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Early Astronomical 'Computer' Found to Be Technically Complex

By JOHN NOBLE WILFORD

A computer in antiquity would seem to be an anachronism, like Athena ordering takeout on her cellphone.

But a century ago, pieces of a strange mechanism with bronze gears and dials were recovered from an ancient shipwreck off the coast of Greece. Historians of science concluded that this was an instrument that calculated and illustrated astronomical information, particularly phases of the Moon and planetary motions, in the second century B.C.

The instrument, the Antikythera Mechanism, sometimes called the world's first computer, has now been examined with the latest in high-resolution imaging systems and three-dimensional X-ray tomography. A team of British, Greek and American researchers deciphered inscriptions and reconstructed the gear functions, revealing "an unexpected degree of technical sophistication for the period," it said.

The researchers, led by the mathematician and filmmaker Tony Freeth and the astronomer Mike G. Edmunds, both of the University of Cardiff, Wales, are reporting their results today in the journal *Nature*.

They said their findings showed that the inscriptions related to lunar-solar motions, and the gears were a representation of the irregularities of the Moon's orbital course, as theorized by the astronomer Hipparchos. They established the date of the mechanism at 150-100 B.C.

The Roman ship carrying the artifacts sank off the island of Antikythera about 65 B.C. Some evidence suggests it had sailed from Rhodes. The researchers said that Hipparchos, who lived on Rhodes, might have had a hand in designing the device.

In another *Nature* article, a scholar not involved in the research, François Charette of the University of Munich museum, in Germany, said the new interpretation of the mechanism "is highly seductive and convincing in all of its details." It is not the last word, he said, "but it does provide a new standard, and a wealth of fresh data, for future research."

Technology historians say the instrument is technically more complex than any known for at least a millennium afterward. Earlier examinations of the instrument, mainly in the 1970s by Derek J. de Solla Price, a Yale historian who died in 1983, led to similar findings, but they were generally disputed or ignored.

The hand-operated mechanism, presumably used in preparing calendars for planting and harvesting and fixing religious festivals, had at least 30, possibly 37, hand-cut bronze gear-wheels, the researchers said. A pin-and-slot device connecting two gear-wheels induced variations in the representation of lunar motions according to the Hipparchos model of the Moon's elliptical orbit around Earth.

The numbers of teeth in the gears dictated the functions of the mechanism. The 53-tooth count of certain gears, the team said, was "powerful confirmation of our proposed model of Hipparchos' lunar theory." The detailed imaging revealed more than twice the inscriptions recognized earlier. Some of these appeared to relate to planetary and lunar motions. Perhaps, the team said, the mechanism also had

gearings to predict the positions of known planets.

Dr. Charette noted that more than 1,000 years elapsed before instruments of such complexity are known to have re-emerged. A few artifacts and some Arabic texts suggest that simpler geared calendrical devices had existed, particularly in Baghdad around A.D. 900.

It seems clear, he said, that "much of the mind-boggling technological sophistication available in some parts of the Hellenistic and Greco-Roman world was simply not transmitted further."

"The gear-wheel, in this case," he added, "had to be reinvented."

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