Authoring : *Katsiampoura Yanna*
Translation : *Λουμάκης Σπυρίδων*
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Summary :

Treatise on mathematics by Maximos Planoudes, written around 1300 with significant importance for the history of science in Byzantium. It introduced and for the first time made use of Arabic numerals.

Date

around 1300

Geographical Location

Constantinople

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1. The So-Called Great Calculation According to the Indians

The So-Called *Great CalculationAccording to the Indians* is Maximos Planoudes' most significant work in the domain of mathematical science. In this treatise, written around 1300, Planoudes uses the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, which he deems «Indian numbers», and introduces the use of zero (cipher). Furthermore, he explains certain calculation methods he calls Indian (hindu). These symbols, except for 0, had already been known and in use (within limited circles) at Byzantium since the 9th century, as it appears in Euclid's codex of 888,[1] as well in the West since the 10th century, while Leonardo of Pisa applied them in his work Liber Abaci, written in 1202. In Byzantium they appeared once and only in the mathematical treatise *Αρχή της μεγάλης και Ινδικής Ψηφοφορίας* (*Principle of the Great and Indian Calculation)*, written in 1252 by an unknown author.[2] While the previous unknown Byzantine author used the form of numerals that had dominated in Italy, Planoudes adopts the Persian numerals, which reveals the Persian influence that reached the late-13th-century Constantinople via the scientific life at Trebizond.[3]

In *Calculation* Planoudes uses for the first time the numeral digit zero in its current use: he places it to the right of the other numeral symbols and divides the numbers according to the positional notation of their digits in monadic (κατά πρώτην χώραν), that is, the numbers that stand alone as a unit, from 1 to 9, in decadic (κατά δευτέραν χώραν), that is, the numbers from 10 to 90, in hecatontadic (κατά τρίτην χώραν), that is, the numbers from 100 to 900, followed by the number for thousands, for myriads, for tens of myriads and so on. That way Planoudes can denote numbers no matter how big, which makes especially easier the study of astronomy.

In the rest of his treatise, Planoudes analyses and explains the four basic mathematical operations (addition, subtraction, multiplication and division). He also discusses matters of astronomy, among which the zodiac and its subdivisions. Finally, he lays special emphasis on studying the calculation of square roots. He first presents Theon of Alexandria's method and the Indian method, and then he moves on to propose his own method, based on the conversion of the numeral digit into degrees and the square root results with maximum approximation. He is not the first to apply this method, which was already known to the commentators of Euclid's and Ptolemaios' work and goes probably back to Hipparchos. However, this method proves Planoudes' profound knowledge of mathematic sciences.

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1. On the codex margin there are certain scholia using Arabic numerals. See Wilson, N.G., *Οι λόγιοι στο Βυζάντιο* (Αθήνα 1991), p. 296.

2. This codex is in Paris, MS. Suppl. gr. 387. Planoudes had studied and used this treatise, which he had borrowed from George Bekkos, as it appears from his correspondence. See Treu, M., *Maximi Monachi Planudis Epistulae* (Breslau 1890, repr. Amstelodamum 1960), no. 46, pp. 64-66.

3. See Tannery, P., "Les chiffres arabes dans les manuscrits grecs", *Mémoires Scientifiques* 4 (1920), pp. 199-205.

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