ABAKION: Applied mathematics in ancient Greece

In 218 BC, Apelles arrived in Corinth with great pomp and proceeded straight to the royal quarters of Philip V. Polybius (5,26) tells us what happened next: As Apelles was about to enter "according to his former custom" (he had been an influential courtier), one of the ushers prevented him, saying that the king was engaged. "Troubled at this unusual repulse, and hesitating for a long while what to do, Apelles at last turned round and retired. Thereupon all those who were escorting him began at once openly to fall off from him and disperse, so that at last he entered his own lodging, with his children, absolutely alone. So true it is all the world over that a moment exalts and abases us; but most especially is this true of courtiers. They indeed are exactly like *psephoi* on an *abakion*, which, according to the pleasure of the calculator, are one moment worth a *chalkous*, the next a *talanton* (ὄντως γάρ εἰσιν οὗτοι παραπλήσιοι ταῖς ἐπὶ τῶν ἀβακίων ψήφοις· ἐκεῖναί τε γὰρ κατὰ τὴν τοῦ ψηφίζοντος βούλησιν ἄρτι χαλκοῦν καὶ παραυτίκα τάλαντον ἰσχύουσιν)."

But what exactly is an *abakion*? How did the "calculator" use the *psephoi*? What other methods of 'applied mathematics' were used in ancient Greece? One should assume that there is plenty of evidence to answer questions like this. After all, Herodotus (2,36) refers to applying *psephoi* for 'logistics' (calculations) when he lists among the basic differences between the Egyptians and the Greeks that the latter "write letters and calculate with *psephoi* by moving their hand from left to right while the Egyptians do it from right to left (γράμματα γράφουσι καὶ λογίζονται ψήφοισι Ἕλληνες μὲν ἀπὸ τῶν ἀριστερῶν ἐπὶ τὰ δεξιὰ φέροντες τὴν χεῖρα, Αἰγύπτιοι δὲ ἀπὸ τῶν δεξιῶν ἐπὶ τὰ ἀριστερά)". And after all, don't we all know that 'the Greeks' 'must have been' 'brilliant in maths', with Thales and Pythagoras and all that?

However, are such assumptions, which are present in most dictionary articles, and school books, on the history of mathematics, really justified? While we have a lot of evidence for Greek 'scholarly' mathematics, collected, e.g., in I. Thomas's two Loeb volumes of "Selections illustrating the history of Greek mathematics" (1951, repr. as "Greek Mathematical Works"; I: Thales to Euclid, II: Aristarchus to Pappus), the evidence for 'applied' or practical mathematics has not even been collected yet. And while we have, for two decades or so now, witnessed the substantial quantity and quality of research on ancient literacy and the historical implications of how widely the art of γράμματα γράφειν was distributed in society, research interest in 'applied mathematics' (λογιστική) appears to have whittled away several generations ago (Walbank, for example, when commenting on the story in Polybius, quoted above, could only refer to the Pauly-Wissowa article "Abacus", published in 1893).

So if we, like Herodotus, regard 'doing sums' (or λογίζεσθαι ψήφοισι) as equally important as 'reading letters', research on the 'applied mathematical literacy' is overdue: Was the so-called 'knowledge of the Greeks from Thales to Pappus' actually known beyond what has been called the 'thin veneer of scholarship which coated ancient culture'? (I have tried to answer a similar question for ancient cartography in a number of publications over the last decade). If so, how was the transfer done? If not, why not? And where did 'applied mathematics' come from? Was it developed further over time? Is its legacy to be found in Byzantine Greece?

The current state of research is not impressive: The standard Histories of Greek Mathematics (e.g. J. Gow 1884, repr. 2004, and Th. Heath 1921, repr. 2005) gloss over 'applied' mathematics as irrelevant for their purpose, and so the standard publications for our topic remain G. Friedlein's "Die Zahlzeichen und das elementare Rechnen der Griechen und Römer" (1869, repr. 1997), and M. Cantor's "Vorlesungen über Geschichte der Mathematik" (4th ed. 1922), while the latest serious specialised research publication appear to be "Die Rechentafel der Alten" by A. Nagl, published in 1914, his addenda to the Pauly-Wissowa article on "Abacus" in Suppl. III (1918), and the "Beiträge zur griechischen Logistik, 1. Teil" by Kurt Vogel, published in 1936 (further "Teile" were never published because of World War II).

The *ABAKION* project will identify, and present in text and image, translation, and commentary, the sources for 'applied mathematics' in ancient Greece, both epigraphical and literary.

— Inscriptions: A number of *abakia* have been found. *Inscriptiones Graecae* II^2 2777-81 lists of marble tables from Salamis and the Athenian acropolis, and a ceramic one from Eleusis, cf. also IG IX 1, 488 (Thyrreion), XII 5, 99 (Naxos), XII 7, 282 (Minoa on Amorgos), XII 8, 61 and 62 (Imbros). However, these publications in most cases just give the plain 'text', which is nothing but a series of numbers, but do not allow the user to envisage the distribution of this 'text' on the artefact, and hence its function. [I shall travel to Athens on March 27th, 2006, to gently ask for access to the stones in the Epigraphical Museum during my later research stay.]

— Images: E.g., the 4th century 'Darius Vase' (Trendall/Campitoglou, Red Figured Vases of Apulia II, 1982, p. 495, no. 18/38, pl. 176,1; in the National Museum at Naples) depicts a treasurer using an *abakion*. [I shall travel to Naples on April 12th, 2006, to see this artefact.]

— Literary sources: As there is no single text from antiquity dealing with λογιστική, the project aims at collecting all references to 'applied mathematics' in general (cf., e.g., Aristophanes' Wasps 656sq: καὶ πρῶτον μὲν λόγισαι φαύλως, μὴ ψήφοις ἀλλ᾽ ἀπὸ χειρός, / τὸν φόρον ἡμῖν ἀπὸ τῶν πόλεων συλλήβδην τὸν προσιόντα) and present the only text which seems to preserve earlier practice, but actually dates from the Byzantine age: The Παράδοσις τῆς ψηφοφορικῆς ἐπιστήμης by the 14th century author Nicolaus Artabasdos "Rhabdas" (ed. P. Tannery in "Notices et extraits des manuscrits 32, 1886, 121sqq. [repr. Mémoires scientifiques IV 1920]).

Once all the evidence, which is widely dispersed, and - given the age and fate of some of the publications - difficult to reach, is collected and presented, it will be, or so I hope, possible to better understand Greek 'applied mathematics' by using the different kinds of evidence to throw light on what remains dark within one genre of source material. It will also be possible then, and only then, to seriously go beyond such 'antiquarian' approaches and pursue questions like the spread of 'mathematical literacy', and the implications for ancient Greek society as a whole.

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