



## The Antikythera Mechanism: the ancient Greek computer that mapped the stars

Built over 2,000 years ago, the Antikythera mechanism calculated the movement of the Sun, Moon and planets using a system of dials and gears.

By [Alexander Jones](#)

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straits between Crete and the Peloponnese: a ship laden with bronze and marble statuary and other luxury objects, en route from the Aegean Sea to destinations in the western Mediterranean, was violently wrecked.

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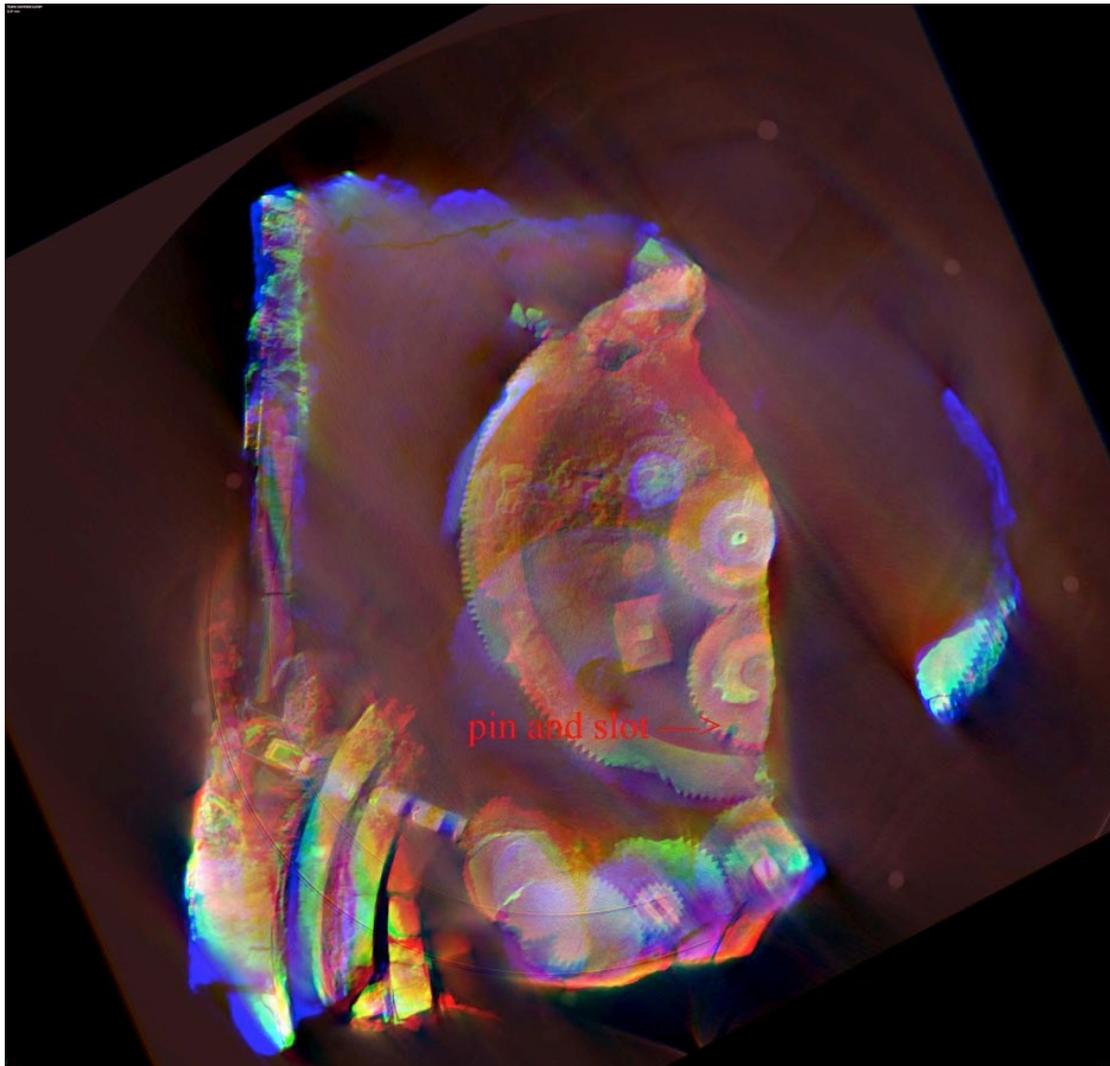


The three largest of the 82 fragments of the Antikythera Mechanism in the National Archaeological Museum, Athens © Weekend Wayfarers/Flickr

No comparable device from Greco-Roman antiquity had previously come to light, and for a while debate raged about what kind of instrument it was. One or two barely legible words inscribed on one fragment suggested some connection with astronomy, but beyond that, the archaeologists and other scholars who inspected it could not agree on its nature and purpose, or whether it was a navigational tool or part of the ship's cargo.

Almost forgotten, it sat in a display case for some years, and in the museum's storage for more. Then from the 1950s through the 1970s the Anglo-American historian of science Derek de Solla Price, recognising that it must be something of unique historical importance, established a framework for studying the Antikythera Mechanism (as he called it, and as it has been

By now it was clear that the Antikythera Mechanism, when intact, was a box with wooden top, bottom, and sides framing bronze plates on the front and back faces; these plates bore several dials, and pointers on the dials indicated temporal cycles and periodically recurring astronomical phenomena. All was driven by an input motion through a revolving shaft on the box's side, representing the passage of time.



Our present understanding of the Antikythera Mechanism is much more complete and secure than Price's, thanks to campaigns of examination and data-gathering by Michael T. Wright and Allan Bromley in the 1990s and by the [Antikythera Mechanism Research Project](#) (AMRP) in 2005. Wright and Bromley found ways to extract three-dimensional information about the fragments' interiors from X-ray radiographs, while the AMRP obtained high-resolution X-ray computed tomography as well as [reflectance transformation imaging](#) (RTI).

The new data yielded much better imaging of gears, dials, and other physical features as well as of the texts inscribed on and around the dials—materials that have now been exploited by researchers from a range of disciplines, including astronomy and mathematics, history of science, and classics, to correct and complete Price's reconstruction.

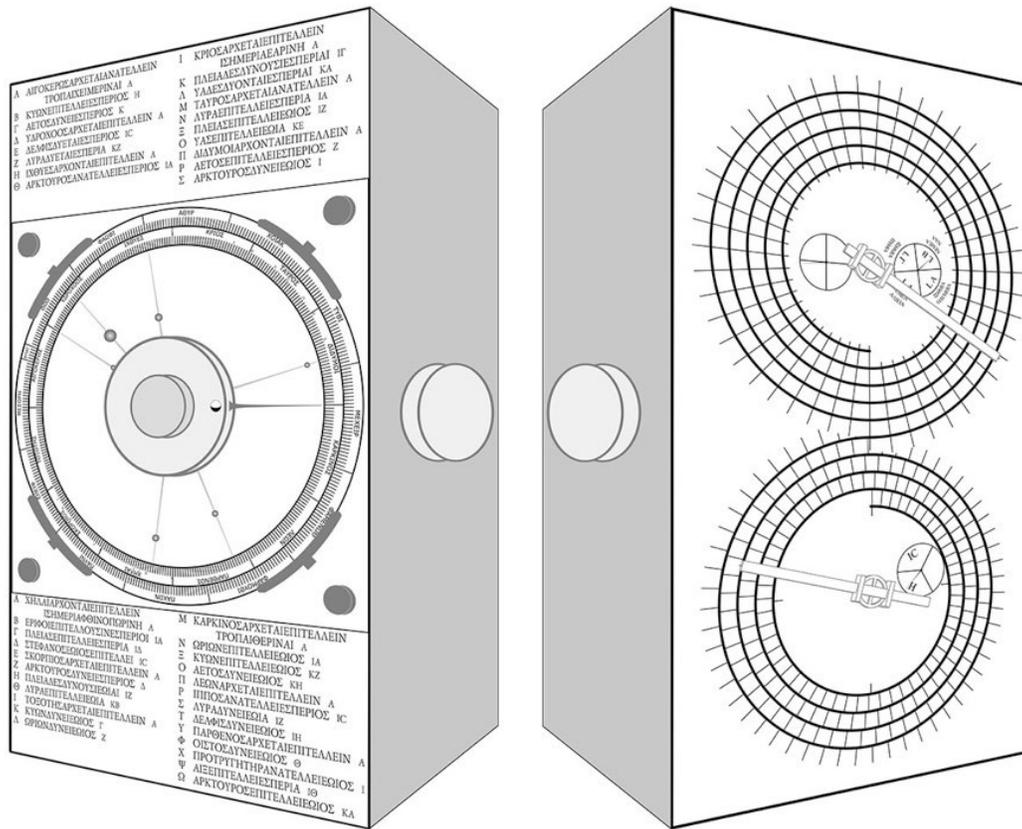
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What, then, was the Antikythera Mechanism? One way to think about it is as a kind of dynamic visual guide to astronomy for the lay person—astronomy, that is, as a Greek intellectual would have understood it around 100 BC.

We can start by considering the back face, which bore two large dials featuring spiral slots and variable-radius pointers ending in pins that rode along the slots. These spirals were a way of stretching out a dial's scale to make room for inscribing a lot of information along it.

Greeks had many regional calendars, but all had in common that the months were approximately coordinated with the Moon's phases. Years sometimes comprised twelve months but sometimes thirteen so that specific months always fell at roughly the same seasons.



Reconstruction of the Mechanism's front and back faces, some details omitted © [Alexander Jones](#)

The fifth century BC astronomer Meton of Athens had proposed a repeating 19-year cycle (which was also known in ancient Babylonia and China) in which eleven of the years had twelve months and eight years had thirteen, for a total of 235. On the Mechanism, the "Metonic Dial" would indicate how each

signs from which one could forecast events affecting regions and peoples, namely eclipses.

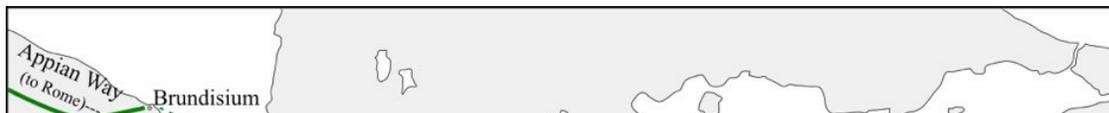


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For centuries, Greek astronomers had explained lunar eclipses as caused by the Moon's entering the Earth shadow, and solar eclipses as caused by the Moon's shadow falling upon the Earth, but the Mechanism did not attempt to show these optical conditions, but just the fact that conditions that make eclipses possible recur approximately after 223 lunar months (a period now called the Saros). Hence the scale of the "Saros Dial" was divided into 223 cells, some of which contained highly abbreviated statements that a lunar eclipse or a solar eclipse or both might take place during the indicated month — vacant cells signified eclipse-free months.

Turning from the back to the front face would have taken the spectator from cycles of time to cosmology in motion. The single front dial combined two perspectives on the system of heavenly bodies, showing where the sun, moon, and planets appear to be at any date by means of pointers along a scale representing the zodiac and subdivided into 360 degrees, while at the same time offering a simplified cross-section image of the cosmos as if seen from outside.





A possible itinerary for the ancient ship carrying the Antikythera Mechanism © Alexander Jones/[d-maps.com](https://d-maps.com)

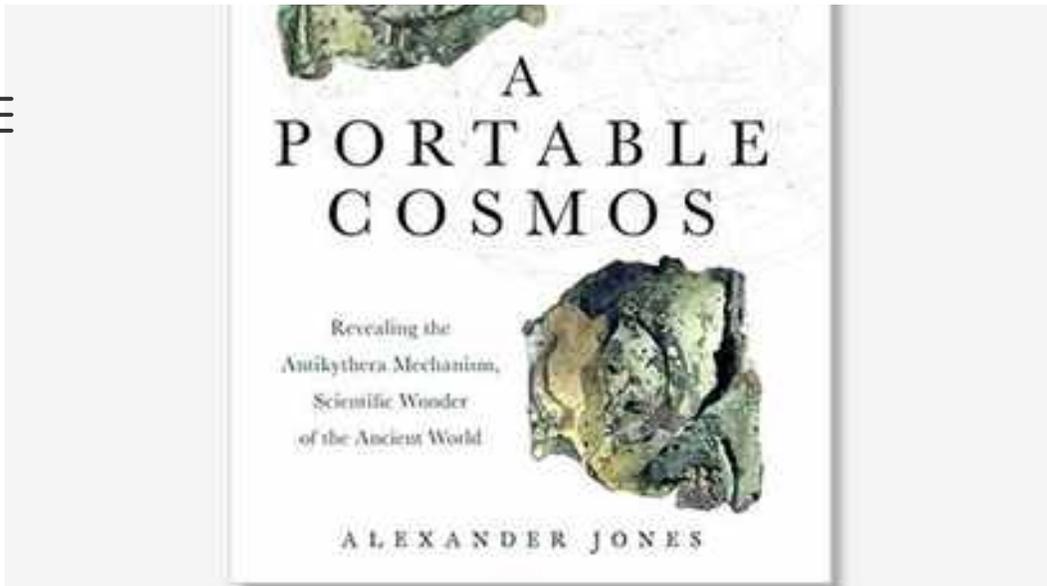
The cosmology was geocentric, with the Earth enclosed by a series of nested spherical shells belonging, in order of increasing distance, to the Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn, and the stars. On the dial, these seem to have been portrayed as ring-shaped spaces between engraved concentric circles, and the heavenly bodies themselves as little spherical attachments to the pointers, each with a distinguishing material and colour.

The apparent motions of the heavenly bodies through the zodiac vary in speed and (in the case of the planets) periodically reverse direction. To reproduce the effect of nonuniform motion mechanically required special devices involving a pin attached to a revolving gear while sliding back and forth in the perforation of a slotted arm or gear. Such a pin-and-slot device for the Moon survives in the largest fragment, but the gearwork for the planets is mostly or entirely lost.

Instruments like the Antikythera Mechanism that employed high-end technology and metalworking to visualise the complexities of science were probably rarities in the Greco-Roman world, and most would have had their metal recycled when they stopped working and were no longer wanted. We are lucky to have this one, saved by an ancient calamity.

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*A Portable Cosmos: Revealing the Antikythera Mechanism* Scientific



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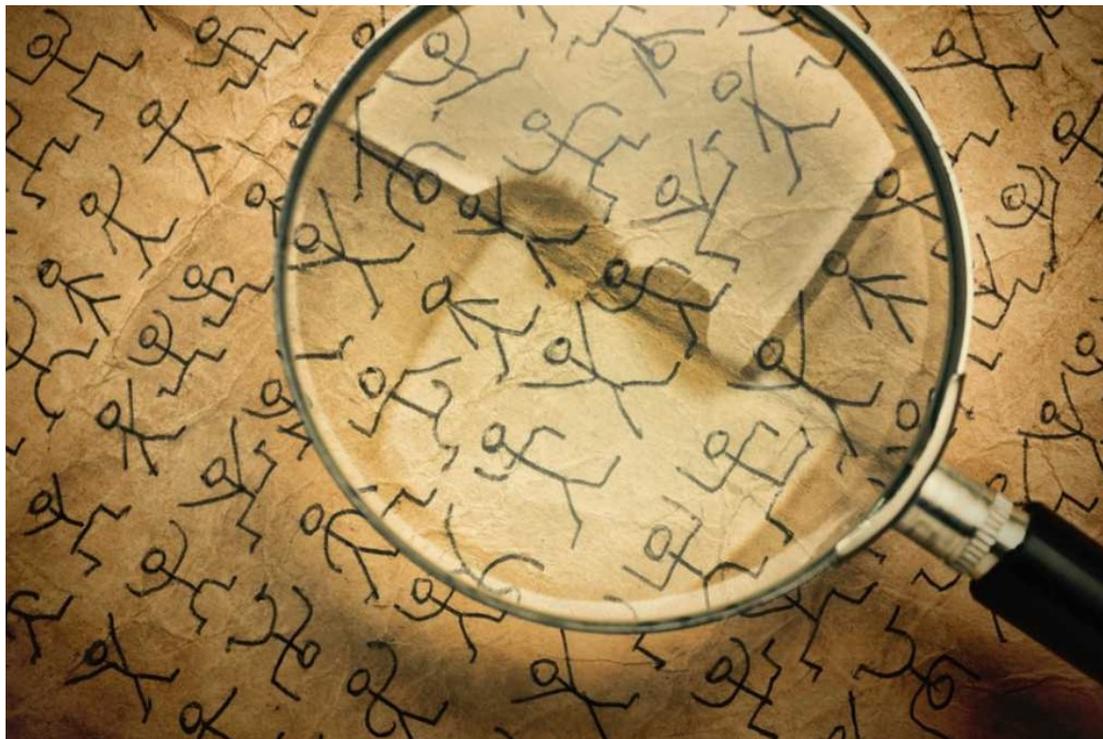
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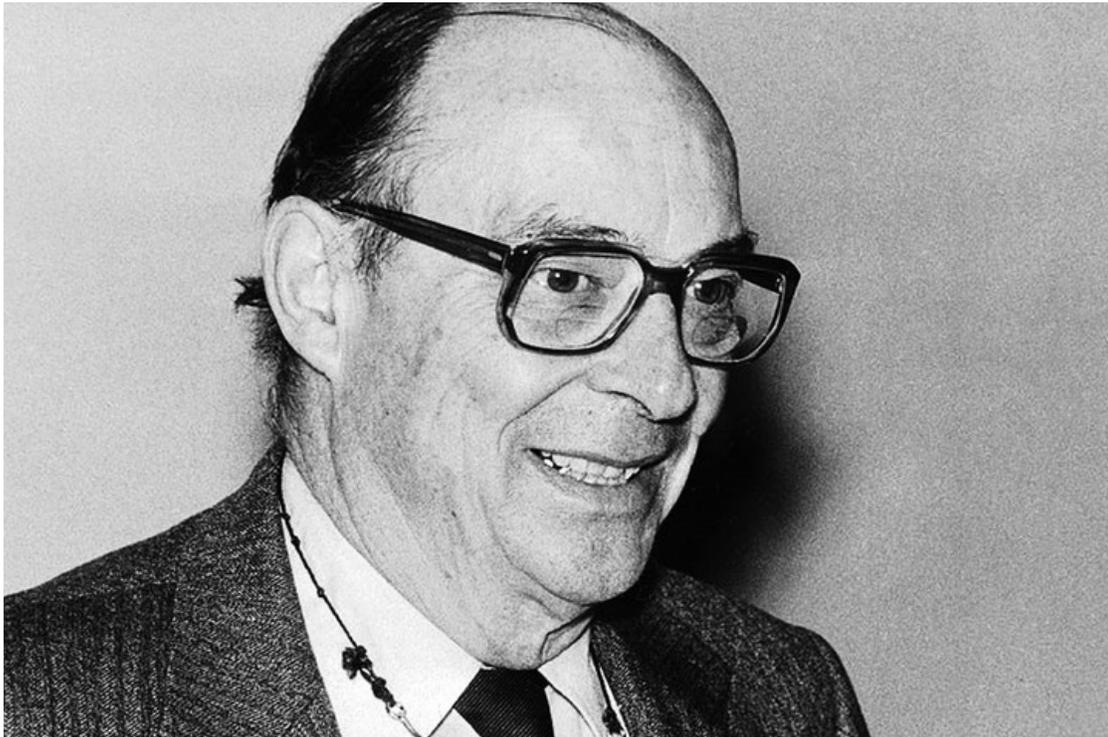
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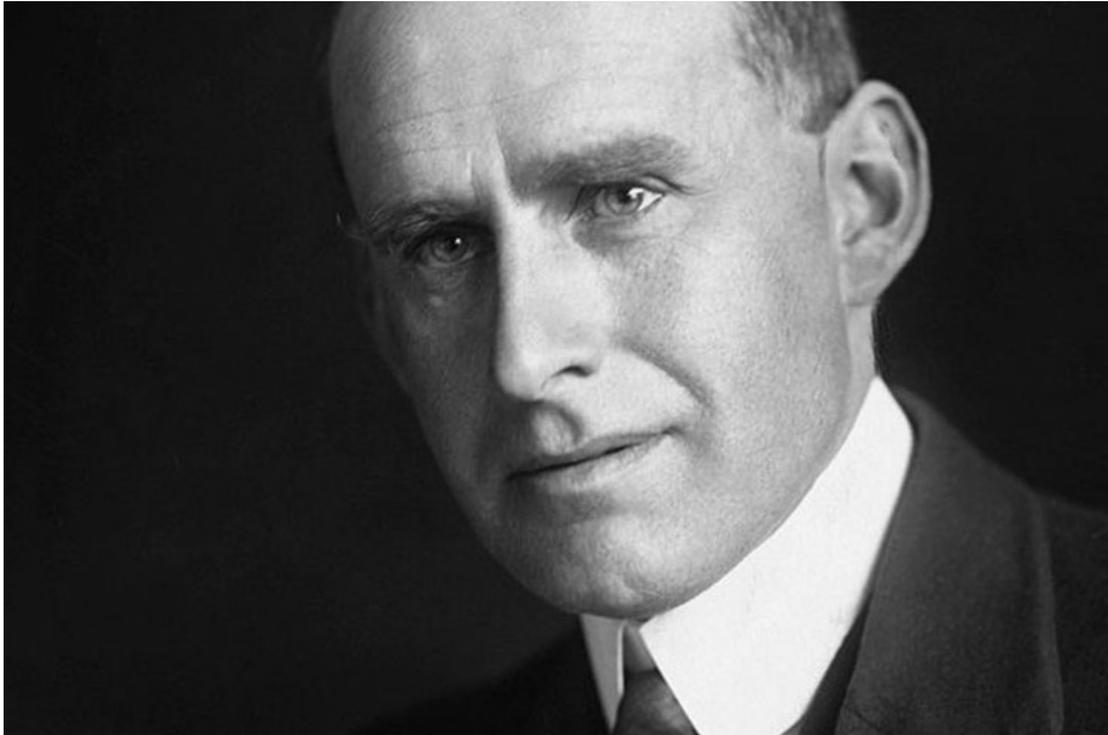
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