

AccessionIndex: TCD-SCSS-V.20121208.872

Accession Date: 8-Dec-2012

Accession By: Prof.J.G.Byrne

Object name: Posters on 'Computation in the era of Queen Elizabeth I'

Vintage: c.1986

Synopsis: Trinity College Dublin, for an exhibition to coincide with the IFIP-1986 conference.

**Description:**

These posters were exhibited to coincide with a conference of the International Federation of Information Processing (IFIP) held in Trinity College Dublin in September, 1986.

These posters describe *Computation in the era of Queen Elizabeth I (1533-1603)*, part of a larger exhibition created by Prof.J.G.Byrne that was entitled *Computing through the Ages* and held in the Long Room of the Old Library in Trinity College Dublin from September, 1986, which amongst other exhibits also included an exhibition on *Charles Babbage's Computing Engines*, see elsewhere in this catalog.

These exhibition materials were re-used as part of the *Treasures of the Mind* exhibition held in the Colonnades Gallery of the Old Library for the TCD Quatercentenary in 1992.

The homepage for this catalog is at: <https://www.scss.tcd.ie/SCSSTreasuresCatalog/>  
Click '*Accession Index*' (1st column listed) for related folder, or '*About*' for further guidance. Some of the items below may be more properly part of other categories of this catalog, but are listed here for convenience.

Accession Index	Location	Vintage	Object and Identification
<a href="https://www.scss.tcd.ie/SCSSTreasuresCatalog/TCD-SCSS-V.20121208.872">TCD-SCSS-V.20121208.872</a>		c.1986	Prof.J.G.Byrne, Posters on <i>Computation in the era of Queen Elizabeth I</i> , for an exhibition to coincide with the IFIP-1986 conference, c.1986. [Prof.J.G.Byrne's IFIP-1986 exhibits and 1992 TCD Quatercentenary exhibits]

**References:**

1. xxx.

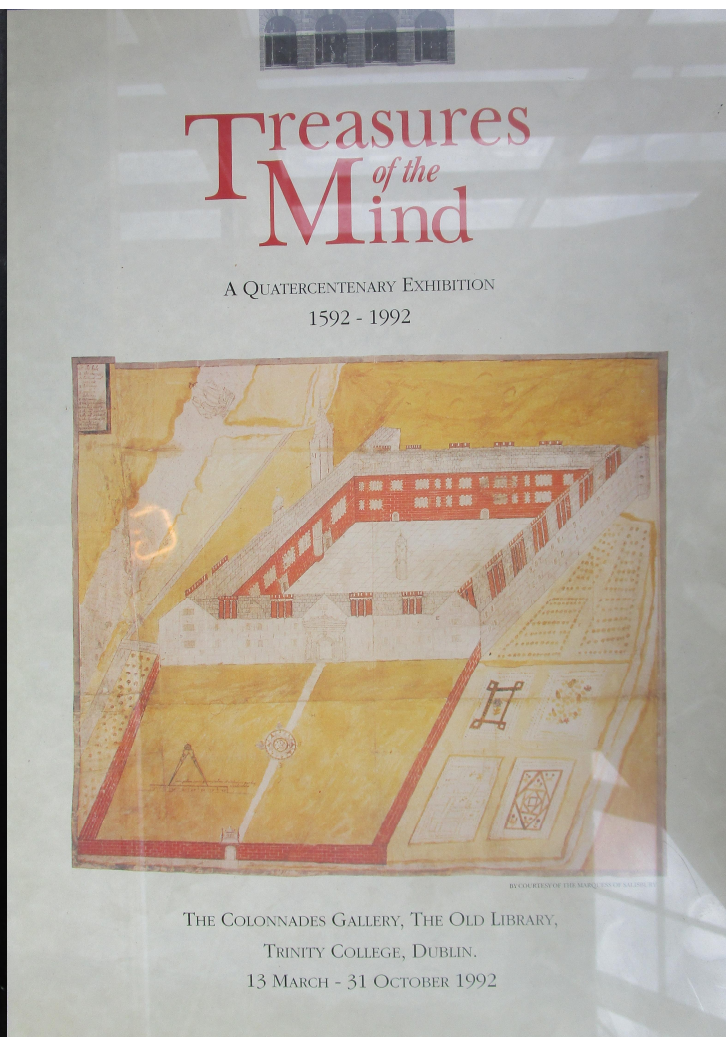


Figure 1: Exhibition publicity materials:  
1986: 'Computing Through The Ages'  
1992: 'Treasures of the Mind'



Computation  
in the era of  
Elizabeth I  
(1533-1603)

Exhibition in preparation

The sector

Earliest plan of  
College

*Computation in the era of Queen Elizabeth I*  
*1533- 1603*

Figure 2: *Computation in the era of Queen Elizabeth I (1533-1603)*  
*Preparatory and final title posters*



## **Computation in the era of Queen Elizabeth I (1533-1603)**

This exhibition marks the fourth centenary of the death of Queen Elizabeth I who founded this College in 1592. The portrait by Marcus Gheerarts of her standing on a map dates from that year. The drawing of the College alongside is from the library of the descendants of William Cecil, who was her principal Minister. As the items on Cuthbert Tunstall and Robert Recorde show computation and mathematics in general was not well advanced in England in the early years of the 16<sup>th</sup> century. Towards the end of the century there was the remarkable development of logarithms by John Napier. A useful computational instrument, the sector, was developed in England by Thomas Hood who published a book on it in 1598. A similar instrument was apparently independently invented by Galileo around 1592.

*Figure 3: Computation in the era of Queen Elizabeth I*



### Cuthbert Tunstall (1474-1559)

In 1522 Tunstall wrote one of the first books printed in England on Arithmetic. It was written in Latin and called *De Arte Supputandi libri IV* [The Art of Computing in four books]. It made no claims as to originality. Tunstall studied in Padua from 1499 to 1505 and he learned about the Italian mathematicians at that time. The book was more popular on the continent than in England and it was reprinted at least seven times. The copies in the College Library were printed in Paris in 1538 (L.ll. 52 and EE. k. 53). Mathematics is defined to consist of Arithmetic, Music, Geometry and Astrology, although the definition of the latter is closer to what would be called Astronomy to-day. Tunstall became Bishop of London in 1522 and wrote no further secular books. He was transferred to Durham in 1530.

Division of 2915410 by 47 is set out as follows:

					1				
				5	9	1	2		
4	7		2	9	1	5	4	1	0
				6	2	0	3	0	
				4	7	7	7	7	
					4	4	4		

Note the way the divisor 47 is carried along.

The most complex arithmetic operations discussed are the finding of square and cube roots. The square root of 57836029 is shown as follows:

	2						
	8		7				4
		4		1			
5	7	8	3	6	0	2	9
	7		6		0		5
	1	4	5	2	2	0	
		1	1	5			

The method taught in schools until the 1960s was based on the theorem of Euclid (Book II Proposition 4, which is expressed algebraically as  $(a + b)^2 = a^2 + 2ab + b^2$ ) and was set out as follows:

$$\begin{array}{r}
 57,83,60,29 \text{ (7605)} \\
 \underline{49} \\
 146 \quad 8 \ 83 \\
 \underline{8 \ 76} \\
 15205 \quad 76029 \\
 \underline{76025} \\
 4
 \end{array}$$

Figure 4: Cuthbert Tunstall, author of one of the earliest English books on arithmetic



DE ARTE SUP-  
putandi libri qua-  
tuor, Cutheberti  
Tonstalli.



PARISIIS.  
EX OFFICINA ROBERTI STEPHANI.  
M.D.XXXVIII.

Figure 5: Cuthbert Tunstall's book on arithmetic  
'De Arte Supputandi Libri Quattuor' by Cutheberti Tonstalli, c.1538



**Robert Recorde  
(c1510-1558)**

Recorde wrote the first widely used book in English on arithmetic. It was published in 1543 with the title *The Ground of Artes*. It was republished many times with extensions by others, until 1699.

He gave three methods for the basic arithmetic operations:

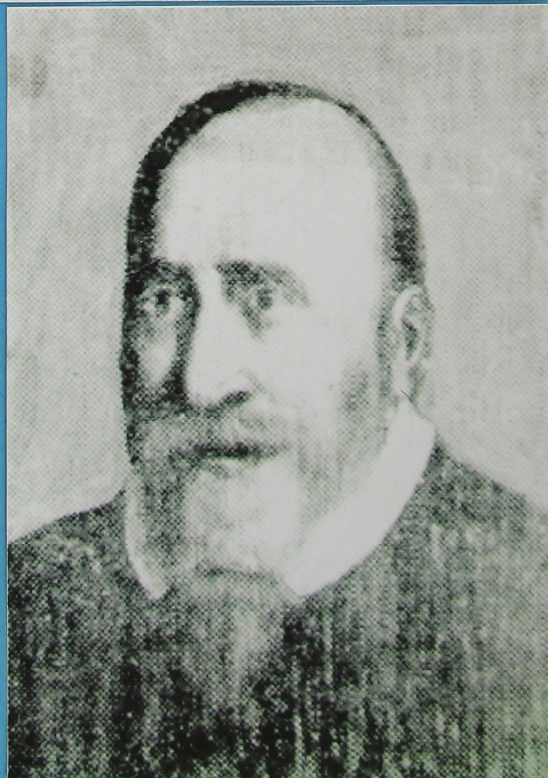
Pencil and paper and tables

Accomptynge by counters

“not only for them who cannot wryte or read but also for them that can do both, but have not at some times their penne or tables with them.”

“The arte of the hande”. He says this method was 2000 years old but not commonly known in England.

Recorde was born in Tenby, Wales and was a medical doctor. In 1551 he was sent to Wexford to manage the silver mines and he was also in charge of the mint in Dublin. The mines were not successful due to no fault of Recorde and he was recalled in 1553.

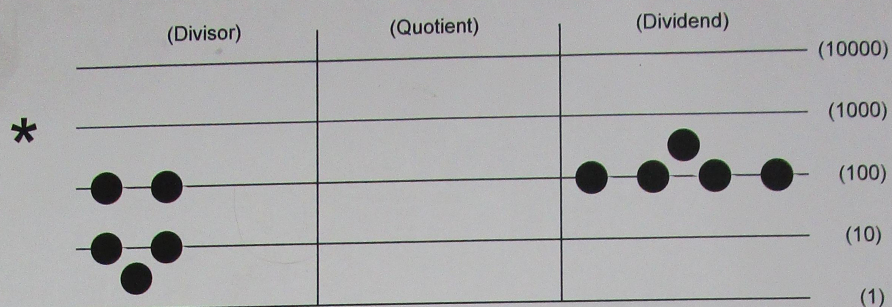


*Figure 6: Robert Recorde, author of the first widely used English book on arithmetic*

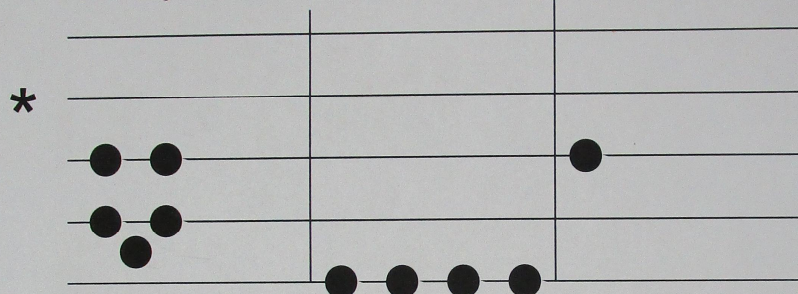


# ACCOMPTYNGE BY COUNTERS

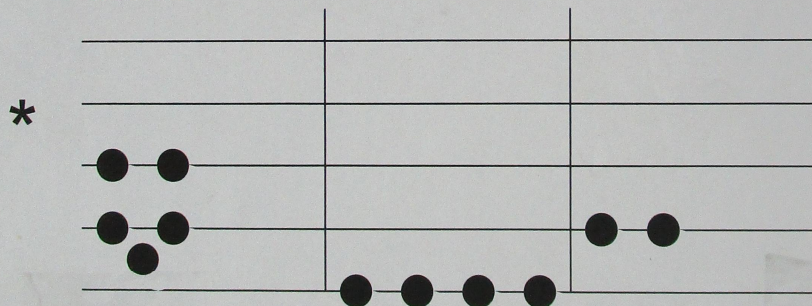
If 225 sheep cost 45 pounds what does each sheep cost?  
As 225 is greater than 40 multiply 45 by 20 to get 900



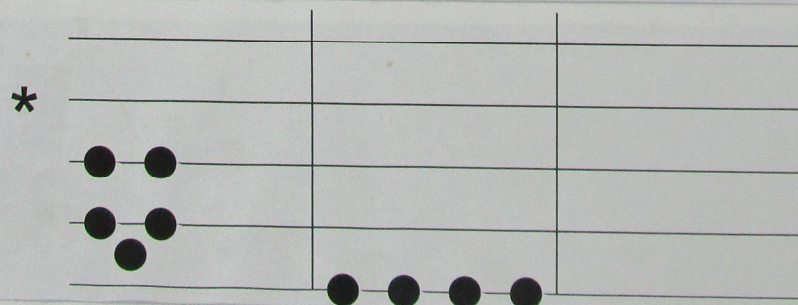
(225) (900)  
Start at highest line; how often does 2 go into 9? 4 with one remaining



Now comes to second line of divisor. 2 by 4 equals which subtracted from 10 leaves 2



Now 5 by 4 = 20 which subtracted from 20 leaves 0 so the answer is 4



The values of the counters or jetons between the rows are half the value of the row above

The \* indicates that the row is worth 1000

The numbers in brackets on the first diagram indicate the value of the jeton

Figure 7: Arithmetic accompanied by counters or jetons, akin to the methods referred to by Robert Recorde (for Jetons, see elsewhere in this catalog)



**John Dee**  
**(1527-1609)**

Dr. John Dee was a favourite of Queen Elizabeth I who called him "my philosopher". Her coronation day was chosen by him. He lived and studied in Louvain from 1548-1551 where he became friendly with Gerard Mercator. During his time there he wrote two books on astronomy. He brought back maps and globes to Trinity College Cambridge and he also brought back navigation instruments. He was consulted by on navigational matters. Martin Frobisher and Francis Drake before their voyages and he also prepared charts for the Muscovy Company who traded with Russia.

In 1570, he wrote a long preface to Henry Billingsley's translation of Euclid's Elements of Geometry, the first time it was translated into English. The translator's opening words were:

*There is (gentle reader) nothing (the works of God only set apart) which so much beautifies and adorns the soul and mind of man as does knowledge of the good arts and sciences. ... Many ... arts there are which beautify the mind of man; but of all none do more garnish and beautify it than those arts which are called mathematical, unto the knowledge of which no man can attain, without perfect knowledge and instruction of the principles, grounds, and Elements of Geometry.*

In his Mathematicall Praeface Dee wrote:

*The art of Navigation demonstrates how, by the shortest good way, by the aptest direction, and in the shortest time, a sufficient ship, between any two places (in passage navigable) assigned, may be conducted; and in all storms and natural disturbances chancing, how to use the best possible means, whereby to recover the place first assigned. What need the Master Pilot hath of other Arts, here before recited, it is easy to know: Hydrography, Astronomy, Astrology and Horometry. Presupposing continually of the common base and foundations of all: namely Arithmetic and Geometry.*

He was interested in cryptography and he probably went to the continent on spying missions. He was never given any official position by Elizabeth although she often visited him in Mortlake where he died on 26<sup>th</sup> March 1609.

*Figure 8: John Dee, philosopher to Queen Elizabeth I*





*Figure 9: John Dee*



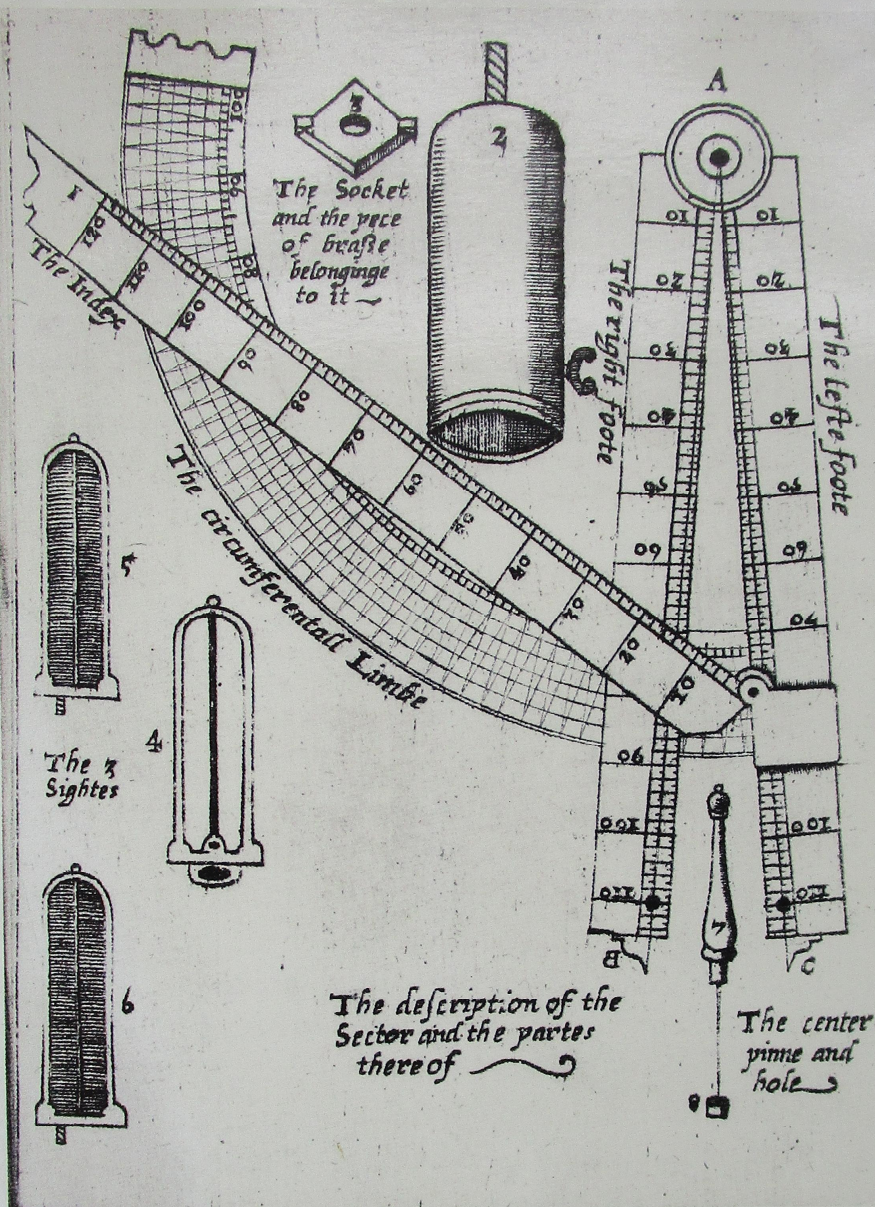
## Thomas Hood

(fl. 1582-1598)

Hood, the son of a tailor, graduated from Cambridge in 1581. When the Privy Council recommended that instruction be given in military matters a lectureship in mathematics was founded in London for the general public and Hood was appointed. His first book was an argument in favour of mathematics and he showed its application to astronomy, navigation, geography, topography, hydrography and military affairs. He invented a sector which was described in a book published in 1598 although it seems certain that he had invented it many years before. The book was dedicated to Lord Mountjoy who led the English army at the battle of Kinsale in 1601. Sir George Carew, the Lord President of Munster, used a quadrant for gunnery calculations when battering the town.

*Figure 10: Thomas Hood, inventor of the Sector*





From  
 The Making and Use of the Geometrical Instrument Called a Sector  
 by Thomas Hood  
 London 1598

Figure 11: How to make and use a Sector, by Thomas Hood





*Figure 12: Illustration of both sides of a Sector*





*Figure 13: Sir George Carew using a Quadrant for gunnery calculations during the Battle of Kinsale, 1601*

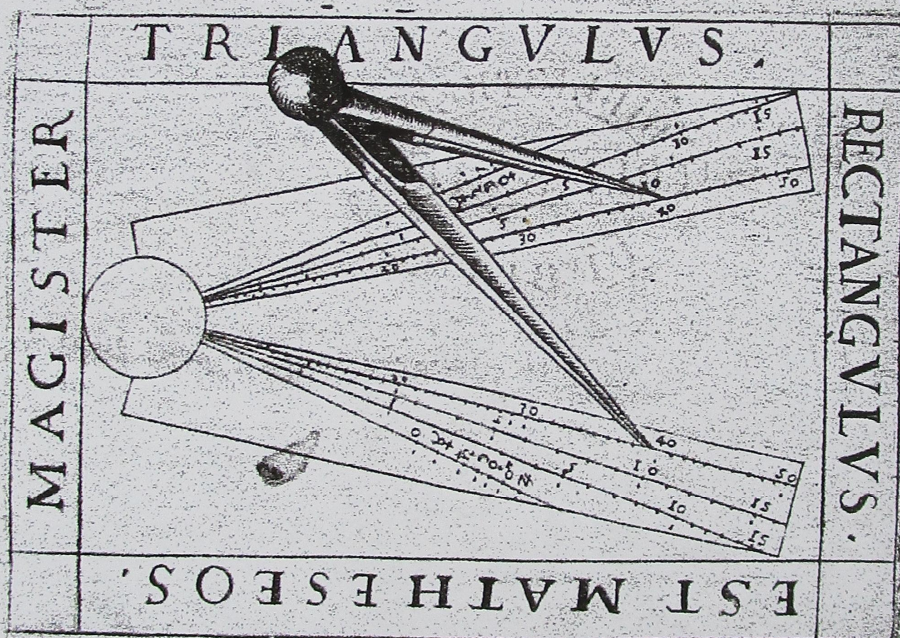


V S V S  
**ET FABRICA**  
**C I R C I N I**

C V I V S D A M P R O P O R T I O N I S ,

Per quem omnia ferè tum Euclidis, tū Mathematicorum  
 omnium problemata facili negotio resolvuntur .

*Opera & Studio BALTHESARIS CAPRÆ  
 Nobilis Mediolanensis explicata .*



PATAVII, Apud Petrum Paulum Tozzium. M.DC.VII.

*Ex Typographia Laurentij Pasquati. & f*

TCD L.ee.40

(By permission of the Board of Trinity College)

Figure 14: 'Usus Et Fabrica Circin Cuiusdam Proportionis, Per quem omnia ferè tum Euclidis, tū Mathematicorum omnium problemata facili negotio resolvuntur', by Opera & Studio Balthesaris Caprae, c.1607, on fabrication and use of Sectors, suppressed by University of Padua 2 months after publication after complaint by Galileo that it was a plagiarized translation from his own work



## Logarithms

The most important development in computation in the late 16<sup>th</sup> century was the discovery of logarithms, probably in 1592, by John Napier, laird of Merchiston near Edinburgh. It came as a bolt from the blue. As his artificial numbers, as he called them were logarithms of sines it has been suggested that the idea of replacing multiplications and divisions by addition and subtraction came from the relation:

$$\sin A \cos B = \frac{1}{2} (\sin(A+B) + \sin(A-B))$$

Although his original logarithms were not to the base 10 he did suggest this in an Appendix to his book on the Construction of logarithms (*De Mirifici Logarithmorum Canonis Constructio* : Edinburgh 1619 TCD EE.gg.46 No. 26). The tables to base 10 were computed by his friend and admirer, Henry Briggs. A table to 14 decimal places of the integers from 1 to 1000 in steps of 1 was published in 1617 and a much larger although incomplete table was published in 1624 (*Arithmetica Logarithmica* London 1624 TCD L. bb. 26). Briggs was a benefactor of TCD, giving £100 in 1609. He corresponded with James Ussher, a very distinguished graduate and Fellow of the College. In one his letters he wrote:

“Napper, Lord of Markinston, hath set my Head and Hands a Work, with his new and admirable Logarithms. I hope to see him this Summer if it please God, for I never saw Book which pleased me better, or made me more wonder.”

*Figure 15: Napier's Logarithms*



### Napier's Bones

“Seeing there is nothing (right well-beloved Students of the Mathematics) that is so troublesome to mathematical practice, nor that doth more molest and hinder calculators, than the multiplications, divisions, square and cubical extractions of great numbers, which besides the tedious expense of time are for the most part subject to many slippery errors, I began therefore to consider in my mind by what certain and ready art I might remove those hindrances. And having thought upon many things to this purpose, I found at length some excellent brief rules to be treated of (perhaps) hereafter. But amongst all, none more profitable than this which together with the hard and tedious multiplications, divisions, and extractions of roots, doth also cast away from the work itself even the very numbers themselves that are to be multiplied, divided and resolved into roots, and putteth other numbers in their place which perform as much as they can do, only by addition and subtraction, division by two or division by three.”

Napier published his book on the Bones (*Rabdologiae* London 1618) after the time of Elizabeth but it is quite likely that he invented them during her reign. They are just the columns of the multiplication table with some additional bones to aid in taking square roots. The photograph, which is displayed by permission of the Board of Trinity College Dublin, shows a set of bones given to the College about 1730 by John Lyon who assisted Swift in his last illness. In the *Rabdologiae* he also described a form of binary arithmetic which he called Location Arithmetic.

*Figure 16: Napier's Bones*



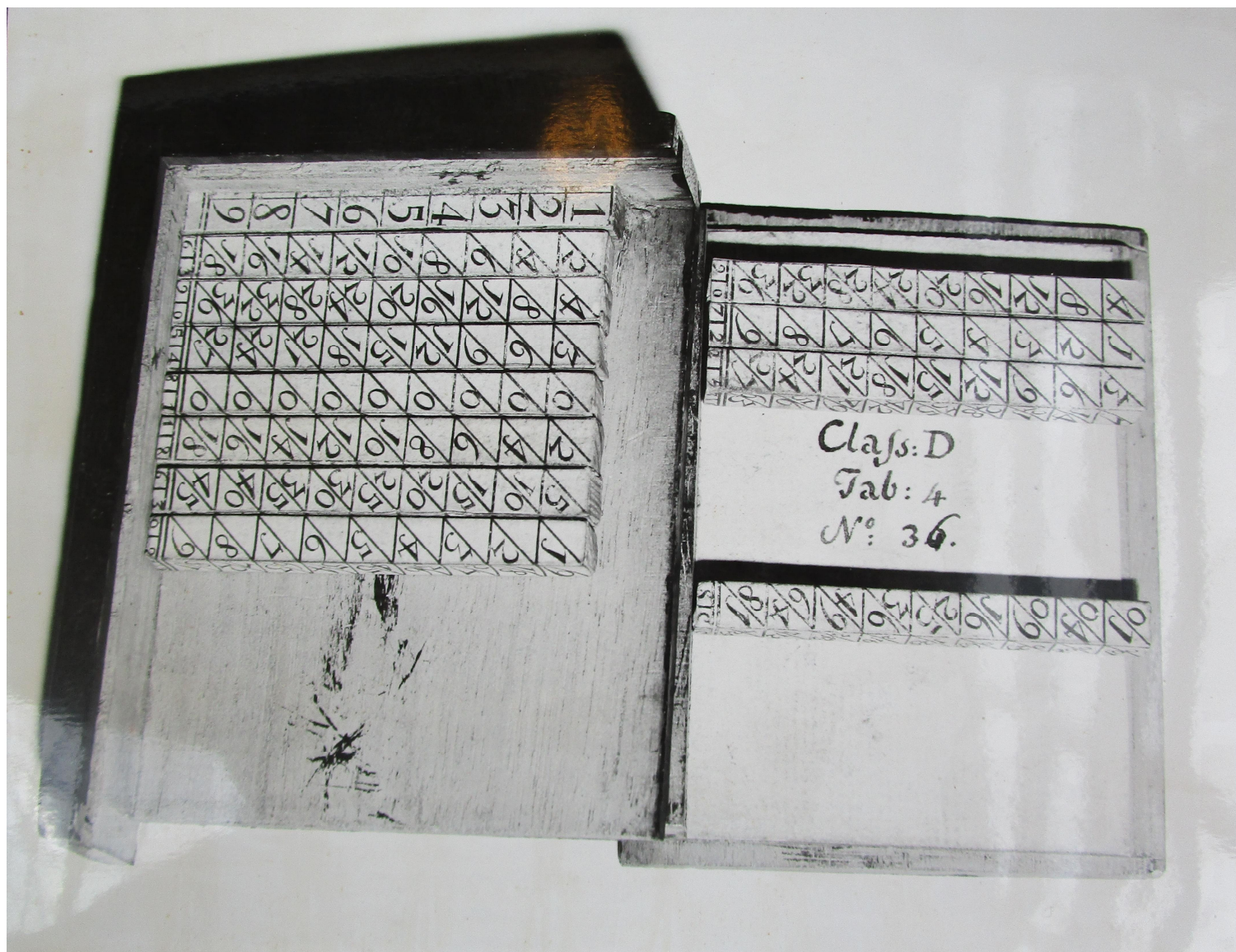


Figure 17: Napier's Bones