prick under the fourth Figure of your Dividend, and draw a Line under your Dividend, so is your Sum prepared to be divided, and will stand thus;

```
3496 ) 912456 (
          .
     ----------
```

Then your Divisor 3496 being Tabulated, look amongst your Rods for the nearest number to 9124 which is less, and you shall find it to be 6992, against which stands on your Tabulat the Figure 2, set 2 in the Quotient, and this Number under the Line, and substract it from 9124, and there will remain 2132, to which number add the next Figure of your Dividend, namely 5. and it makes 21325, under which number draw a Line, then will your Sum ſtand thus

```
3496 ) 912456 ( 2
        6992
        21325
```

Then among your Rods ſeek the neareſt number to 21325 and you ſhall find 20976 to be the neareſt number leſs, againſt which in your Tabulat ſtands 6, ſet 6 in the Quotient, and 20976 under the Line, ſubſtracting it from 21325, which when you have done, there will remain 349, to 349 add the next Figure in your Dividend, which is 6 your laſt Figure, and it makes 3496, under which draw a Line, and your work will ſtand as here you ſee.


```
3496 ) 912456 ) 26
        6992
        21325
        20976
         3496
```

This done, look amongſt your Rods for the neareſt number to 3496, and you ſhall find the exact number at the top of the Rods, againſt which ſtands the Figure 1 on the Tabulat, ſet 1 in the Quotient, and ſubſtract 3496 from 3496, the remainder is nothing, and ſo is your Diviſion ended, the work ſtanding thus, and 3496 the Diviſor is contained in 912456 the Dividend, 161 time.

(56)


```
3496 ) 912456 ( 361
       6992
       21325
        20976
         3496
         3496
         0000
```

A third Example ready wrought by the last and best way of Division. I will only set it down ready wrought, leaving the practice of it to your self.

Let it be required to divide 73020506 by 3496.


```
3496 ) 73020506 ( 20886 3050/3496
       6992
       31005
       27968
        30370
        27968
         24026
         20976
          3050
```

This Sum thus divided, produceth in the Quotient 20886, and 3050 remaining, so that the Quotient with Fraction and all is,

20886 $\frac{3050}{3496}$ Which shews that 3496 the Divisor is contained in 73020506 the Dividend, 20886 times, and 3050 remaining.

This Example well practised, together with them before-going, are sufficient instruction for any Student whatever, and he that can perform these need not despair the most difficult that can be proposed. And so I conclude with Division.

CHAP. VIII.

Concerning the *Rule of Three* OR *Golden Rule,*

Both *Direct* and *Reverse*, or *Reciprocal.*

TO Discourse of this Rule at large were to run into a Labyrinth, for it

it was the performance of working Multiplication and Division by the Rods that was here aimed at, and he that can Multiply and Divide may command this *Golden Rule*, wherefore I will shew you the nature or order of placing the Numbers, and also the manner of working an Example in either of them.

The *Rule of Three* is that Rule which teacheth by having three Numbers in proportion one to another given, to find a fourth, which shall be in proportion to them also.

In this *Rule direct* the fourth Number which is sought, is to have the same proportion to the third, as the second Number hath to the first: As if the three Numbers given where 2—4—and 8, say, as 2 is to 4, so is 8--to what? multiply 4 by 8 (that is the second Number by the third) and the Product will be 32, which divide by 2 (the first Number) the Quotient

Quotient will be 16, which is the fourth Number in proportion to the third, as the ſecond is to the firſt; for as 4 the ſecond Number, contains 2 the firſt Number twice, ſo 16 the fourth Number contains 8 the third Number twice alſo.

But in the *Reciprocal Rule of Three*, there the proportion is not as the firſt to the ſecond, ſo the third to the fourth: But *as the Firſt is to the Third, ſo is the ſecond to the Fourth.* As if the Numbers were 3, 4, and 6, ſay, As 3 the firſt Number, is to 6 the third Number, ſo is 4 the ſecond Number; to what? Multiply 4 the ſecond Number by 3 the firſt Number, the Product is 12, which divide by 6 the Third Number, and the Quotient will be 2: for as 6 the third Number contains 3 the firſt Number twice, ſo 4 the ſecond Number contains 2 the fourth Number twice alſo: And in this conſiſts the difference

ference between the *Direct* and *Reciprocal Rule of Three.*

A Queſtion in each Rule,

1. *In the Direct Rule*;

If four Men eat two Pecks of Corn in one week, how many Pecks will ſerve an hundred Men the ſame time?

Men	Pecks	Men.
4	2	100.

Multiply 2 the ſecond Number by 100 the third Number, the Product will be 200, which divide by 4 the firſt Numbers, and the Quotient will be 50, and ſo many Pecks will ſuffice 100 men the ſame time.

2. *In the Reciprocal,*

If twelve men do any piece of work in 8 days, *8 days, how many men must be imployed to do the same piece of work in 2 days*

Day	Mn	Days.
8	12	2.

Multiply 8 the first Number, by 12 the second, their Product is 96, which divide by 2 the third Number, the Quotient will be 48, and so many men will do the same work in 2 days, for as 8 days is to 2 days, so are 12 men to 48 men, *&c.*

CHAP. IX.

Of the Extraction of ROOTS.

THe Extraction of *Roots*, which is the difficultest part of Multiplication and Division, is expeditiously and certainly performed by the Rods, for the easie and expedite performance of which, there are two Rods on purpose, one for the Square, the other for the Cube Root, of which I will speak; first, Of their Fabrick: secondly, of their Use.

Of the Fabrick of the Rods for Extracting of Roots.

Of the same matter, and of the same length and thickness of your other

ther Rods, let there be made another Rod but three times the breadth of the former, the Inscription on one side serving to extract the Square, and that on the other side for the Cube Root, each of which are divided into three Rows or Colums.

That which serveth for the Square Root, hath in the top or uppermost Square between the Diagonal thereof, these Figures 0-1, in the second 0-4, in the third 0-9, in the fourth 1-6, in in the fifth 2-5, in the sixth 3-6, in the seventh 4-9, in the eighth 6-4, and in the ninth or lowermost 1-8, which are the Square Numbers belonging to the nine Digits.——

In the second Colume of the same Rod, in the first Square is inscribed 2, in the second 4, in the third 6, in the fourth 8, in the fifth 10, in the sixth 12, in the seventh 14, in the eighth 16, and in the ninth 18.

In the last or third Colume there are

are the nine Digits orderly descending, namely, 1, 2, 3, 4, 5, 6, 7, 8, 9. This Rod thus made is fitted for the Square Root.

That which serveth for the Cube Root, hath in the top or uppermost Square of the first Colume towards the left hand between the Diagonal thereof, these Figures, 0-01, in the second 0-08, in the third 0-27, in the fourth 0-64, in the fifth 1-25, in the sixth 2-16, in the seventh 3-43, in the eighth 5-12, and in the ninth 7-29, which are Cube Numbers orderly descending —— The second Colume of this Rod contains these square Numbers, 1, 4, 9, 16, 25, 36, 49, 64, 81, orderly descending.—— The third and last Colume of this Rod hath in it the nine Digits, 1, 2, 3, 4, 5, 6, 7, 8, 9, orderly descending also.

This Rod thus prepared and inscribed, is fit for extracting of the Square

Square and Cube Roots, a Figure of either ſide whereof you have at the beginning of the Book: That which ſerveth for the Square Root having the word *Square* written over head, that for the Cube Root, hath *Cube* writen over head.

Thus having given you the Fabrick and Inſcription of the Rods, I will now ſhew you their uſe; And firſt,

Concerning the Extracting of the Square-Root.

In Extracting of the Square-Root, you muſt as in common Arithmetick, when you have ſet down your Number, make a Prick uuder the firſt Figure towards your right hand, and ſo ſucceſſively under every ſecond Figure, then under thoſe Pricks, draw two Lines parallel whereinto ſet the Figures of your Root as you find them: Your Number being thus pla-

ced

ced and pricked as before is directed, and as in the following Example you ſee done, you may proceed to Extract the Root thereof as followeth.

Example 1. Let it be required to find the Square Root of this Number 12418576, firſt, make a Prick under 6, another under 5, another under 1, and another under 2, under which Points draw two Lines, in which you muſt place your Root, and then will your Number ſtand thus,

12418576
 . . . .

Take the Rod for Extracting of the Square-Root, and look in the firſt row or Colume thereof for the neareſt Number you can there find leſs then 12 (which is as far as the firſt Prick in your Number reaches) and you

ſhall

ſhall find 9, againſt which in the third Colume you ſhall find 3, ſet 3 under the firſt point between the Lines, and 9 under the Line, and ſubſtracting 9 from 12, there will remain 3, which ſet over 12, ſo will your Number ſtand thus;

```
  3
12418576
 .  .  .  .
---------
  3
---------
  9
```

Then in the middle Colume of your Rod between 9 and 3 there ſtands 6, take therefore one of your Rods which hath 6 at the top thereof, and lay it upon your Tabulat by the left ſide of your ſquare Rod, then being there is 341 to the next Prick, ſeek the neareſt Number leſs upon your two Rods, and you ſhall find the next leſs to be 325, againſt which in the laſt Colume of your Square Rod ſtands 5, therefore place 5 under your ſecond Prick, and ſet 325 under 341, and ſubſtracting

it from 341, there will remain 16 which ſet over head, then will the Sum appear thus;

```
 16
  3
12418576
 .  .  .  .
---------
  3  5
---------
  9
 325
```

And in the middle Colume of your Square Rod againſt this 5 there ſtands 10, for this 10 you ſhould take a Rod that hath 10 at the top, but being there is no ſuch, take therefore one that hath a Cypher, and place that between your Square Rod and your Rod of 6, and change your Rod 6 for one of 7, then ſhall you have upon your Tabulat one Rod of 7, another of 0, and your Square Rod.

Thus muſt you always do when the Number in the middle Colume exceeds 10.

Then looking upon your Sum you ſhall find 1685 to your third Prick look therefore upon your Rods for the neareſt

neareſt leſs Number, which you ſhall find to be 1404, againſt which ſtands 2 in the laſt Colume, ſet 2 between the Lines under the third Prick, and 1404 under 1685, and ſubſtracting it from 1685, and there will remain 281, which place above, ſo will your Sum ſtand thus;

281
16
3
12418576
• • •
3 5 2
9
325
1404

And becauſe the Number ſtanding againſt 2 in the middle Colume of your Square Rod between 1404 and 2 was 4, ſet 4 under your laſt Prick, and take a Rod of 4, and put it between your ſquare Rod and your Rod of 0; and becauſe 28176 remains upon your Sum to the laſt Prick. Look upon your Rods for the neareſt Number thereunto, and you ſhall find the very Number it ſelf to ſtand againſt the Figure

Figure 4, ſet therefore 28176 below, and ſubſtract it from that above, and there will remain nothing, which denotes the Number, 12418576 to be a ſquare Number, and the Root thereof to be 3524, and the work finiſhed will ſtand thus;

00000
281
16
3
Square 12418576
• • • •
3 5 2 4 Root.
9
325
1400
28176

This Sum had it been wrought by that ſecond way of Diviſion, which I ſhewed in Chapter 7, it would ſtand as followeth: Square

Square 12418576 (3524 Root.

9
341
325
1685
1404
28176
28176
00000

Caution.

If at any time you look for the remainder upon your Rods, and you cannot find it there, you must then place a Cypher between the Lines, and proceed to the next Figure, as by trying this other Example which I have inserted for practice will appear.

Another

Another Example added for Practice.

90
54895
67
21
2

1177162376 94

3 4 3 0 9 8

9
256
2049
617481
5489504

CHAP. X.

Concerning the Extraction of the Cube Root.

THere is somewhat more difficulty in Extracting of the Cube,

then

then of the Square Root. Wherefore (before I come to Example) I will deliver the manner of the Operation, together with such Cautions as are to be observed in the performance thereof; All which immediately follow in this

GENERAL RULE.

Write down the Number whose Cube Root you are to Extract, and under the first Figure towards the right hand make a Prick or Point, and so under every third Figure towards the left hand, till you come to the end of your Number. Under these Pricks draw two Parallel Lines, (as you did in Extracting the Square Root) between which Lines you are to place the Figures of your Root as you find them; — Then beginning at the Figure (or Figures) of the left hand Prick, and going forward towards the right hand Extract (by help of the Rod for Extracting

tracting the Cube Root) their Root, or if the true Number be not on the Plate, then the nearest less, and placing this Root, (which never exceeds one Figure) between the Lines, and under its Point, and take its Cube from the uppermost Figure, which stands before (or leftwards) of the first Point, and note the Remainder above.

Secondly, Keep the Triple of this Root found, in the head or top of the Rods, and triple the Square of the same Root, and set this Triple one the head of the Rods, and apply it leftwards of the Cubick Rod, and the reserved Rod (or Rods) right-wards, the Cubick Rod being in the midst between them, and out of the left hand Rods, and the Cubick Rod together, pick or find out the Multiple, (or next less Number) then the Figures preceding the second Point, which write apart in a Paper, and note its Quotume over its utmost right-hand Figure, and write the

Square of that Quotume left-wards from the Quotume it ſelf, even in that order as you find them in your Cubick Rod, and under every ſeveral Figure of this Square, write their Multiples found right-wards, even ſuch as the Figures themſelves do ſhew. So that every Multiple may end under its Figure or Quotume; then add together theſe Multiples croſs-wiſe, and take their ſum from the Figures foregoing the ſecond Point, and write the Remainder over them, but write the right-hand Quotume before noted under the ſecond Point between the Lines, for the ſecond Figure or Quotume of the Root: And ſo is performed the Operation of the ſecond Point, which you muſt repeat through the ſeveral Points, even to the laſt.

But in the practice by this Rule, you may ſometimes be at a ſtand, wherefore to this *GENERAL RULE*

RULE (that there may be no obſtacle) I will add theſe two *CAUTIONS.*

I. CAUTION.

But in all Operations and Points it muſt be obſerved, *That if no Multiple (no not the leaſt of all) found in the left Rods, and the plate, may be ſubſtracted from the foregoing Remains, then a Cypher [o] muſt be put under that Point for the Quotume, the Remains being untouched, and abiding as before.*

II. CAUTION.

And if the aforeſaid Sum to be taken away, cannot be taken from the Figures going before its Point, the ſmaller Multiples muſt be added, which the next upper Quotumes in the

Cubick Rod do shew in the Rods, whose Sum may be taken away therefrom.

EXAMPLE

Of the

Cubick Extraction.

Let 22022635627 be a Number given, whose Cube Root you desire: Set down your Number, and point it, (beginning at 7 the last Figure towards the right hand, and so under every third Figure) and draw two Parallel Lines under it, and it will stand in this maner;

22022635627

Look

Look in your Rod for the Extracting the Cube Root, for the nearest Cube Root of the Figures of your given Number standing before the first Point towards your left hand, namely for the nearest Cube Root of the Number less then 22, which you shall find to be 2, which set between the two Lines just under the first Point, and its Cube (which is 8) set under the Line, and substract it from the Figures above the Line, namely from 22, and there will remain 14, which place orderly above, then will your work stand thus, and the work of your first Point finished.

4
22022635627
2
8

Secondly

Secondly, For the finding of the Root belonging to the second Prick, triple the Quotume or Figure which is under the first Prick (namely 2) and it is 6, find therefore a Rod which hath 6 at the head thereof, and lay that Rod by the side of your Cubick Rod towards the right hand, then triple the Square of 2 (which is 4) and it makes 12, which found among the Rods, place by the side of the Cubick Rod towards the left hand.

Then from the Rods which lie on the left hand of the Cubick Rod, and the Cubick Rod it self, find the nearest lesser Number then the Figures standing before the second Prick, namely, less then 14022, and in the ninth place you shall find 11529, which write by it-self as

in the Margine, and over 9 the last Figure towards the right hand (drawing first a Line between) set its Quotume, and by it its Square 81, in the same order as you find them stand in your Cubick Rod.

819
11529
6
48
16389

Then write under 1, its Multiple, which is shewed right-wards against 1 in the Cubick Rod, and is the single Figure 6, and under 8 write the Multiple that it shews right-ward against 8 in the Cubick Rod, which is 48, and these three Multiples so written cross-wise below the Line, and added together (as in the Margine) do produce 16389, which, because they cannot be taken from the upper Figures standing before the second Point, namely from 14022, the Number 9 (before taken) is to be rejected, as being too great, and instead of 819 (by the second Caution) the next higher Notes in the Plate are to be taken, which are 648, and the Multiples that these do shew, namely the Octuple among the left Rods, which is 10112, and the Quadruple among the right Rods which is 24, and the Sextuple among the right Rods which is 36, being added cross-wise (as in the Margine) do produce 13952, which substracted from 14022, (the Figures standing before the second Prick) there remains 70 for the remain of the second Prick, and let there be taken for the Quotume of the second Prick, the right-most of the chosen Figures 648, which is 8, which place under the second Point between the Lines; so is the second Figure of your Root found, and your work will stand thus,

```
  648
------
10112
   24
   36
------
13952
```



```
      70
 14
 2 2 0 2 2 6 3 5 6 2 7
 .     .     .
 ---------------------
   2   8
 ---------------------
   8

 1 3 9 5 2
```

Thirdly, Put the Triple of the precedent Quotumes (*viz.* 28 between the Lines) which is 48, being taken out of the Rods, and put them on the right side of the Cubic Rod, and get the Triple of the Square of the same 28, which may be found to be 2352, which taken out of the Rods, and place on the left-side of the Cubic Rod: And of the Multiples on the left-hand Rods, and the simple single Figures upon the Cubick Rod (the

```
  28
  28
-----
 224
  56
-----
 784
   3
-----
2352
```

least of which being 235201) there is none so little that may be substracted from the Figures belonging to the third Point, namely from 70635: Therefore (by the first Caution) the Remains abiding, or continuing as they are you must put a Cypher under the third Point, for the third Quotume belonging to the third Point: And thus the Operation of the third Point is accomplished, and the work will stand as followeth;

```
    070
    14
    2202263 5627
    .      .      .
    ——————————————
    2   8   0
    ——————————————
    8
    13952
```

Fourthly, Set the Triple of the foregoing Quotumes (*viz.* 280) which

which is 840 on the right-hand, and the Triple of the Square of the same 280, which is 225200 on the left-hand, and the Cubick Rod between them; Then out of the left-most Multiples, choose that which is next less then the Figures belonging to the fourth Point, namely 70635627, which is this 70560027,

```
      280
      280
    ———————
    22400
    560
    ———————
    78400
        3
    235200
```

which stands against 3 on the Tabulat, wherefore write this Number 70560027 upon Paper as in the Margine, with a Line over it, and set over the Line the Quotient 3, over its right-most Figure, and the Square of the said Quotume 3, which is 9, left-ward thereof, and the Noncuple found in the right-hand

```
         93
    ————————
    70560027
    7560
    ————————
    70635627
```

hand Rods, which is 7560 write under 9, let these two Multiples be added as in the Margine, and the Sum will be 70635627, which substracted from the Figures foregoing the fourth Prick, and there will nothing remain; therefore let the right-most of the Figures of 93, *viz.* 3, be placed under the fourth and last Point, for the fourth and last Quotume of the Root, and so the whole and perfect Cubick Root of the given Number 22022635627, is 2803, and being nothing remained, it is a perfect Cubick Number. The like is to be done in other Numbers, but I shall forbear to give you any more Examples, there falling out in this all the variety that at any time may happen for the *General Rule* and the two *Cautions* before premised are here made applicable to Practice; wherefore to this Treatise for the present I will put

An End.

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Advertisement.

Errata.

Pag. 3. l. 17. for----65 ſic 650 r. & *ſic* &c. p.4.l.15. for *Figure* I.r.*Figure* 1. p.6.l.10. for *be* r. &c. p. 7. l. 11. for 650 r. &c

p.11.*lines*	10	read	2 Inches $\frac{2}{10}$
	11		$\frac{1}{2}$ of an Inch.
	12		$\frac{1}{12}$ of an Inch.

p.12. l. 13. dele *for*, p. 15. l. 15. for *Figure* r. *Square Cube*, p. 17. l. ult, for *Figure* r. *Figures* p. 22. l. 4. r. and ſo on *to*.