ΙΔΡΥΜΑ ΜΕΙΖΟΝΟΣ ΕΛΛΗΝΙΣΜΟΥ

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Summary :

Philo of Byzantium was one of the greatest mathematicians and engineers of Antiquity. He lived mainly in Alexandria and studied with Ctesibius. He focused mainly on the design of war machines/ engines. His main written work was the “Mechanical Syntax”, the 4th book of which, dedicated to war engines, is preserved almost intact in Greek.

Date and Place of Birth

280 B.C.

Main Role

Mathematician, engineer

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1. Biography

Philo was one of the most important mathematicians and engineers of the Hellenistic period. Although he originated from the city of Byzantium, Philo spent most of his life in Alexandria.[1] According to the most prevalent view he was born around 280 B.C. His floruit is placed between 260 and 180 B.C. He is considered a student of Ctesibius, a leading figure in engineering, who had studied particularly the issue of pumping water as well as several other theoretical and practical problems of the times.[2]

2. Writings: The Mecahanical Syntax

Philo studied extensively almost all sections of mechanics. He was interested in original constructions, particularly when they offered solutions or when they explained theoretical problems. He engaged himself with levers, with “pneumatics”(i.e. problems related to the qualities of warm air and steam), with automatons, water clocks and war and siege engines of all sorts. His main written work, the “Mechanical Syntax”,[3] an encyclopedia of applied mechanics of his time, was divided in 8 books:

A. Introduction

B. “Mochlika”: a study on levers and the movement of objects with their aid

C. “Limenopoiika”: a study on the construction of harbours and embankments

D. “Velopoiika”: A study for the construction of ballistic weapons

E. “Pneumatics”: A study on the possibilities offered by air and steam

F. “Automatopoika”: A study on the construction of automatons based on the power of steam

G. “Poliorketika”: The earliest and most comprehensive study on the construction of walls, on protection during a siege as well as on the war and siege engines and techniques.[4]

H. On epistles: this was an original study for the writing of secret or codified or even “invisible” letters.

From these eight books, the 4th and the 7th ones are preseved almost intact in Greek, and they are both dedicated to a certain Ariston. This is the reason why Philo's name is related mainly to constructions of this type, although he did not claim the paternity of most of them, who are based on the ground-breaking mind of Ctesibius.

2. 1. Velopoiika (Ballistics)

In this book Philo describes the most importat ballistic weapons of his time as well as the precepts of their function. These weapons, which threw either arrows or stones, were divided in two basic categories: those who functioned through torsion, and those who functioned through bending. The first category comprised the euthytonon, the palintonon or ballista, the cheiroballista and the polyvolon. The second category comprised the gastraphetes and the oxybolon. Philo remarked with accuracy that although many engineers had been occupied with designing weapons, and made use of the same precepts and the same materials, some of them managed to design ballistic weapons which threw their missiles straight and directly to their targets, others had failed their expectations. The reason was not always clear. Thus, Philo said, the saying of Polycleitos was probably valid, according to which perfection comes gradually with slight changes upon several attempts.

2. 2. Siegecraft

In this work, which is the earliest of this type, Philo describes, among other things, a complicated type of walls, which were established in the Hellenistic period, and which were designed to withstand the new siege and ballistic machines. The ground plan of these walls had the shape of zigzag, with an interchange of triangular and polygonal or quadrangular towers.[5] Such fortifications, quite avant-guarde for their time, were already constructed in Ephesus, Dura-Europos and Euryalos in Syracuse.

To Philo is also attributed a treatise on the seven wonders of the world, and thus the name of the mathematician was related also to this list which dates in the Hellenistic era.

3. Constructions

As most mathematicians and engineers of the Hellenistic period, Philo did not focus solely on theory, but went on to create constructions which could prove the validity of his theoretical considerations. The most important constructions which are attributed to Philo himself are the bellows, a water pump based on the use of buckets in direct connection to one another, a ballistic weapon used with compressed air as well as the pump with piston. All these constructions were practically applied. Apart from those, Philo also made some objects which functioned with the power of steam, in order to prove his theories in the field of “Pneumatics”; among those objects were a horse drinking water, a little girl pouring water and a siren for a lighthouse. Thus he became a precursor and inspirer of Hero of Alexandria.

4. Impact of his work

Philo is considered as the link between Ctesibius and Hero. It is almost certain that the latter had in mind the “Mechanic Syntax” of Philo, on which he probably based his studies on the Automatons.

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1. Alexandria was the most important centre for the study of arts and sciences in the Hellenistic world.

2. There are, however, other views, according to which Philo was older than Ctesibius.

3. For a comprehensive presentation of the Mechanical Syntax, see Ferrari, G., “Mecanica allargatta”, in *Atti del convegno La Scienza Ellenistica, Pavia 1982* (Napoli 1984), pp. 227-296.

4. See Winter, F.E., *Greek Fortifications* (London 1971); Garlan, Y., *Recherches de poliorcétique grecque* (Athènes 1974) as well as the more recent McNicoll, A.W., Milner, N.P., *Hellenistic Fortifications from the Aegean to the Euphrates* (Oxford 1997).

5. See Cuomo, S., *Ancient Mathematics* (London-New York 2001), p. 63.

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Bibliography :

- **Heath T.L.**, *A History of Greek Mathematics, I-II*, Oxford 1931
- **Milner N.P.**, **McNicoll A.W.**, *Hellenistic Fortifications from the Aegean to the Euphrates*, Oxford 1997, Oxford Monographs on Classical Archaeology
- **Winter F.E.**, *Greek Fortifications*, London 1971
- **Wilson A.**, "Machines, Power and the Ancient Economy", *JRS*, 92, 2002, 1-32
- **Ferrari G.**, "Mecanica allargatta", Giannantoni, G. – Vegetti, M. (eds), *Atti del convegno, La Scienza Ellenistica, Pavia 1982*, Napoli 1984, 227-296
- **Garlan Y.**, *Recherches de poliorcétique grecque*, Athènes 1974
- **Cuomo S.**, *Ancient Mathematics*, London – New York 2001