# Mechanics and Mathematics in Ancient Greece

Subjects: Engineering, Mechanical | Mathematics

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This entry presents an overview on how mechanics in Greece was linked to geometry. In ancient Greece, mechanics was about lifting heavy bodies, and mathematics almost coincided with geometry. Mathematics interconnected with mechanics at least from the 5th century BCE and became dominant in the Hellenistic period. The contributions by thinkers such as Aristotle, Euclid, and Archytas on fundamental problems such as that of the lever are sketched. This entry can be the starting point for a deeper investigation on the connections of the two disciplines through the ages until our present day.

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The link of mathematics with mechanics is ancient and complex enough to be given a thorough and neat explanation. The same terms ‘mechanics’ and ‘mathematics’ today have a very different meaning with respect to that in ancient times. In particular, herein, we focus on their meaning and relations in classical and Hellenistic Greece.

Actually, the ancient Greek term μεχανη meqanh (‘mechane’) indicated the discipline that dealt with equipments, in particular those for lifting weights. However, the meaning is not limited to this and in general also encompasses other inventions. As for mathematics, the question is more complex: as a matter of fact, it is not even clear how Pythagoras and Thales, for example, intended their discipline; moreover, there are no mathematical treatises before Plato (4th century BCE), even though during the last half of the 5th century BCE, there were meaningful testimonials of a handful of mathematicians intensely concerned with geometrical problems. This period is named the *Heroic Age of Mathematics* in [1] (p. 42.): its main characters were Archytas of Tarentum (b. c. 428 BCE), Hippasus of Metapontum (f. c. 480 BCE), Democritus of Abdera (b. c. 460 BCE), and Hippocrates of Chios (b. c. 470 BCE). In any case, the mathematicians of the 4th century that attended Plato’s Academy also left no written epistemological considerations: Taethetus of Athen (c. 314-c. 369 BCE), Theodorus of Cyrene (b. c. 390 BCE), Eudoxus of Cnidus (d. c. 355 BCE), Menaechmus (f. c. 350 BCE), and Autolycus of Pitane (f. c. 330 BCE), see for instance [1][2].

On the other hand, Aristotle’s position is clear, probably interpreting the thought of the important mathematicians of his time:

[.] as the mathematician investigates abstractions (for before beginning his investigation he strips off all the sensible qualities, e.g., weight and lightness, hardness and its contrary, and also heat and cold and the other sensible contrarieties, and leaves only the quantitative and continuous, sometimes in one, sometimes in two, sometimes in three dimensions, and the attributes of these *qua* [i.e., inasmuch] quantitative and continuous, and

does not consider them in any other respect, and examines the relative positions of some and the attributes of these, and the commensurabilities and incommensurabilities of others, and the ratios of others; but yet we say there is one and the same science of all these things—geometry), the same is true with regard to being.

[3] (11, 3. 27)

Here, mathematics seems to be identified with geometry, but in other passages of Aristotle's writings, the meaning of the term is broader and also applies to optics, astronomy, and music, which Aristotle considered subordinate to geometry (optics and astronomy) and arithmetic (music):

Similar evidence is supplied by the more physical of the branches of mathematics, such as optics, harmonics, and astronomy. These are to some extent the converse of geometry. While geometry investigates physical lines but not *qua* physical, optics investigates mathematical lines, but *qua* physical, not qua mathematical.

[4] (II, 194a, 7 ff.)

In another point of Aristotle's writings mechanics as well appears as a subordinate science, thus another form of mathematics:

The same account may be given of harmonics and optics; for neither considers its objects *qua* sight or *qua* voice, but *qua* lines and numbers; but the latter are attributes proper to the former. And mechanics too proceeds in the same way.

[3] (M, 3, 1078a)

It is not known why Aristotle exposed this thesis, as the mathematical treatment of mechanics was for sure more recent to him than that of the other subordinate sciences. It is probable that Archytas of Tarentum was the first to introduce a geometric study of mechanics, perhaps limited to the lever. This is what Diogenes Laertius (c. 200 CE) wrote on the subject much time later:

He was the first to bring mechanics to a system by applying mathematical principles; he also first employed mechanical motion in a geometrical construction, namely, when he tried, by means of a section of a half-cylinder, to find two mean proportionals in order to duplicate the cube. In geometry, too, he was the first to discover the cube, as Plato says in the *Republic*.

[5] (volume 2, book 8, 83, pp. 395–396)

It is unlikely that Aristotle was referring to his own studies as the Mechanica problemata (see below): indeed, it is true that this treatise employs geometry, but it is also of dubious attribution and of uncertain dating.

## References

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4. Aristotle. Physica. In The Internet Classical Archive; Hardie, R.P.; Gaye, R.K., Translators; Available online: http://classics.mit.edu/Aristotle/physics.mb.txt (accessed on 27 December 2021).
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