Newton, Isaac
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ARITHMETICA UNIVERSALIS;

SIVE

DE

COMPOSITIONE

ET

RESOLUTIONE

ARITHMETICA

LIBER.

Auctore IS. NEWTON, Eq. Aur.

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LUGDUNI BATAVORUM,

Apud JOH. ET HERM. VERBEEK, Bibliopolæ

MDCCXXXII.

DE MULTIPLICATIONE.

Numeri qui ex Multiplicatione duorum quorumvis numerorum non majorum quàm 9 oriuntur, memoriter addiſcendi ſunt. Veluti quod 5 in 7, facit 35, quòdque 8 in 9 facit 72, &c. Deinde majorum numerorum multiplicatio ad horum exemplorum normam inſtituetur.

Si 795 per 4 multiplicare oportet ſubſcribe 4, ut vides. Dein dic, 4 in 5 facit 20, cujus poſteriorem figuram 0 ſcribe infra 4, priorem vero 2 reſerva in proximam operationem. Dic itaque præterea 4 in 9 facit 36, cui adde præfatum 2 & fit 38, cujus poſteriorem figuram 8 ut ante ſubſcribe, & priorem 3 reſerva. Denique dic 4 in 7 facit 28 cui adde prædictum 3 & fit 31. Eoque pariter ſubſcripto habebitur 3180 numerus qui prodit multiplicando totum 795 per 4.

$$\begin{array}{r} 795 \\ 4 \\ \hline 3180 \end{array}$$

Porrò ſi 9043 multiplicandus eſt per 2305, ſcribe alterutrum 2305 infra alterum 9043 ut ante, & multiplica ſuperiorem 9043 primò per 5 pro more oſtenſo, & emerget 45215, dein per 0 & emerget 0000, tertiò per 3 & emerget 27129, denique per 2 & emerget 18086. Hoſque ſic emergentes numeros in ſerie deſcendente ita ſcribe, ut cujuſque inferioris ultima figura ſit uno loco propior ſiniſtræ quàm ultima ſuperioris. Tandem hos omnes adde & orietur 20844115, numerus qui fit multiplicando totum 9043 per totum 2305.

$$\begin{array}{r} 9043 \\ 2305 \\ \hline 45215 \\ 0000 \\ 27129 \\ 18086 \\ \hline 20844115 \end{array}$$

Decimales numeri per integros vel per alios decimales perinde multiplicantur, ut vides in his exemplis.

$$\begin{array}{r} 72{,}4 \\ 29 \\ \hline 6516 \\ 1448 \\ \hline 2099{,}6 \end{array} \qquad \begin{array}{r} 50{,}18 \\ 2{,}75 \\ \hline 25090 \\ 35126 \\ 10036 \\ \hline 137{,}9950 \end{array} \qquad \begin{array}{r} 3{,}9025 \\ 0{,}0132 \\ \hline 78050 \\ 117075 \\ 39025 \\ \hline 0{,}05151300 \end{array}$$

Sed nota quod *in producto numero tot semper figuræ ad dextram pro decimalibus abscindi debeant quot sunt figuræ decimales in utroque numero multiplicante.* Et si fortè non sint tot figuræ in producto numero, deficientes loci circulis adimplendi sunt, ut hic fit in exemplo tertio.

Simplices termini Algebraici multiplicantur ducendo numeros in numeros & species in species ac statuendo factum Affirmativum *si ambo factores sint affirmativi aut ambo negativi, &* Negativum *si secus.*

Sic $2a$ in $3b$ vel $-2a$ in $-3b$ facit $6ab$; vel $6ba$: Nihil enim refert quo ordine ponantur. Sic etiam $2a$ in $-3b$ vel $-2a$ in $3b$ facit $-6ab$. Et sic $2ac$ in $8bcc$ facit $16abccc$ sive $16abc^3$; & $7axx$ in $-12aaxx$ facit $-84a^3x^4$; & $-16cy$ in $31ay^3$ facit $-496acy^4$; & $-4z$ in $-3\sqrt{az}$ facit $12z\sqrt{az}$. Atque ita 3 in -4 facit -12 & -3 in -4 facit 12.

Fractiones multiplicantur ducendo numeratores in numeratores ac denominatores in denominatores. Sic $\frac{2}{3}$ in $\frac{5}{7}$ facit $\frac{10}{21}$; & $\frac{a}{b}$ in $\frac{c}{d}$ facit $\frac{ac}{bd}$; & $2\frac{a}{b}$ in $3\frac{c}{d}$ facit $6\frac{a}{b}\times\frac{c}{d}$ seu $6\frac{ac}{bd}$; & $\frac{3acy}{2bb}$ in $\frac{-7cyy}{4b^3}$ facit $\frac{-21accy^3}{8b^5}$; & $\frac{-4z}{c}$ in $\frac{-3\sqrt{az}}{c}$ facit $\frac{12z\sqrt{az}}{cc}$ & $\frac{a}{b}x$ in $\frac{c}{d}xx$ facit $\frac{ac}{bd}x^3$. Item 3 in $\frac{5}{2}$ facit $\frac{15}{2}$ ut pateat si 3 reducatur ad formam fractionis $\frac{3}{1}$ adhibendo unitatem pro Denominatore. Et sic $\frac{15aaz}{cc}$ in $2a$ facit $\frac{30a^3z}{cc}$. Unde obiter nota quod $\frac{ab}{c}$ & $\frac{a}{c}b$ idem valent; ut & $\frac{abx}{c}$, $\frac{ab}{c}x$ & $\frac{a}{c}bx$; nec non $\frac{\overline{a+b}\sqrt{cx}}{a}$ & $\frac{a+b}{a}\sqrt{cx}$, & sic in aliis.

Quantitates radicales ejusdem denominationis (hoc est, si sint ambæ radices quadraticæ, aut ambæ cubicæ, aut ambæ quadrato-quadraticæ, *&c.*) multiplicantur ducendo terminos in se invicem sub eodem signo radicali. Sic $\sqrt{3}$ in $\sqrt{5}$ facit $\sqrt{15}$, & $\sqrt{ab}$ in $\sqrt{cd}$ facit $\sqrt{abcd}$.

Et

Et $\sqrt[3]{5ayy}$ in $\sqrt[3]{7ayz}$ facit $\sqrt[3]{35aay^3z}$. Et $\sqrt{\frac{a^3}{c}}$ in $\sqrt{\frac{abb}{c}}$ facit $\sqrt{\frac{a^4bb}{cc}}$ hoc est* $\frac{aab}{c}$. Et $2a\sqrt{az}$ in $3b\sqrt{az}$ facit $6ab\sqrt{aazz}$ hoc est $6aabz$. Et $\frac{3xx}{\sqrt{ac}}$ in $\frac{-2x}{\sqrt{ac}}$ facit $\frac{-6x^3}{\sqrt{aacc}}$ hoc est $\frac{-6x^3}{ac}$. Et $\frac{-4x\sqrt{ab}}{7a}$ in $\frac{-3dd\sqrt{5cex}}{10ee}$ facit $\frac{12ddx\sqrt{5abcex}}{70aee}$.

* Vide Cap De [illegible]

Quantitates pluribus partibus constantes multiplicantur ducendo singulas unius partes in singulas alterius, perinde ut in Multiplicatione numerorum ostensum est. Sic $c-x$ in a facit $ac-ax$, & $aa+2ac-bc$ in $a-b$ facit $a^3+2aac-aab-3bac+bcc$. Nam $aa+2ac-bc$ in $-b$ facit $-aab-2acb+bbc$, & in a facit $a^3+2aac-abc$, quorum summa est $a^3+2aac-aab-3abc+bbc$. Hujus multiplicationis specimen unà cum aliis consimilibus exemplis subjectum habes.

$$\begin{array}{r}
aa+2ac-bc \\
a-b \\ \hline
-aab-2abc+bbc \\
a^3+2aac-abc \\ \hline
a^3+2aac-aab-3abc+bbc
\end{array}
\qquad
\begin{array}{r}
a+b \\
a+b \\ \hline
ab+bb \\
aa+ab \\ \hline
aa+2ab+bb
\end{array}$$

$$\begin{array}{r}
a+b \\
a-b \\ \hline
-ab-bb \\
aa+ab \\ \hline
aa\ * -bb
\end{array}
\qquad
\begin{array}{r}
yy+2ay-\frac{1}{2}aa \\
yy-2ay+aa \\ \hline
aayy+2a^3y-\frac{1}{2}a^4 \\
-2ay^3-4aayy+a^3y \\
y^4+2ay^3-\frac{1}{2}aayy \\ \hline
y^4\ * -3\frac{1}{2}aayy+3a^3y-\frac{1}{2}a^4
\end{array}$$

$$\begin{array}{l} \frac{2ax}{c} - \sqrt{\frac{a^3}{c}} \\ 3a + \sqrt{\frac{abb}{c}} \\ \hline \frac{2ax}{c}\sqrt{\frac{abb}{c}} - \frac{aab}{c} \\ \frac{6aax}{c} - 3a\sqrt{\frac{a^3}{c}} \\ \hline \frac{6aax}{c} - 3a\sqrt{\frac{a^3}{c}} + \frac{2ax}{c}\sqrt{\frac{abb}{c}} - \frac{aab}{c}. \end{array}$$

DE DIVISIONE.

Divisio in numeris instituitur quærendo quot vicibus Divisor in Dividendo continetur, totiesque auferendo, & scribendo totidem unitates in Quoto. Idque iteratò si opus est, quamdiu divisor auferri potest.

Sic ad dividendum 63 per 7, quære quoties 7 continetur in 63 & emergent 9 pro quoto præcisè. Adeoque $\frac{63}{7}$ valet 9. Insuper ad dividendum 371 per 7, præfige divisorem 7, & imprimis opus instituens in initialibus figuris Dividendi proximè majoribus Divisore, nempe in 37, dic quoties 7 continetur in 37? Resp. 5. Tum scripto 5 in Quoto, aufer 5×7 seu 35 de 37, & restabit 2, cui adnecte ultimam figuram Dividendi nempe 1, & fit 21 reliqua pars Dividendi, in qua proximum opus instituendum est. Dic itaque ut ante quoties 7 continetur in 21? Resp. 3. Quare scripto 3 in Quoto, aufer 3×7 seu 21 de 21 & restabit 0. Unde constat 53 esse numerum præcisè qui oritur ex divisione 371 per 7.

$$\begin{array}{l} 7)\ 371\ (53 \\ \quad\ \ 35 \\ \quad\ \ \ 21 \\ \quad\ \ \ 21 \\ \quad\ \ \ \ 0 \end{array}$$

Atque ita ad dividendum 4798 per 23, opus primò instituens in initialibus figuris 47 dic quoties 23 continetur in 47? Resp. 2. Scribe ergo 2 in Quoto, & de 47 subduc 2×23 seu 46, restatque 1, cui subjunge proximum numerum Dividendi, nempe 9, & fit 19 in subsequens