

The "Cosmos" of the Antikythera Mechanism
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(Not for circulation or citation.)

Fragments B, A, and E of the Mechanism bear on their rear sides (originally parts of the back dial face) offsets of a long Greek inscription, the mirrored image of an inscribed plate that rested against the dial face during the centuries that the Mechanism was in the sea. Of the inscribed plate itself the only remains are one substantial fragment (Fragment 19) that was adhering to the rear face of Fragment A when the Mechanism's fragments were discovered in 1902, and a few smaller bits that are still attached to Fragments B and E.

The part of this inscription on Fragment B comprises 29 incomplete lines, with a partially preserved left¹ margin evident from coincident word or syllable beginnings. Fragments A and E bear 25 incomplete lines; no margin survives, but since the continuation of the inscription's left margin from Fragment B runs through the middle of preserved lines on Fragments E and A, it is clear that the left margin of the lower part of the inscription lay considerably further left (i.e. right with respect to the dial face) of the upper part's margin. Thus unless the text on the inscribed plate was laid out in blocks with different margins, the plate must have been in two pieces either as constructed or through breakage. Moreover, it is not certain how many lines, if any, are lost between the lowest preserved line on Fragment B and the highest preserved line on Fragment E. We will therefore refer to the section of the inscription on Fragment B as Part I, and that on E and A as Part II, with separate line numbering for each part.

The lines of the original inscription were evidently much longer than the longest preserved line (I.22, comprising 35 preserved or certainly restored letters), perhaps running to seventy letters or more. Although an unbroken restoration running line-to-line is nowhere possible, we have enough text to determine the contents and general structure of the inscription: it is an item-by-item description of the external features of the Mechanism, beginning with the front displays (Part I) and continuing with the displays of the upper back (Part II lines 1-19) and the lower back (Part II lines 20-25). The Greek is standard Hellenistic *koinê*, and employs some technical vocabulary from Greek astronomy, calendrics, and mechanics.

The front face of the Mechanism is known, from surviving elements and the currently accepted reconstruction of the gearwork, to have had the following features:

- a fixed circular ring representing the zodiacal circle, divided into twelve sectors labelled with the zodiacal signs and further graduated into 360

¹ In speaking of the inscription, we use "left" and "right" with respect to the original inscribed plate; thus the "left" margin is actually the right edge of the offsets on Fragment B.

- degrees, with letters of the Greek alphabet inscribed above the graduation marks to signify solar longitudes corresponding to stellar visibility phenomena and the Sun's entry into zodiacal signs that were listed on separate inscribed plates;
- immediately surrounding the zodiacal ring, a removable circular ring representing the 365-day Egyptian calendar year, divided into twelve larger sectors labelled with the Greek names of the Egyptian months and one smaller sector for the five "epagomenal" days, and graduated into 365 day-divisions;
 - a smaller circular disk in the middle of the space inside the zodiacal ring, which revolved to represent the Moon's apparent motion through the zodiac while displaying through a hole near its periphery a revolving ball, half black, half white, that represented the Moon in its cycle of phases.

In addition, the very presence of a dial representing the Egyptian calendar year in (adjustable) correlation with the zodiac implies that there must have been some indication of the longitude of at least the mean Sun. Since the display of the Moon's longitude is known to have incorporated a variable rate of progress with a single periodic anomaly, it appears probable that the Mechanism somehow displayed both the true longitude of the Sun (with a single anomaly) and, for the sake of the Egyptian date, the mean Sun.

Following fourteen lines that are too fragmentary to interpret, Part I of the inscription continues with at least thirteen lines (15-27)² describing elements of the front displays, as follows:

- 15: a "little sphere" (σφαίριον) in motion, presumably representing one of the heavenly bodies
- 16: a pointer projecting from something
- 17: description of (at least) two rings, one graduated in 360 parts and so identifiable as the zodiacal ring, the next presumably the Egyptian calendar ring
- 18: something in motion through something
- 19: something belonging to the planet Venus
- 20: something revolving, perhaps in relation somehow to Venus
- 21: a golden "little sphere" situated on a pointer
- 22: mention of a solar ray, and of a "circle" (?) below the Sun
- 23: something belonging to the planet Mars, and something travelling through something
- 24: something belonging to the planet Jupiter, and something travelling through something
- 25: a "circle" belonging to the planet Saturn, and a "little sphere"

² Line 28 apparently mentions "bosses" (ἀσπίδίσκαι); it is unclear where these were on the Mechanism. Line 29, beyond being a back-reference ("the aforesaid") is too fragmentary to interpret.

- 26: something beside the "cosmos"
- 27: letters of the alphabet lying beside something, presumably the index letters inscribed on the zodiacal ring or the corresponding letters on the inscribed plates to which they refer

What can we learn from this text? First, we note that from line 17 on, there is nothing referring to the Moon and, surely, no room for even a brief description of the Moon display in the lost portions of the lines. The Moon display must have been set out somewhere before line 17. Secondly, we see references to all the other heavenly bodies, in the order Venus, Sun, Mars, Jupiter, Saturn, that is, one version of the standard Greek ordering of the planets according to their presumed increasing distance from the Earth. In these schemes, the relative order of Mercury and Venus varied; the inscription appears to have more space for a reference to Mercury preceding rather than following Venus, and we may tentatively restore the name at the end of line 17 and the beginning of 18.

The five planets were surely displayed in a more or less uniform manner on the Mechanism, and their descriptions in the inscription would also have been expressed in a similar manner. On this assumption, each planet is assigned a "circle" (κύκλος) in a spatial relation to the previously described heavenly body, a "little sphere" (σφαίριον), and something travelling through something—almost certainly the "little sphere" travelling through the "circle". There are no surviving mentions of pointers belonging to the planets; however, the Sun is represented by a golden "little sphere" situated on a pointer, and another pointer mentioned in line 16 may belong to the Moon.

The interpretation of this section of the inscription hinges on three questions: what were the "circles", what does the text mean by "above" in line 22, and what is the "cosmos" of line 26? The preserved text is not suggestive of separate dials for each of the planets. If we were dealing with a ring of five subsidiary dials, one would expect the description of the Sun to precede those of all the planets, and it would be strange to specify the location of Mars' dial as "above the Sun" if what is meant is "above the axis of the solar and lunar pointers". Moreover, the verb διαπορεύομαι, "travel through", is not appropriate for a pointer revolving around a dial (cf. Part II lines 17 and 24, where we have "the end [*scil.* of the pointer] moves...").

The key is the word κόσμος. The only thing it can plausibly refer to is the entire dial display itself with the Moon, Sun, planets, and (by way of the zodiacal dial) fixed stars. I propose therefore that the space inside the zodiacal ring was divided into concentric rings representing a schematic "Aristotelian" cosmology. The Sun and planets would then be represented by "little spheres" of varying colors revolving around the cosmic axis within their respective "circles". One can imagine two ways of doing this: each circle itself might be a moving part, with the ball fixed to it, or the ball might be mounted on a pointer revolving over a stationary background engraved with the circles. With the former kind of arrangement, pointers for the planets might have been dispensed with.

In addition to fitting the inscription text, a reconstruction along these lines brings the Mechanism into much closer relation with classical authors' descriptions

of planetaria, with their emphasis on the visual imitation of the cosmos rather than schematic and quantitative representation of apparent motions by pointers on dials.

