

THE ABACUS OF LAVRION

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I. Description of the tablet

In the museum of Lavrion there is a tablet of white marble with index number 90, which is 93.5 cm in length, 50 and 47.5 cm in its great and small breadth, respectively, and 6-8 cm in thickness. This tablet was found by the archaeologist Maria Salliora - Oikonomakou at a place called "the harbour of Pasha" in 1977 [1]. This place coincides with the harbour of the ancient city of Sounion. There are thirteen depthless engravings 2-5 cm long, perpendicular to the greatest and smallest sides of the tablet. These engravings are almost equidistant and they could not be considered as a kind of measure [2].

A leaden plug passes exactly through the centre of gravity of the tablet and protrudes from the back about 15 cm. This means that there was no weight moment to produce its rotation and, therefore, it must have been plugged on a rather inclined wall.

There are two rows of seven symbol-letters each, engraved on the down right quarter part of the tablet parallel to its great side. The distance between the rows is 5-6 cm and among the symbol-letters it is 1-4.5 cm (Figure 1).

II. The interpretations of the epigraph.

II.1. The musical interpretation

The archaeologist Peter Themelis was the first to say without giving any proof that the epigraph was a musical distich. His brother, the musicologist Dimitrios Themelis, tried to give proofs by breaking the three-legged symbol-letters into three parts. The fragments happened to coincide with note-symbols, which are contained in Alypius' Tables [3,4]. Thus a polyphonic and impressionistic [5] composition resulted, which had a bold counterpoint for its era!

For a number of reasons based on the ancient Greek musical theory [6] this interpretation is not fitting.

II.2. The numerical and metrological interpretation

We are of the opinion that the symbol-letters in the two rows of the epigraph are numbers and constitute the display of a unique abacus. This abacus was used in the money business of those dealing in pure silver of Lavrion .

Abaci were considered as the first calculators in the world and they had been known to Greeks since the prehistoric ages [7].

Another unique abacus was found by Rangabe in Salamis island (Greece) in 1846 [8]. It is a marble tablet measuring 150X75 cm and belongs to the epigraphic museum of Athens under the index number 11515. There are three rows of numbers engraved on the tablet, each one parallel to the upper, the lower, and the left side of it as follows:

Upper-side 1000, 500, 100, 50, 10, 5, 1 obol, 1/2 of obol, 1/4 of obol, 1 chalkous (=1/8 of obol)

Lower side: 1 talent (=6000 drachmas), 5000, 1000, 500, 100, 50, 10, 5, 1, 1 obol, 1/2 of obol, 1/4 of obol, 1 chalkous.

Left side: 1000, 500, 100, 50, 10, 5, 1, 1 obol, 1/2 of obol, 1/4 of obol, 1 chalkous.

There are also groups of 11 and 5 parallel lines, engraved on the tablet parallel to its long and small sides, respectively.

Some other marble tablets, parts of abaci, have also been found in Greece. The abacus of Naxos island has the following numbers engraved on it:

Drachmae 1000, 500, 100, 50, 10, 5, 1, 3 obols, 1 obol, 1/2 of obol [9].

The abacus of the ancient city Minoa on the Amorgos island has the numbers: Drachmae 1000, 500, 100, 50, 10, 5, 1, 1 obol, 1/2 of obol [10].

There are the following three rows of numbers engraved on the abacus of Eleusis [11]:

500, 100, 50, 10, 5, 1, 1 obol

500, 100, 50, 10, 5, 1, 1 obol, 1/2 of obol

500, 100, 50, 10

We must elucidate that:

(i) all the numbers of the aforementioned four abaci are of the acrophonic numerical system of Greeks [12, 13, 14, 15, 16].

(ii) All integer numbers, except the one of the talent, are of the form $1X10^k$ or $5X10^k$ where $k=0,1,2$, or 3 at most.

The epigraph on the tablet of Lavrion is interpreted by means of the alphabetic numerical system of Greeks [12, 17, 18].

The first diplet of symbols in the first row represents five myriads i.e. 50000 and in the second row represents one myriad i.e. 10000.

The second diplet of symbols in the first row stands for 5000 and in the second row stands for 1000.

In the first row $\Phi=500$, $N=50$, and $E=5$.

In the second row $P=100$, $I=10$, and $A=1$.

In other words the first five symbol-letters in each row represent 55555 and 11111 drachmas, respectively.

The sixth symbol in the first row because of its position (it is after 5 drachmas) and its shape (it is an inclined rather than a vertical line) represents 1 stater (= 2 drachmae).

C, the last symbol-letter in the first row, stands for 1/2 of obol.

A small horizontal line, the sixth symbol in the second row, used to symbolise 1 obol in Argos, Aegina island, Nemea, Troizina, Oropos, and Pergamos as well [11].

X represents 1 chalkous (=1/8 of obol).

The following data are in favour of the acceptance of the abacus (Figure 2):

(i) There are numbers of the same form ($1X10^k$ or $5X10^k$) but in alphabetic numerical system on the tablet of Lavrion. We must notice that these numbers are larger by one order of magnitude i.e. $k=0,1,2,3$, and 4. In our opinion this fact was necessary since huge amounts of money were exchanged in the commerce of pure silver.

(ii) The existence of the thirteen equidistant depthless engravings on the tablet of Lavrion can now be explained.

(iii) The abacus of Lavrion was found at the place called «the harbour of the ancient city of Sounion». The abacus of Rangabe was found in the Salamis island, across the city of Sounion [8].

(iv) The functionality of the room, in which the tablet of Lavrion was found, is unknown until today. Now we dare say that this room was the accountancy of the silver-mines of Lavrion.

For all four aforementioned reasons we believe that the abacus of Lavrion was more recent in relation with the other ones, known until today.

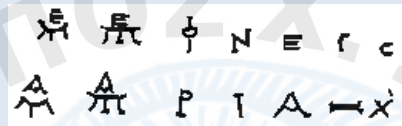


Figure 1. The epigraph on the tablet of Lavrion.

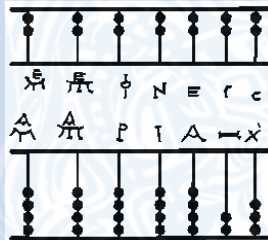


Figure 2. The final form of avacus of Lavrion.

V. ΒΙΒΛΙΟΓΡΑΦΙΑ

1. Μαρία Σαλλιώρα - Οικονομάκου, Αρχαία Αγορά στο Λιμάνι Πασά Λαυρίου, Από το Αρχαιολογικό Δελτίο, Τόμος 34 (1979)" Μελέτες. Αθήνα 1986.
2. (Δημητρίου Γ. Θέμελη, Ειδικοί Τομείς Ιστορίας της Μουσικής. Τα λείψανα της αρχαίας Ελληνικής μουσικής. Σημειογραφία, Ερμηνεία, Σημειώσεις, Υπηρεσία Δημοσιεύσεων ΑΠΘ, Θεσσαλονίκη, 1990.
3. Janus, C., Musici scriptores Graeci, Lipsiae in Aedibus B.G. Teubneri, MDCCCXCIX.
4. E. Pohlmann, Denkmaler altgriechischer Music, Sammlung, Ubertragung und Erlauterung aller Fragmente und Falschungen, Verlag Hans Carl, Nurnberg, 1970.
5. Rosa Capasso, Τεχνικές Μουσικής Σύνθεσης Αρχαίες και Σύγχρονες, Μουσικοτροπίες, τεύχος 4/91/Δεκέμβριος 1991.
6. ARISTOXENUS, The Harmonics, Ed. and Trans. by H. S. Macran, Oxford University Press, New York, 1902.
7. Ευαγγέλου Σ. Σταμάτη, Ιστορία των Ελληνικών Μαθηματικών, εν Αθήναις, 1976.
8. Inscriptiones Graece XII 5, 99, Βερολίνο 1903, σελίδα 27.
9. Inscriptiones Graece XII 7, 282, Βερολίνο 1903, σελίδα 73.
10. Πρακτικά Αρχαιολογικής Εταιρείας του έτους 1884, που δημοσιεύθηκαν το 1885, σελίδα 72.
11. Marcus Niebuhr Tod, The Greek numeral notation, Annual of the British School at Athens, 18, 1911/12, 98-132.
12. Κωνσταντίνος Σιαμάκης, ΤΟ ΑΛΦΑΒΗΤΟ, Θεσσαλονίκη, 1988.
13. Gino Loria, Ιστορία των Μαθηματικών, Μετάφρ. Μιχαήλ Κ. Κωβαίος, τόμος Α', Έκδοση Ελληνικής Μαθηματικής Εταιρείας, Αθήνα, 1971.
14. Sir Thomas L. Heath, A manual of Greek Mathematics, Oxford, at the Clarendon Press, 1931.
15. V. Gardthausen, Griechische Palaeographie, τόμος 2, Λιψία 1913.
16. W. Wattenbach, Anleitung zur griechischen Palaeographie, Λιψία 1895, σελίδα 123.