The horizontal sundial of Athens

Theodossiou, E., Manimanis, V.N. and Kalyva, E.-M.

Abstract

In Athens of the 5th Century BC, lived the great astronomer and geometrician Meton who carried out his observations using his *heliotropium* (heliotrope), a kind of improved sundial. He might have placed many sundials in Athens, as well as carved calendars used for daily purposes.

In Athens, we also find the magnificent monument of Andronicos Kyrrhestes, a hydraulic clock, decorated with eight sundials, carved on the sides of the octagonal construction, and an archaic water clock, preserved in the Museum of the Ancient Roman Agora (Old Market).

Nevertheless, we find no horizontal sundial of that period; the only sundial of Athens dates from the middle 19th Century and it is placed at the entrance of the National Garden. It was initially made as an ornament for the Palace of Othon, the first king of modern Greece, and then relocated to its current position.

Keywords: *sundial, heliotropium, National Garden, Athens, Greece*

1. From the Heliotropium to modern Sundials

During the era of Pericles, in 432 BC, the famous geometrician, architect and great astronomer Meton suggested the application of a new time period, divided in 19 tropic years, after which the phases of the Moon were repeated in the same days and dates of each year. This 19-year long cycle, which combined the solar and lunar calendar, was called Cycle *of Meton* or *Cycle of the Moon.*

According to Diodorus the Siculus (IV, Book XII, 36, 1-3) "*When Apseudes was archon in Athens, the Romans elected as consuls Titus Menenius and Proculus Geganius Macerinu. ... In Athens Meton, the son of Pausanias, who had won fame for his study of the stars, revealed to the public his nineteen-year circle, as it is called, the beginning of which he fixed on the thirteenth day of the Athenian month of Scirophorion ".*

From Diodorus the Siculus we know that the *Cycle of Meton* was applied on the 13th day of the *Skiroforion*, the 12th month of that time's attic calendar. This possibly being the 27th of June, according to the proleptic Julian Calendar.

Meton himself possibly chose this date having astronomically calculated the summer solstice taking place at that day.

Meton and his assistant Euktemon placed his heliotropium, a kind of improved sundial on the wall of the Pnyx. According to Philochurus (*Schol. to Aristophanes 997)* what Meton set up was a sundial, on the wall of the Pnyx.

The great astronomer Claudius Ptolemy (2nd Century AD) informs us that, Meton was making his astronomical observations using the *heliotropium.* With Euktemon, they discovered, using this instrument, that the equinoxes and the solstices do not divide the year into four equal seasons. Furthermore, the heliotropium was used in Antiquity to observe the summer solstice. As mentioned by Claudius Ptolemy (Book III, 3) *"Furthermore if, because of its antiquity, we compare the summer solstice observed by the School of Meton and Euktemon (though somewhat crudely recorded) with the solstice which we determined as accurately as possible, we will get the same result. For that [solstice] is recorded as occuring in the year when Apseudes was archon at Athens, on Phamenoth 21 in the Egyptian calendar [-431 june 27], at dawn".*

This calculation took place in 432 BC and was used as the basis for determining the apparent annual solar orbit.

It is a fact that, during the solstice, the shadow of a pole, vertical to the ground, is the maximum or the minimum possible shadow, depending on whether it is the summer or the winter solstice respectively.

The German mathematician and astronomer Carl Friedrich Gauss in 1820 manufactured an instrument also called *heliotrope*, when he turned his interest in Geodesy. This instrument reflects the sunbeams towards a specific target to be used for geodesic observations. Today it is no longer in use.

Meton was a known architect; Phrynichus in his *Menotropos* mentions Meton as an engineer and geometrician, who manufactured fountains.

The new Cycle of Meton as well as he himself was partly supported and partly criticized, something common to all calendrical revisions. The usefulness of the new calendar was questioned, and Meton was satirized by Aristophanes (414 BC) in the comedy "*The Birds" (Meton, 992-1020).* Furthermore, there is a saying "*αναβάλλεσθαί τι ες τον Μέτωνος ενιαυτόν",* for something being postponed for a long time.

Despite these, Meton placed sundials and calendars carved on plates made by stone or bronze at the Athenian Forum and in Kolonos.

Athens had a tradition in measuring time, and yet the only ancient clocks that we find are the magnificent monument of Andronicos Kyrrhestes (the "Tower of the Winds"), a hydraulic clock, decorated with eight sundials, carved on the sides of the octagonal construction, and an archaic water clock, preserved in the Museum of the Ancient Roman Agora.

2. The horizontal sundial of Athens

The horizontal sundial, which decorates Athens, belongs to a much later time, in the 19th Century. It was made as an ornament for the Palace of Othon (Otto von Wittelsbach), the first king of Athens, after the liberation of Greece from the Ottoman Empire.

Othon was the second-born child of King Ludwig I von Wittelsbach of Bavaria (1786-1868) and reigned in Greece from 1833 until 1862. His father, visiting Athens in 1835, borrowed 100,000 golden pounds the Greek State to build the Palace, designed by Friedrich von Gaertner and founded in the presence of King Ludwig II, in January 1836. It was only completed in 1842 and the horizontal sundial was then placed as an ornament besides the marble stair, leading to the Gardens of the Palace (Royal Garden).

Today, this sundial is located at the entrance of the National Garden from the side of Queen's Amalias Avenue in Athens. Unfortunately, the original gnomon (style) probably made by the famous sculptor Nikeforos Lytras was stolen, and on its place now stands a simple bronze copy.

On its plate, one reads the exact coordinates of its location: *latitude 37º 58,3΄ N* and *longitude 23º 44΄ E*.

On the one side of the marble pedestal are the solutions of the equation of time for every five days time-period throughout the year, and on the other side one reads the ID of the sundial: *"The present sundial was initially placed on the western side of the Palace during the reign of Othon and it was afterwards relocated, upon this marble pedestal, in April 1929".*

And it was then, when the Palace became the *House of the Greek Parliament* and the Royal Garden was given to the people and was renamed into *National Garden.*

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Address of the authors:

Department of Astrophysics, Astronomy and Mechanics,
School of Physics, University of Athens, Panepistimiopolis, Zographou, GR 15784
E-mail: etheodos@cc.uoa.gr

The monument of Andronicos Kyrrhestes (the "Tower of the Winds") in Athens, decorated with eight sundials carved on the sides of the octagonal construction (north side).

The sundial of modern Athens, at the entrance of the National Garden from the side of Queen's Amalias Avenue (west side).

The sundial of modern Athens, at the entrance of the National Garden from the side of Queen's Amalias Avenue (east side).

The sundial of modern Athens, at the entrance of the National Garden from the side of Queen's Amalias Avenue (southeast side).