ΑΚΑΔΗΜΙΑ ΘΕΣΜΩΝ ΚΑΙ ΠΟΛΙΤΙΣΜΩΝ
ACADEMY OF INSTITUTIONS AND CULTURES

Στοά των Επιστημών-Επιστημονική Επιθεώρηση

Stoa of Sciences-Scientific Review

Τόμος 1
Volume 1

Ελληνιστική Αστρονομία και Μηχανική
Hellenistic Astronomy and Mechanics

Τεύχος B
Issue B

Ο Μηχανισμός των Αντικυθήρων
The Antikythera Mechanism

Corpus operae I

Διεύθυνση- Direction
ΙΩΑΝΝΗΣ ΧΙΟΥ ΣΕΙΡΑΔΑΚΗΣ, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης
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ISSN: 2241-9993

Έτος εκδόσεως - Year of issue : 2017

Mediterranean Archaeology and Archaeometry, Vol. 6, No 2, pp. 6-8

BREAKING NEWS

Decoding the earliest "computer": the Antikythera astrolabe. Science and technology in ancient Greece

Ioannis Liritzis
Editor-in-Chief

The Antikythera mechanism is a complex mechanical device found in a wreck off the island of Kythera. After several research efforts scientists finally decoded this early 'computer' bringing in new information concerning ancient Greek technological advancements in astronomy, that could be seen as of the greatest discoveries of our era.

The chronicle

In the Easter of 1900, just off the tiny island of Antikythera in the Aegean Sea, sponge-fishers from Simi found by chance a very important ancient shipwreck dated to 2nd to the early 1st century B.C. The plethora of objects included bronze fragments of furniture, marble and bronze statues and statuettes, pottery, luxury glass and silver vases, wooden parts of the ship and other. Of the most important find was a corroded bronze mechanism embedded to calcareous cemented matter caused by the seawater. The mechanism was associated to the School of Poseidonius of Rhodes and dated c.87 B.C. The mechanism is a four piece fragmentary, fragile and partly missing calculating device with geared wheels, display scales and Greek inscriptions, displayed at the National Archaeological Museum in Athens.

Early research (1902-1934) was made by Svoronos, Stais, Rados, Rediadis, Theophanides and even attempted a reconstruction.

Later research (1953-1974) was applied by mechanical engineer in collaboration with Karakalos (1973) who applied industrial X-ray radiography and recovered revolutionary structural data and 30 geared wheels. Dr Derek de Solla Price made a second model (two replicas) (Price, 1974). Since then, several other models were made by Roumeliotis, Freeth (2002 a, b), Casselman and Lysozyme.

The third research phase (1990 till today) was studied by computer scientists (Bromley and Gardner) as well as mechanical engineer Michael Wright, Greenwich Museum, London. The film images were taken by the laborious X-ray linear tomography. A replica was made by Michael Wright upgrading earlier model by Price producing eventually modifications till this year.

The last research effort (2005 till today) the mechanism was studied by the Antikythera Mechanism Research Project researchers from a consortium of public and private establishments led by Mike Edmunds University of Cardiff and included Universities of Athens and Thessaloniki, The National Archaeological Museum Athens, the Center for History and Palaeography, Cultural Foundation of the National Bank of Greece, X-Tek Systems, and Hewlett-Packard. They applied a powerful microfocus X-ray computer assisted tomography (CAT) using reflectance imaging to enhance surface details. The first results were announced in this week issue of the international scientific journal of *Nature* and at the same time during the 2-day international conference (30th Nov to 1st Dec., in Athens) where the present information is retrieved from (Deconding the Antikythera Mechnism, Abstract Book). The results are indeed exciting and enabled new detailed 3D reconstruction of the internal structure of the Antikythera Mechanism using a total of one terabyte of CAT data and the surface polynomial mapping images. (Fig. 1)

Fig.1 slices from the X-ray CAT showing the inner structure of fragment A and an invisible text inside fragment E (not in scale) (Abstract Book, p.20)

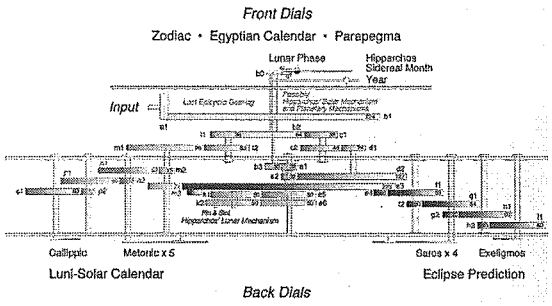

Fig.2 The gearing system showing the new reconstruction by the recent discoveries from the CAT X-ray technology and reflectance imaging (Abstract Book, p.33)

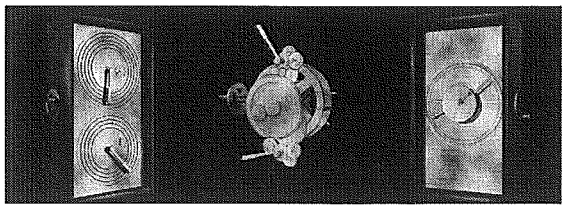

Fig.3 a) 3D models of the back dials, the back gears and the front dial, based on the recent data (Abstract Book, p.6)

The results

Every single gear in the corroded mechanism is revealed, studied, mapped with all the details possible, accurate teeth count estimations, axial positions, and gear interrelations. Back dials were in the form of spiral. New inscriptions, completely unknown until now and sealed for 21 centuries inside this ancient computer by corrosion and the calcification have been read, the "user manual" has been decoded. All these new data provided intriguing new information about the use of its astronomical device.

The device is rich with astronomical elements; 1) eclipse predictions, 2) zodiac, 3) Egyptian calendar, 4) luni-solar calendar, 5) 19-year Metonic cycle, 6) Callippic subsidiary dial, 7) a triple Saros or Exeligmos dial, 8) inscriptions in Greek, 9) glyphs (astronomical symbols in the dials), 10) time periods of 19, 76, 18+ and 54+ years were identified (Heath, 1913, Dicks, 1970).

The lower back dials are a Saros/Exeligmos system which strongly suggests that it was implemented by a fixed-axis train including a gear with 223 teeth (Fig.2).

The CAT supports the new idea that the epicyclic system at the back of the Mechanism exploits the pin-and slot mechanism discovered by M.T.Wright an extraordinary mechanical realization of Hipparchos' Lunar Theory. The new data are of paramount importance and offer a complete reconstruction of the gearing mechanism (Fig.3).

The text from inscriptions include terms like αποκαταστασις (recovery), διάστημα (interval), στηριγμός (prop), περαίωσις (completion), χρυσούν σφαιρίον (golden sphere), ηλιος (sun), names of planets Hermes, Venus, verbs like προσάγειν (bring forward), επέτεινεν (spread), προσήει (permitted to approach), numbers like 265, 340, 130, all providing a more concrete view about the possibility of displaying distances between planets at a given moment.

Discussion and implications

Early Greeks were particularly able to develop theories for nature according which the phenomena were subjected to rational and invariable rules. The example of ancient Greeks is a strong argument supporting the view which considers science as the spear of human intellect (Cardwell, 1994). We now have a clearer view on the influence of mechanical models on the Greek view of the Universe. Surely such a complex device is the result of gradual development of astronomical observation and mechanics, going back to Archemides, Pythagoras, Hesiod, the Minoans and the Myceneans (Blomberg & Henriksson, 1996). It is even suggested that observations were made by using magnified lenses (in a cane), as those found in excavations

and dated from Late Mycenean to Hellenistic times and depicted in 4th century black on red vase.

The ancient Greek astronomy was in a highest point than thought from available evidence, although textual reports refer to mechanical devices such as the automata and early astrolabe (Hill, 1996)).The group of inscriptions is extremely interesting in terms of astronomy, technology, geography and even linguistics, for example the name of Spain (ΙΣΠΑΝΙΑ, ISPANIA) appears for the first time.

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