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The Antikythera Mechanism, the oldest known astronomical device and Mechanical Universe

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Abstract

The Antikythera Mechanism is the oldest known advanced scientific instrument. Without doubt, it is the oldest known analogue computer made with gears and the first known Mechanical Universe and probably Planetarium. Not only was an astronomical instrument suitable for observations, but it also served as a climatological and meteorological device. Certainly, such devices were in use as educational instruments in Antiquity and possibly operated as a cartographic tool. Made by Greek scientists with appropriate knowledge of astronomy, mathematics, physics, engineering and metallurgy, the bronze geared device enabled the constructor to perform specific calculations with gear trains and the user to find the position of celestial bodies in the sky. It was constructed during the Hellenistic period, probably around 150 to 100 BC.

The Antikythera Mechanism depicts the position of the Sun, the Moon (its phase), predicts eclipses and shows when the Greek Crown Games should occur: the Olympics, the Pythian, the Isthmian, the Nemean, the Naan, some of the very important festivities that enable the common person to keep the time in a functional calendar very useful in agricultural, fishing and hunting.

1. Introduction

The Antikythera Mechanism was found in 1900-2 in an ancient shipwreck by sponge divers near the small Greek island of Antikythera, a castle of pirates for centuries. Fragments of its bronze body are now exhibited in the National Archaeological Museum of Athens. This wonderful instrument was salvaged together with many treasures in the same shipwreck of the 1st century before Christ which was on its way from Greece to Rome with tones of Greek items (about 100 marble and bronze statues), merchandise or official war lute. Although the Antikythera Mechanism looks like an oxidized grand mother's clock, the story of its discovery still surprises the humanity.

2. Why to construct such a Mechanism

Astronomy is the oldest science. Humans have been watching the sky attempting to understand their environment and their position and role in the Nature. This eventually led them to try to evaluate their existence in the Cosmos. As a result, Philosophy and Humanity were born. Form prehistoric times humans develop calendars and through this improve Astronomy and Mathematics. The study of the sky has been developed in all longitudes and latitudes worldwide, as it is an applied and practical science, necessary to regulate life and social rhythms in ancient as well as in modern societies. Gradually, humans have noticed and tried to understand the regularity of motions of celestial bodies, stars, Sun, Moon and planets. People performed observations of the celestial bodies, invented mathematics initially to measure the time and later to construct astronomical models. Eventually, they constructed astronomical instruments, which sometimes embedded in their buildings, temples, palaces, roads of a city; so that they last long and now they are available all, even the layperson that has the common knowledge of calendars and Astronomy.

3. What is the Mechanism and what does the Mechanism?

The Antikythera Mechanism is an Astronomical instrument designed for: Observations, Astronomical computer, Calendar mechanism, Meteorological or Climatological device, School demonstration device, Show up to friends, Measure Geographic latitude, Measure Geographic longitude (with its Moon

Mechanism) and hence suitable for Cartography and Navigation.

The device calculates: the position of the Sun, the position of the Moon, the phases of the Moon during the month and it predicts the eclipses of the Sun and the Moon. It consists of many complicated calendars, based on the Solar year (Egyptian Calendar), the four year Olympiad period, the lunisolar Saros period of 18 years 11 days and 8 hours. The latter predicts the solar and lunar eclipses.

Moreover, the mechanism possesses the lunisolar Exeligmos of 54 years and one month (equal to 3 Saros cycles), which predicts more accurately the solar and lunar eclipses and the lunisolar Meton's 19 years circle which is used today to calculate the Christian Easter. Furthermore, it has the 19 year cycle of Hebrew calendar, the lunisolar Callippus cycles 76 years, which is a multiple of Meton´s cycle and more accurate. It also hosts a pointer for the Olympic Games and other Greek festivities.

5. Have there been any other similar devices?

Although the Mechanism is the only survived device of its type, definitely it is not the only instrument of its kind. Certainly, there have been many other mechanisms before this one probably much simpler. It is know that Archimedes constructed two similar devices as well as Posidonius, a very important philosopher that had a University in Rhodes, as we read in Cicero. The Antikythera Mechanism is both an accurate computer and a scientific instrument. Its pointers can move around scales, circular and spiral, divided in days or months.

6. The manual of the instrument

Extensive research of the fragments of the device revealed that a user's manual existed within the instrument. From the manual we understand that as an instrument could have been used to do observations and even to measure angular distances of two celestial bodies in the sky. It is also written in the manual that the device has trunnions that can be used to aim at a celestial body, to pass a sunray and to measure the altitude of the Sun, as the constructor mentions sunray.

7. How it works?

The mechanism is made of bronze gears with several trains and axles, that move several pointers along several scales, several circular and two large scales made of thick Archimedes-like spirals divided in months and lunations. The latter contain inscriptions with the time of predicted solar or lunar eclipse. Several pointers show the position of the Sun and the Moon and its phase during the month. An astonishing discovery was that the motion of the Moon follows to a good approximation of the second law of Kepler.

8. The first planetarium?

It is very possible that this astronomical computer predicted the position of the planets, as there are several terms concerning planetary motions and the names of Aphrodite (Venus) and Hermes (Mercury) on it. This is not a surprise as the Planetarium was one of the two instruments made by Archimedes, almost a century before the Antikythera Mechanism. Additionally, there is a possibility, as there are indications, that the mechanism was an anaphoric clock.

9. Summary and Conclusions

The Antikythera Mechanism, the oldest known complex scientific instrument, the oldest computer and Mechanical Universe, is a Planetarium, constructed around 150-100 BC in the Greek world. Trains of bronze gears perform mathematical operations, move pointers in scales and give the positions of the Sun, the Moon and age of the Moon, eclipses. The planets were also probably shown in appropriate displays as we read in ancient texts. The Mechanism maintains calendars based on Meton's period (19 years) and Callippus' period (76 years), determines the dates of the Olympic Games, Pythian, Isthmian, Naan and Nemean. Its excellent Educational use will be presented too.

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