

## Heron of Alexandria <sup>[1]</sup>

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### A Beautiful Mind

Heron of Alexandria (c. 10 CE - c. 70 CE) is one of the most fascinating figures in Greek history, standing alongside mathematicians such as Pythagoras <sup>[3]</sup>, Archimedes <sup>[4]</sup> and Euclid <sup>[5]</sup> as a major contributor to the history of science. This fascinating man was a brilliant geometer and mathematician, but he is most commonly remembered as a truly great inventor.

This genius built steam engines <sup>[6]</sup>, programmable computers, robots and surveying instruments, many of which show the workings of a keen and insightful mind, and he is certainly worthy of being mentioned alongside Archimedes <sup>[4]</sup>, Leonardo Da Vinci and Edison as one of the greatest inventors in human history.

## Heron of Alexandria - The Legacy

Despite the lack of historical records on Heron's life, the breadth of his writings on mathematics and mechanics leave little doubt that he was well educated. Heron was strongly influenced by the writings of Ctesibius of Alexandria and may even have been a student of the ancient mechanical engineer. His works draw on a wide range of sources, written in Greek, Latin, and Egyptian, and he added his own ideas to this solid basis.

Heron's writings in mathematics and mechanics reveal that he was practical by nature, often using ingenious means to attain his goal, such as his design for a steam engine, war catapults, and various machines for lifting that used compound pulleys and winches.

Heron was also precise in dictating the types of materials that should be used to make the machine function properly. Interestingly, Heron designed several mechanical devices to simulate temple miracles, including a device attached to the temple door which made a trumpet play when the door was opened, a coin-operated holy water dispenser, and a device for opening temple doors using heat and water power.

## The Life of Heron of Alexandria

Very little is known about the life of Heron of Alexandria. There are many mentions of writers called Heron (or Hero), but it was a very common name in the Hellenistic world. Historians think that he was born in the great seat of learning, Alexandria, Egypt, at about 10 CE, and

that he was an ethnic Greek, although a few historians believe that he was Babylonian or Mesopotamian.

Heron taught at the University of Alexandria where, judging by the contents of his books, he taught mathematics, physics, pneumatics and mechanics. In these fields, he made many excellent contributions and, along with Archimedes, explored the practical uses of mathematics and physics.

Heron wrote at least 13 books, covering a range of topics:

## Geometry and Mathematics

- *Definitiones*: A glossary of geometric terms
- *Geometria*: A basic introduction to geometry
- *Geodesia*: Only fragments of this work remain
- *Metrica*: This is made up of three books showing how to calculate areas and volumes, as well as divide them. This book was lost for centuries, until rediscovered in 1894.
- *Stereometrica* (Volumes I and II): These volumes provide examples of how to perform three-dimensional geometry for spheres, pyramids, cubes and other solids. It is based upon the second volume of the *Metrica*.
- *Mensurae*: Contains descriptions of the various tools that can be used to make measurements, as laid out in the *Metrica* and *Stereometrica*.
- *Geoponicus*: Only fragments of this work remain.

These books all covered mathematical theory, including formulae for calculating the area of shapes and the volumes of solids, and the books also contain good approximations of square roots and cube roots. It must be noted that historians are unclear whether these texts were the work of Heron or written by someone else. As with many Ancient Greek texts, often only available in Arabic or Latin, or gleaned from other secondary sources, it is difficult to determine the original authorship.

Whoever wrote these texts, they contain the first known references to a systematic geometric system with standard terminology and symbols. All of the geometrical texts concentrate largely on the practical uses of the formulae and the examples are related to solving real-world problems.

## Surveying

- *On the Dioptra*: This book contained extensive explanations about the practical and mathematical methods for land surveying. It also included information about the Dioptra, the forerunner of the modern theodolite, which allowed surveyors to calculate angles and heights with great precision. The text also described the odometer, used for calculating distances via the rotation of a wheel of known circumference.

## Mechanics

- *Mechanics I and II*: There is also a reference to a book called the *Baraculus*, but this is believed to be an alternate title for the same books. In these treatises, Heron discussed how to move heavy weights using gears and pulleys, and the text was written for architects, engineers and builders. This book is divided into three distinct parts, the first

dealing with wheels, proportions, scales, equilibria, balance, centers of gravity and simple gears. The second explains the theories behind five powers: Winches, pulleys, screws, wedges, and levers. The third concentrates upon cranes and sledges.

## Pneumatics

- Pneumatica: in this book, Heron wrote about pressure, and included descriptions of machines such as the siphons, fountains, slot machines, a fire engine, his famous steam driven aeolipile, and a temple-door-opening machine. These all worked with the pressure of steam, air, or fluid.

## Automatic Machines

- Automatopoieta: This book is where Heron included his designs for automatic machines, many of which were programmable computers using gears and knotted ropes. It could be argued that they were the first robots using simple binary language.

## War Machines

- Belopoiika (On Engines of War): This included explanations and diagrams of various weapons of war, including a crossbow known as the Gastraphetes and various other artillery engines.

## Optics

- Catoptrica (On Reflecting Surfaces): This book looked at the properties of mirrors, although only fragments remain.

## Other Books

- Water Clocks: Four books, of which only tiny fragments remain
- Euclid: A commentary on [Euclid](#) [5] and the resolution of some of the outstanding problems with Euclidean methods

## Heron of Alexandria - The Enigma

Even the date of death of this great inventor is uncertain. While we know little of his life, we know a lot about his work and his inventions, some of which he may have built, some of which he didn't. His work certainly influenced the great [Islamic scholars](#) [7] and certainly influenced greats such as Leonardo Da Vinci.

His work on mechanics was revived during the Industrial Revolution, and some of his techniques in mechanics and surveying were used up until the 19th Century, ensuring that Heron of Alexandria deserves a place alongside the likes of [Euclid](#) [5] and [Archimedes](#) [4] as Greek mathematicians whose work lasted for centuries after their death.

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