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GEARS FROM THE GREEKS: THE ANTIKYTHERA MECHANISM AND THE EARLY HISTORY OF COMPUTER SCIENCE

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ABSTRACT

A discovery in 1900 extends the history of computer science back to circa 50-80 BCE. The Antikythera Mechanism was discovered in an ancient shipwreck, and is the only such geared mechanical device known for at least the next 1000 years. It consists of a clockwork – like mechanism containing more than 30 toothed gears, including a system of differential gears. This early calculator has been the subject of intense scholarly research. to determine what it is and what it was intended to do. It has been found that this device was used to calculate, among other things, lunar eclipses and planetary positions. It is already clear that computerscience has deeper historical roots than previously realized.

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Characteristics of the Antikythera shipwreck:

- The shipwreck occurred sometime between 50 and 80 BCE.
- The shipwreck occurred on a major trade route from the Eastern Mediterranean to Italy (Rome) and Sicily.
- It was discovered at Easter, 1900 by a crew of sponge divers.
- The ship was 50 meters in length, and at 42 meters depth.
- The divers could descend only twice a day, and could stay only five minutes. They had no benefit of SCUBA apparatus or compressed air.



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Characteristics of the Antikythera Mechanism:

- **The mechanism is in 7 main and 75 smaller fragments at the National Archaeological Museum in Athens.**
- **The mechanism contains 30 bronze gears, with between 15 and 223 triangular teeth.**
- **The mechanism is an astronomical calculator with the ability to predict lunar and solar eclipses, as well as solar, lunar, and planetary positions.**
- **It is based on the theories of Hipparchus, and on the ellipticity of the Lunar orbit.**
- **The inscription on the mechanism's flat surfaces is an instruction manual in its use.**

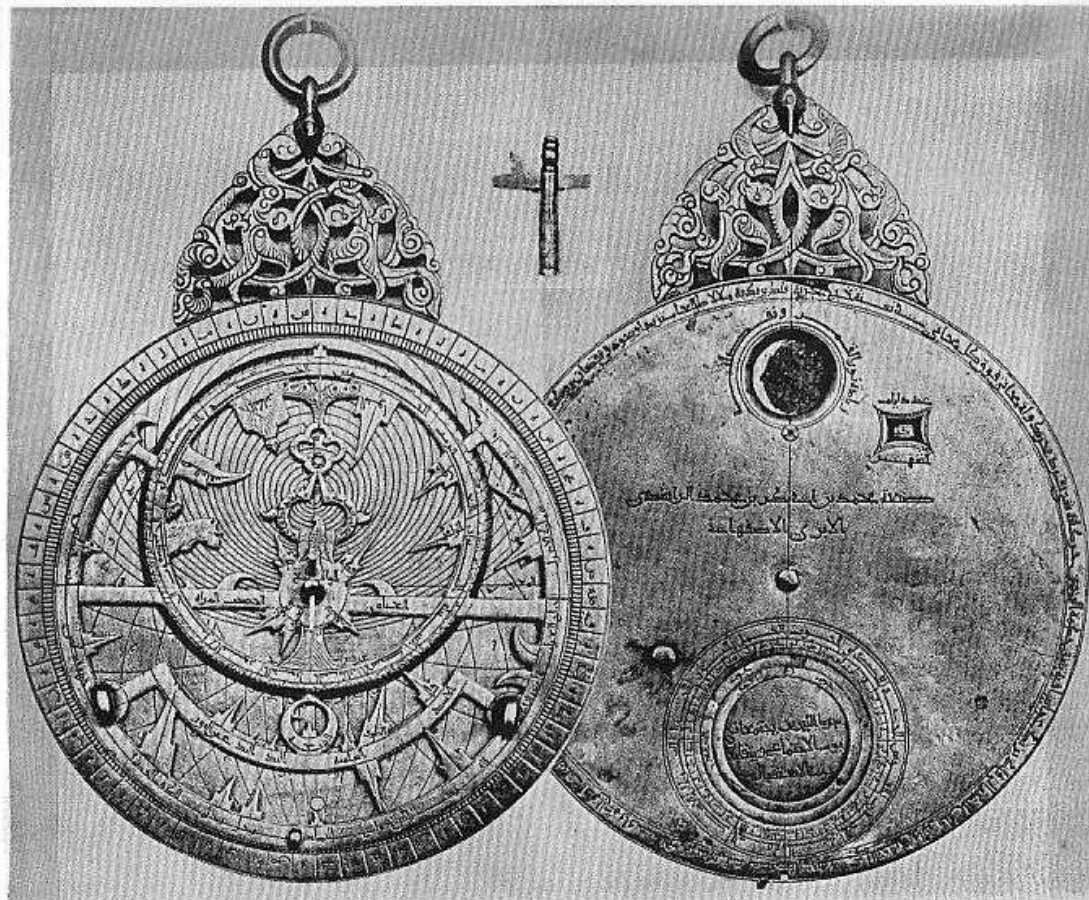


FIG. 42. Astrolabe containing geared calendar work. The instrument, now in the Museum for History of Science, Oxford, was made by M. b. Abi Bakr, Isfahan in 1221/2 A.D. and the gearing follows the design reported by al-Biruni ca. 1000 A.D. and contains many similar features to the Antikythera mechanism.

Figure 42. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.



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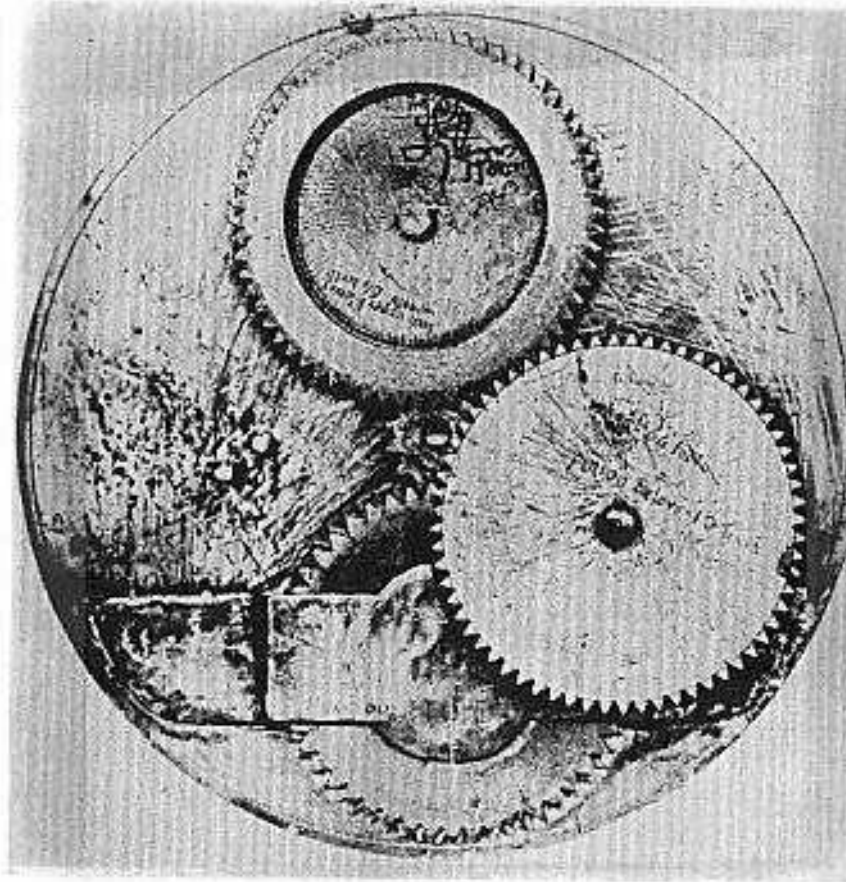


FIG. 43. Interior mechanism of the Oxford astrolabe.

Figure 43. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

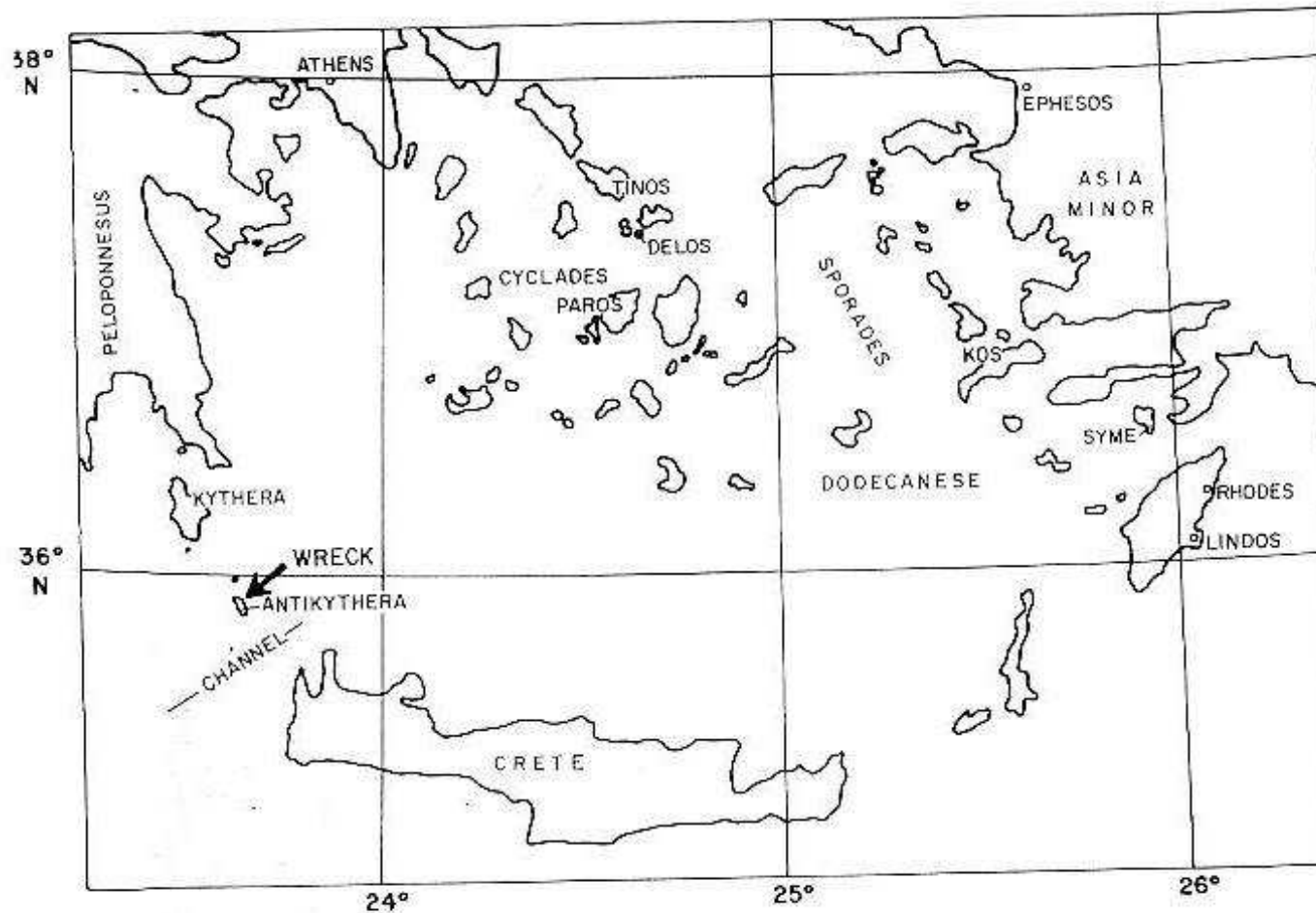


FIG. 1. Map of the Aegean Islands.

Figure 1. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

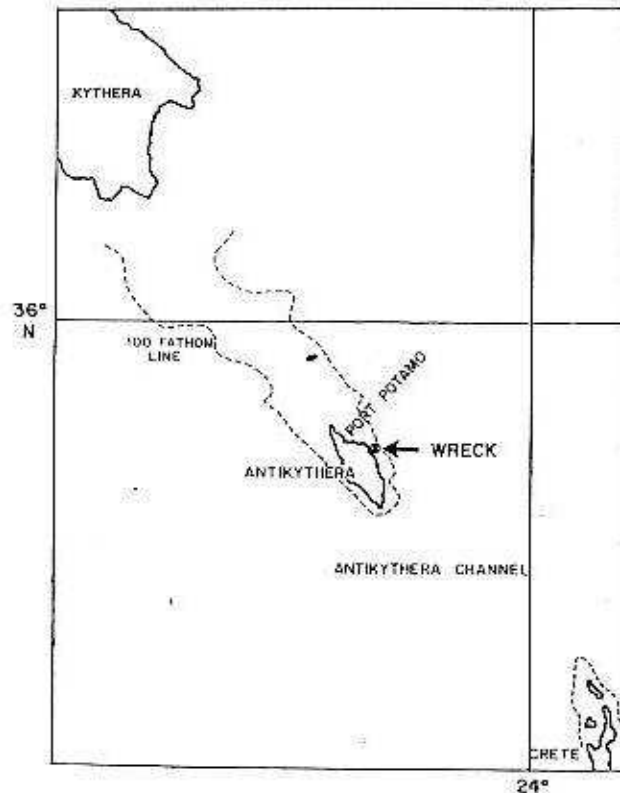


FIG. 2. Map of the Antikythera Channel.

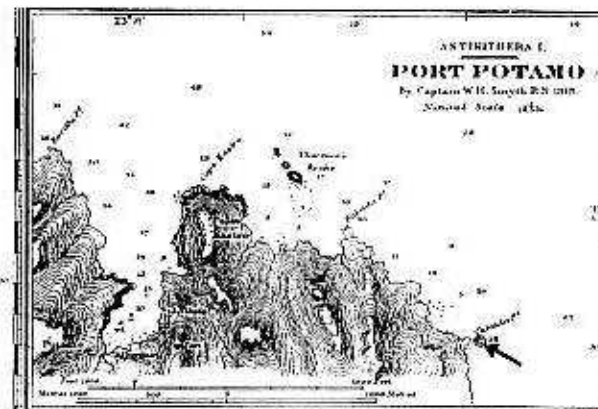


FIG. 3. Map of Antikythera, Port Potamo, showing wreck.

Figures 2, 3. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

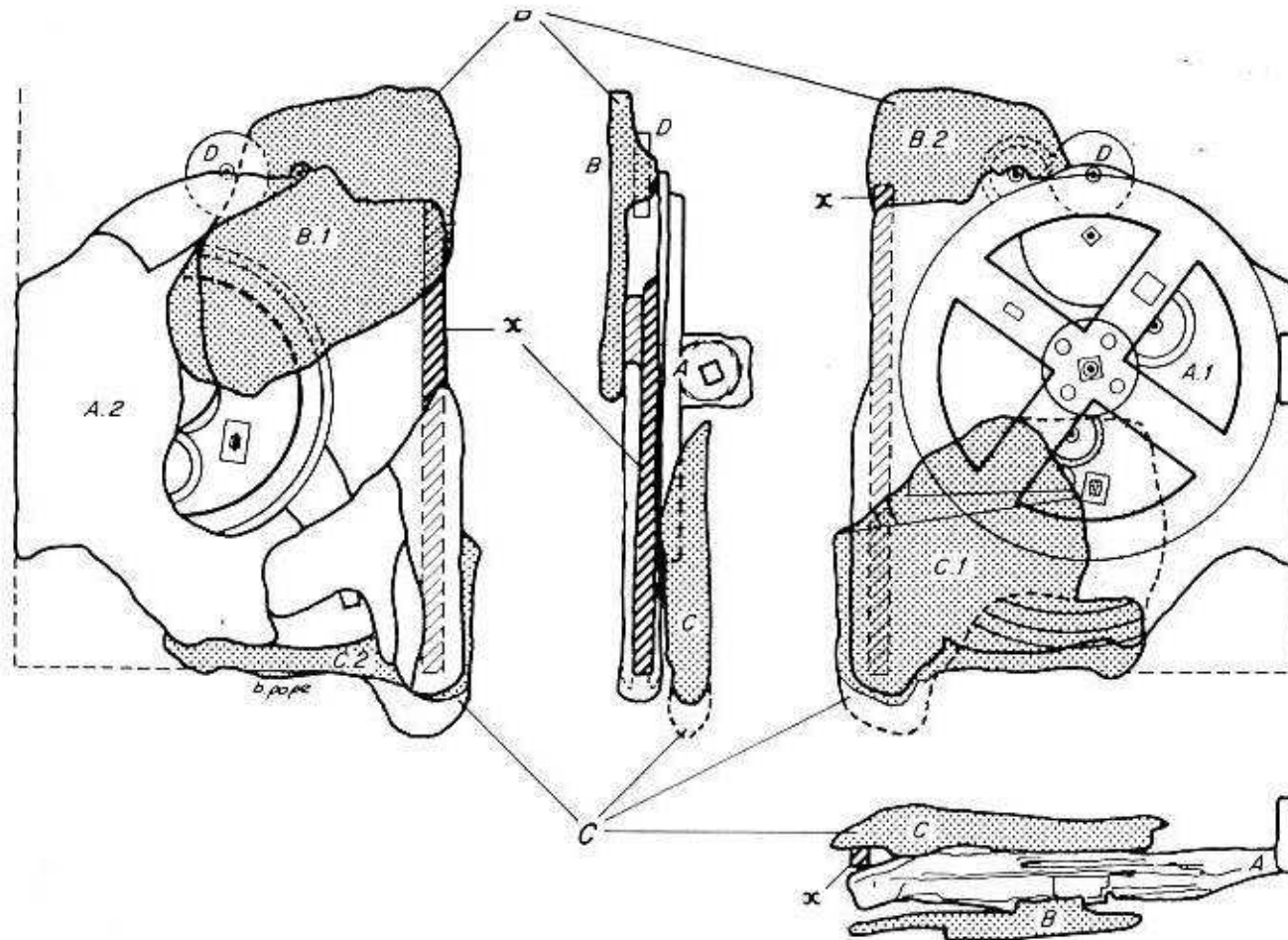


FIG. 6. Schematic diagram showing the joins of the four main fragments. The wooden member whose shrinking may have provoked the splitting apart of the original mass is shown at *x*.

Figure 6. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

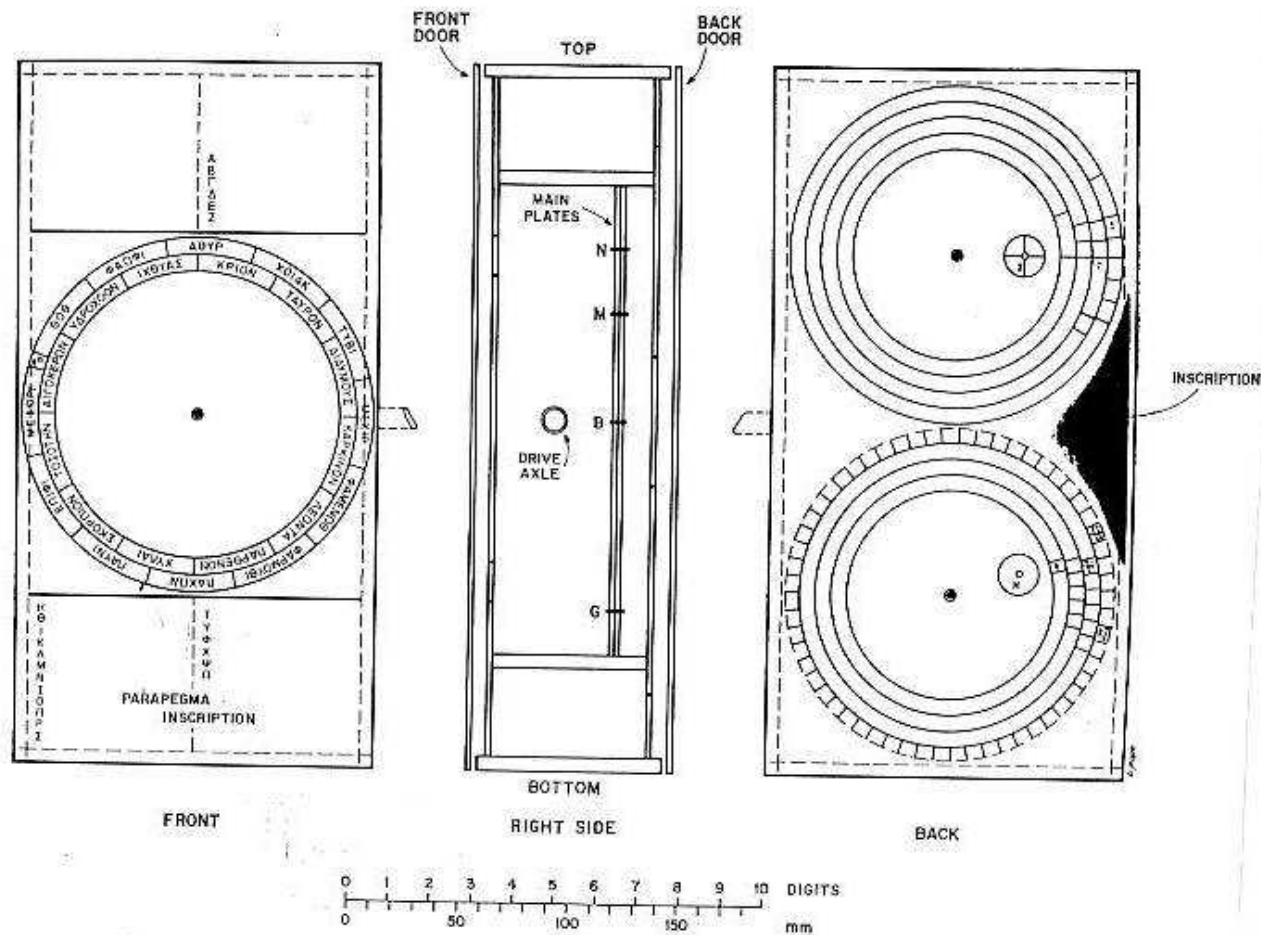


FIG. 7. Reconstruction of the dial plates and casing.

Figure 7. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.



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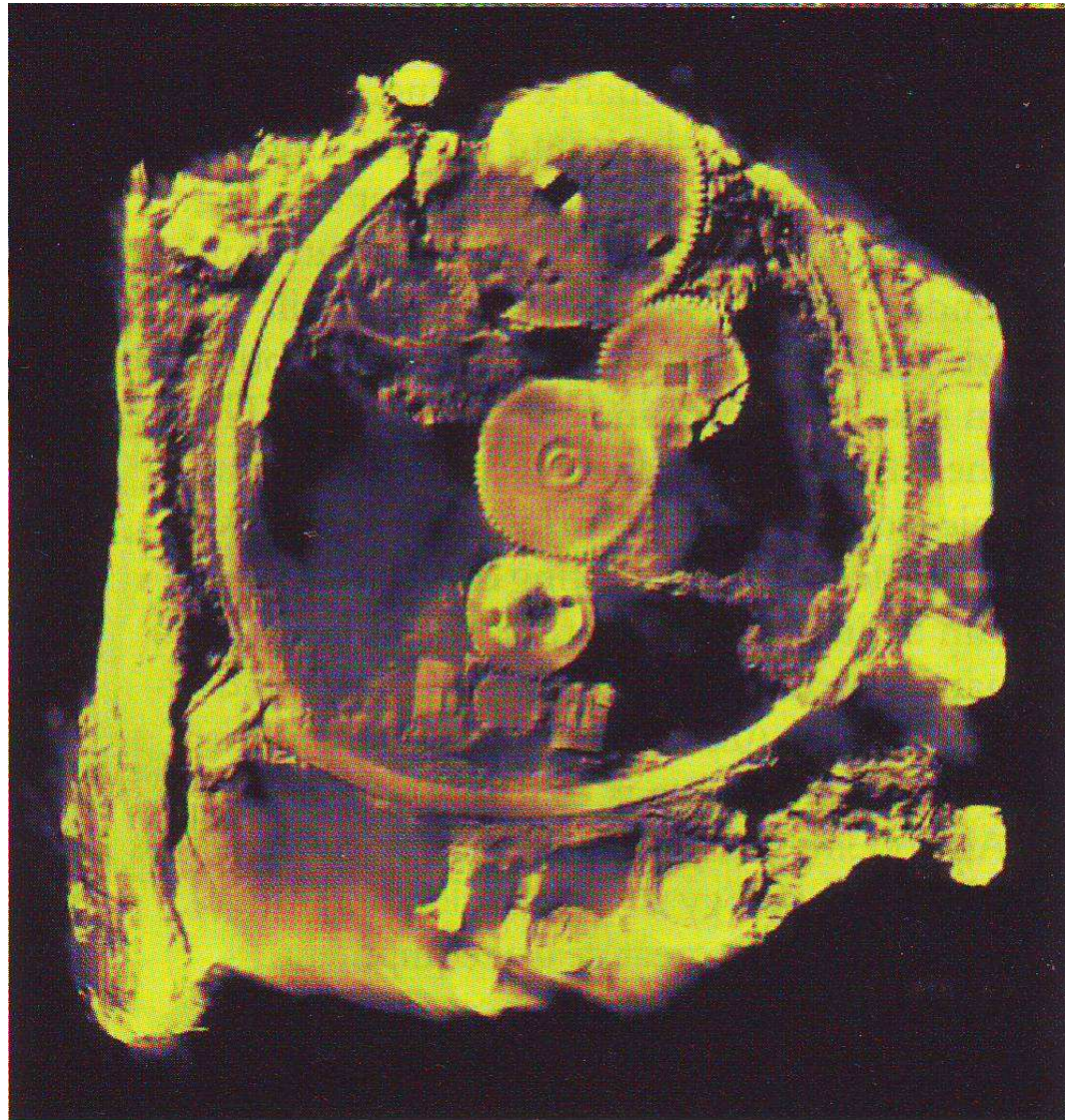
Lobell, Jarrett A.: "The Antikythera Mechanism", *Archaeology*, March/April 2007, pp 42-45.



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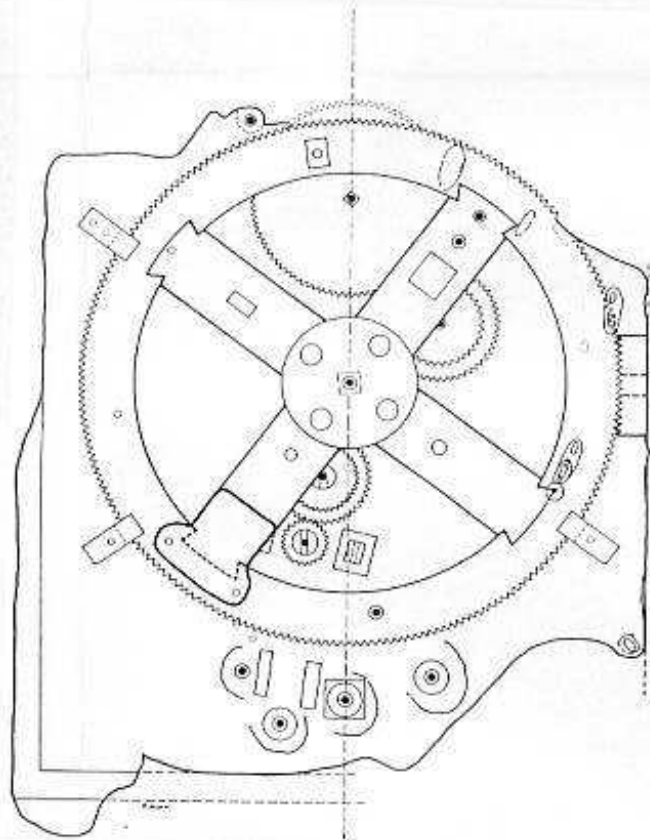


FIG. 11. Schematic of front of main fragment.



FIG. 13. Front of Fragment A, before cleaning. A.1.

Figures 11, 13. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

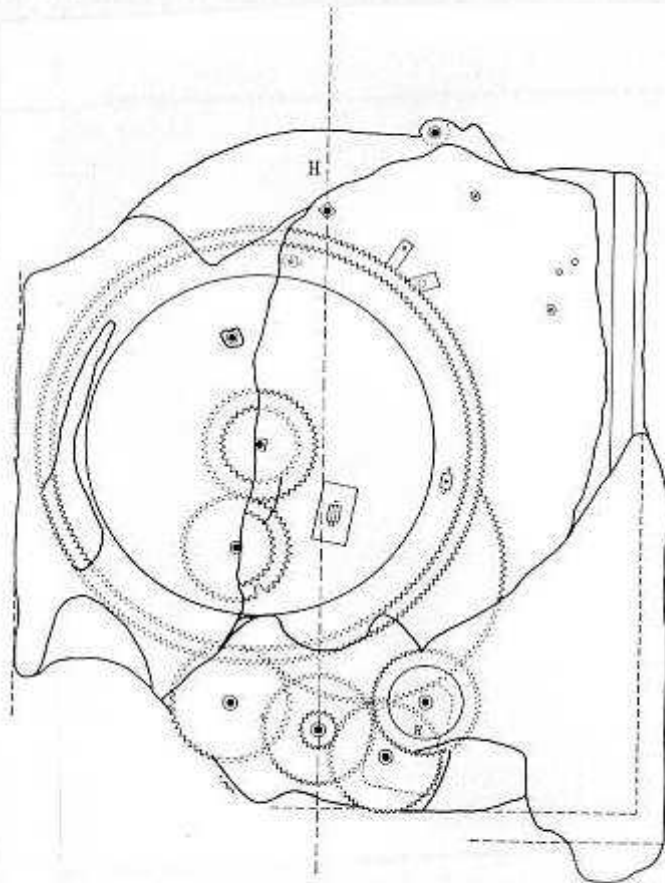


FIG. 14. Schematic of back of main fragment.

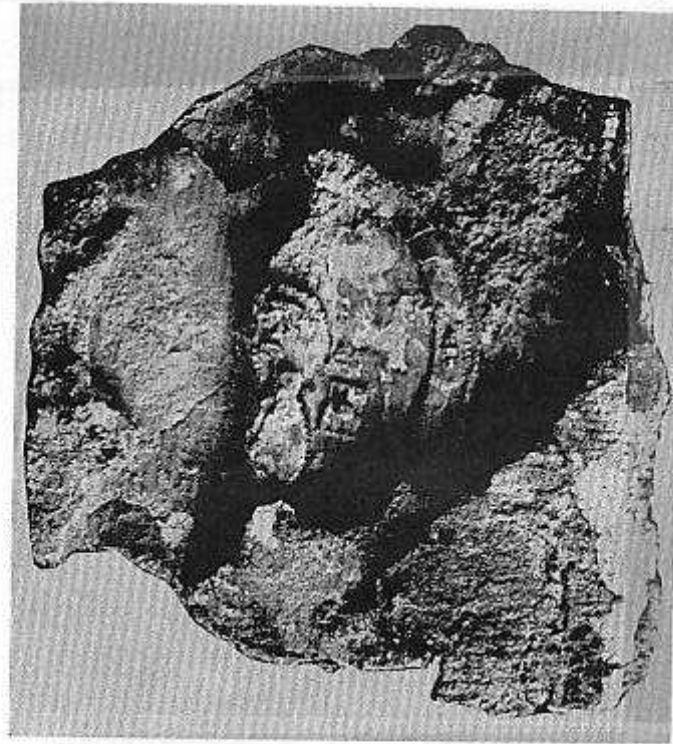


FIG. 16. Back of Fragment A, before cleaning. A.2.

Figures 14, 16. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.



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FIG. 21. Radiograph of Fragment A seen from front. The contrate gear *A* is on the right, the rings of the lower back dial are at the bottom left.

Figure 21. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.



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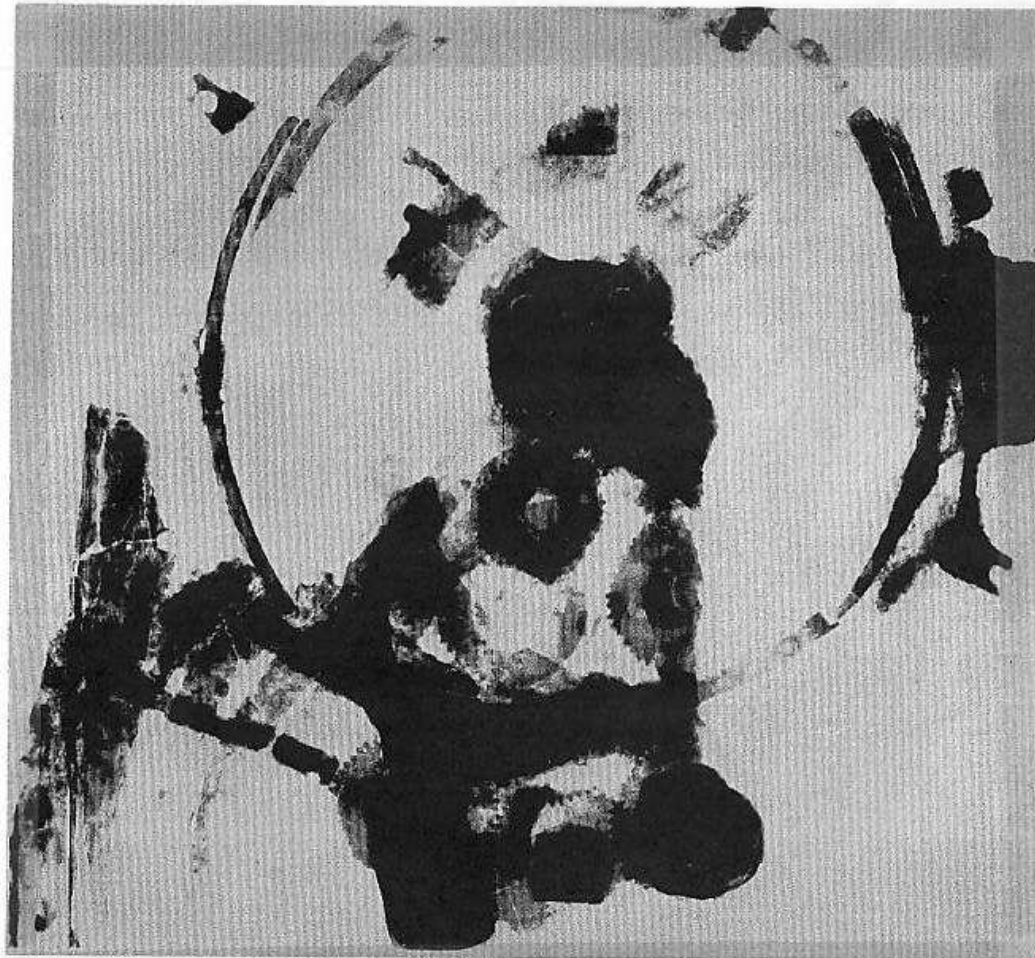


FIG. 22. The same with higher penetration showing inner gearing.

Figure 22. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

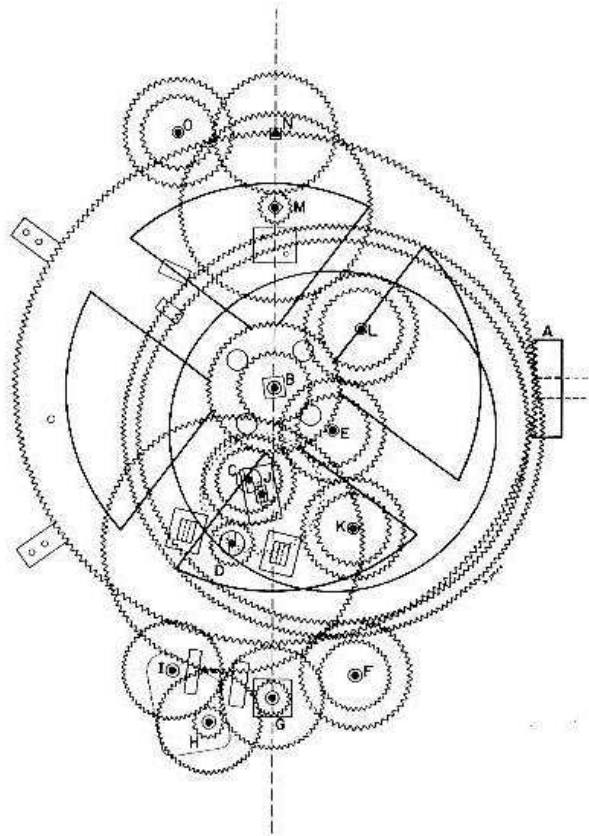


FIG. 29. General plan of all gearing, composite diagram.

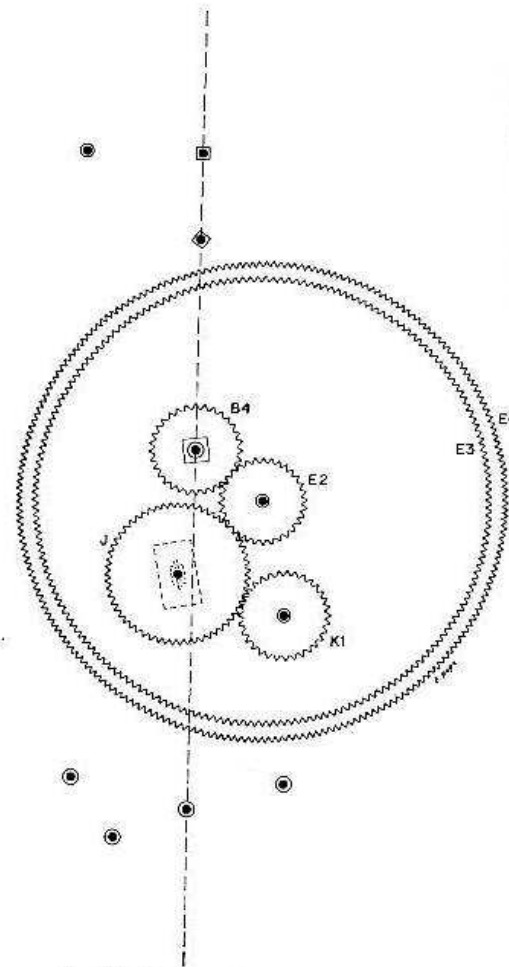


FIG. 31. Gearing on back of differential turntable.

Figures 29, 31. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

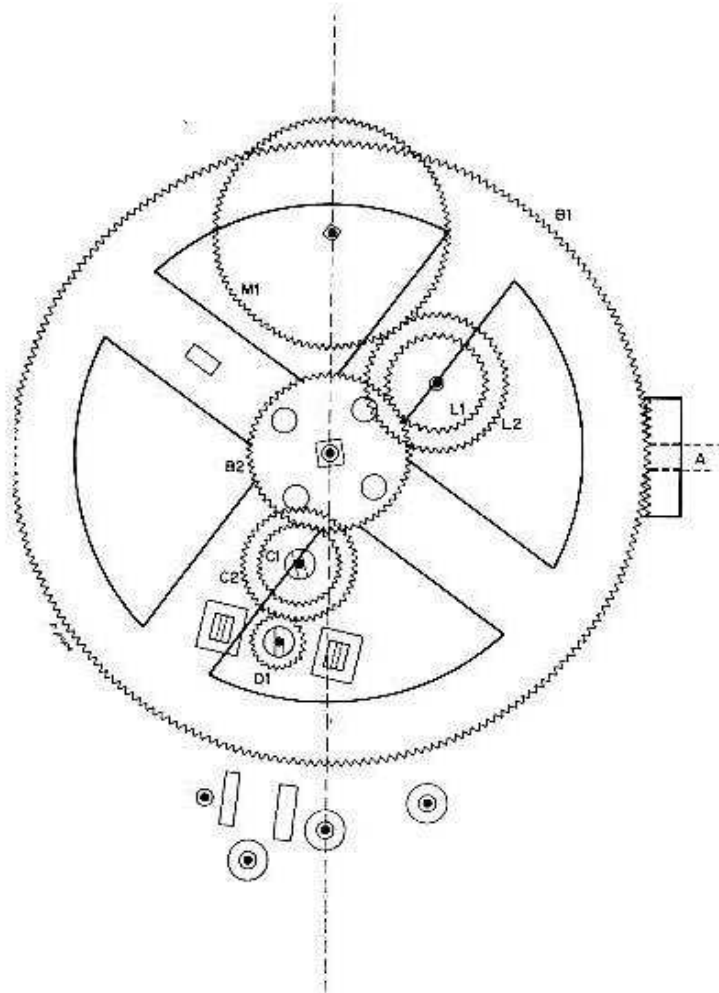


FIG. 30a. Gearing on front of main plate.

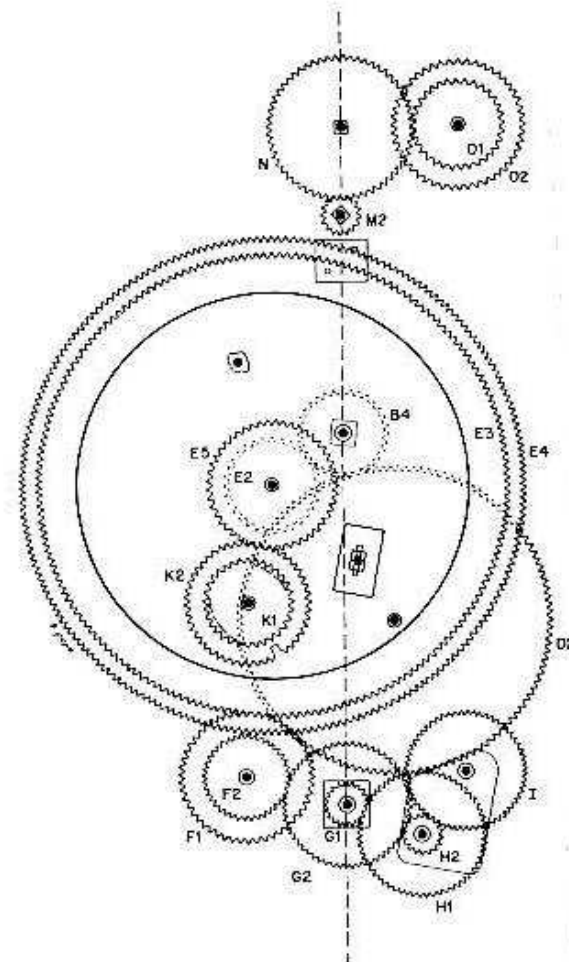


FIG. 30b. Gearing on back of main plate.

Figures 30a,b. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.

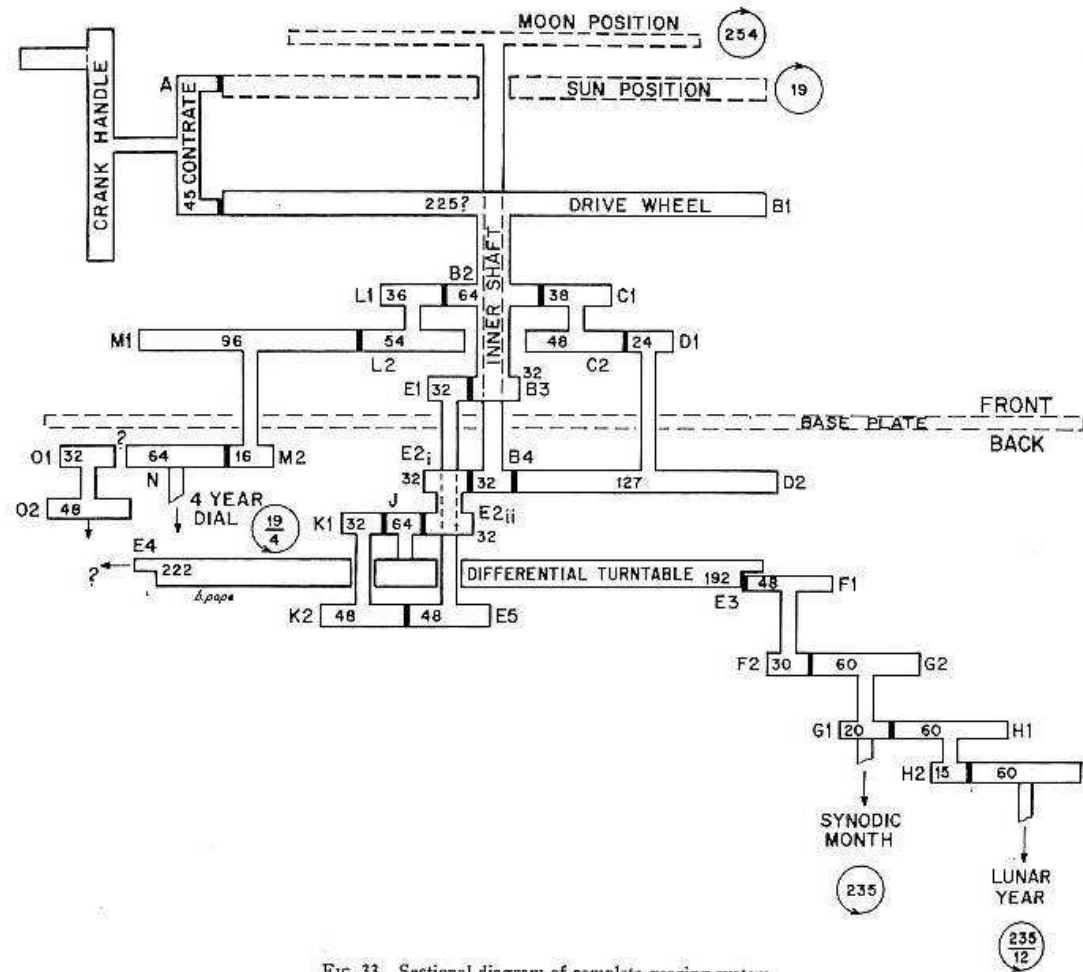


FIG. 33. Sectional diagram of complete gearing system.

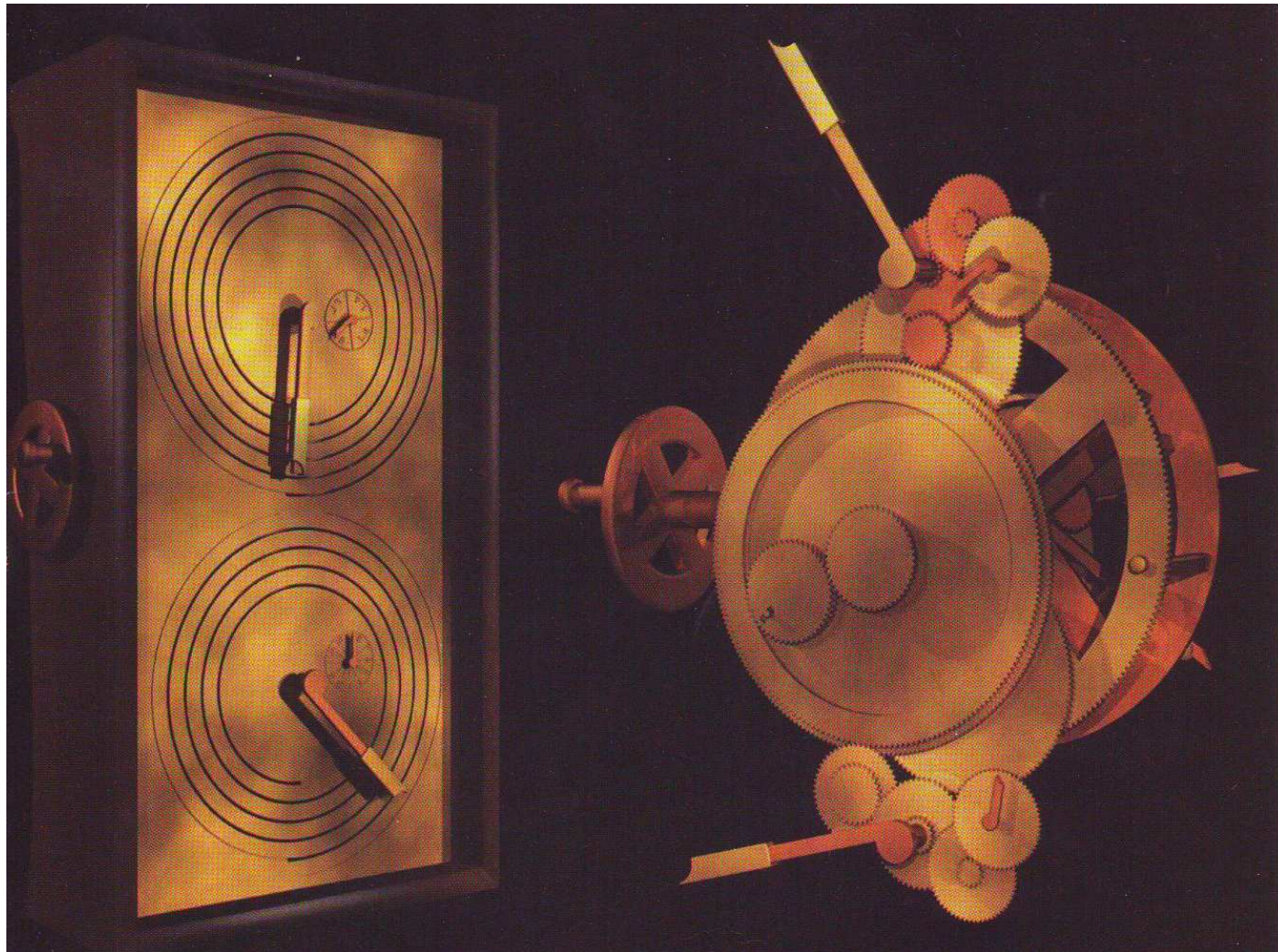
Figure 33. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.



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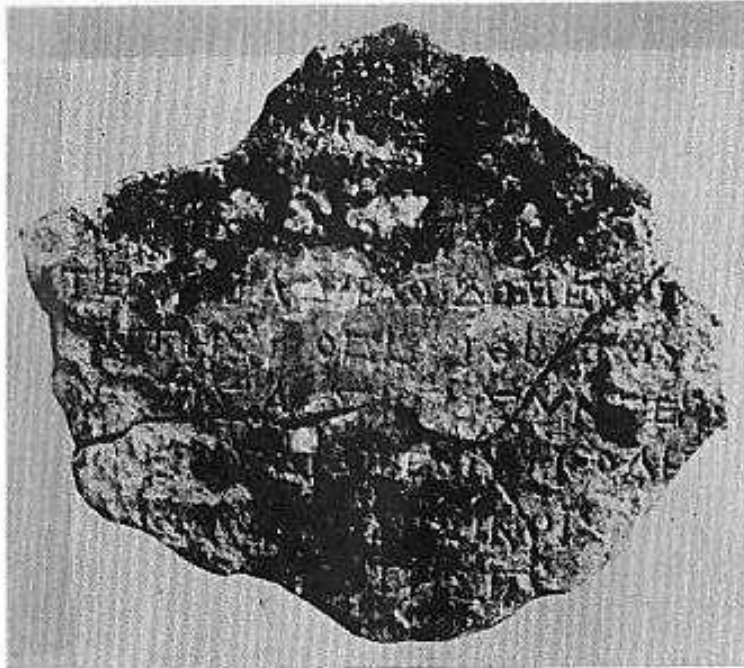


FIG. 39a. Fragment containing lines 36-45 of back door inscription (see also fig. 40) oblique illumination.



FIG. 39b. Same fragment with direct illumination. This is the only place where more than a few inscribed letters can satisfactorily be photographed.

Figures 39a,b. Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.



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References on the Antikythera Mechanism:

- 1.) Price, Derek de Sola: “Gears from the Greeks: The Antikythera Mechanism – a Calendar Computer from ca. 80 B.C.” *Trans. Am. Philosophical Soc.*, Volume 64, Part 7, 1974.
- 2.) Lobell, Jarrett A.: “The Antikythera Mechanism”, *Archaeology*, March/April 2007, pp 42-45.