SCIENTIFIC INSTRUMENTS OF THE NATIONAL OBSERVATORY OF ATHENS (1842-1970)

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The present study focuses on the scientific apparatus used from the time of the establishment of the Observatory of Athens (1845) and up to 1970. Most of these instruments remain in the site of the Observatory.

BRIEF HISTORY

The year 1837 sees the establishment of the newly founded Greek state first University in Athens. At that time, George Vouris, who was originally from Ioannina but was raised and educated in Vienna, taught Astronomy in the Department of Physics and Mathematics (part of the Faculty of Philosophy). In 1838, aided by the Austrian ambassador to Athens, he intercedes with the Baron George Sina, a rich Greek who lived in Vienna, to convince the latter to assume the cost for the construction of an Observatory in Athens. Sinas responds positively. The area of the hill of the Nymphs, opposite of Acropolis, is selected as the site for the building and the construction of the Observatory begins. The architect of the building was the Danish Theophil Hansen.

The edifice of the Observatory is built in the manner of a cross, aligned to the four cardinal directions. At the centre of the cross rises a dome, which housed the Ploessl telescope. The telescope dome is made of copper and was constructed by Monser, a German blacksmith who lived in Athens at the time. The foundation stone of the Athens Observatory, the first one in the Balkans area, was laid on June 26th, 1842 during a solar eclipse. G. Vouris was appointed first director of the Observatory.

Among the first instruments of the Observatory (purchased by Vouris in Vienna in 1845), most notable were:

1. A Fraunhofer equatorial refracting telescope, constructed by Ploessl House.
2. A meridian equatorial refracting telescope with a 94mm diameter, made by Starke House.

3. Two pendulums (a stellar pendulum manufactured by Kessel and one of average time made by Berthoud) and a Kessel timekeeper.

Vouris calculated the coordinates of the Observatory, which helped in the latter charting of the entire Greek dominion, and published a series of meteorological observations for the years between 1839 and 1841. He resigned in 1855.

The next director of the Observatory was Johan Friedrich Julius Schmidt, who resided in Athens until his death, a total of twenty-five years (1859-1884). The state, in which the Observatory had come into, did not offer suitable ground for scientific research. This is why Baron Simon Sinas, the son of George, offered to provide the salary of the new director. The instruments Schmidt found at Athens' Observatory paled in comparison with what he was accustomed at using all these years abroad, while he lacked assistants. Nevertheless, Schmidt managed to produce substantial scientific work. He was an excellent observer and published thousands of observations which, in conjunction with his extensive lunar studies, earned him and the Observatory of Athens international acclaim. His most famous work was the topographic map of the Moon he chartered after 34 years of observations and includes more than 30,000 calderas. We should note that many astronomy books published in the second half of the 19th century mention the Observatory of Athens and Schmidt.

Following Schmidt's death in 1884, Kokkidis, who at times worked as his assistant, temporarily assumed the direction of the Observatory without receiving payment. Kokkidis had studied astronomy in Berlin and in the Observatory of Paris. His work in the Observatory included meridian observations aimed at the precise calculation of time, observations on the maculae of the Sun and a minor contribution to Schmidt's visual map of the moon. After Dimitrios Aiginitis was elected to the post of the Director of the Observatory in 1890, Kokkidis limited himself to his duties as an Astronomy professor at the University until his death on March 7th, 1896.

Aiginitis was born in Athens on July 22nd, 1862. He studied in the Department of Physics and Mathematics of the University of Athens; in 1886, at the age of 24, he was awarded the title of "Doctor of the Philosophy of Mathematics". Subsequently, on a scholarship from the University, he further pursued his studies on astronomy in Paris. He became particularly known through one of his publications which dealt with the stability of the solar system. In this paper, Aiginitis proved that the motion of the Earth periodically changed in time. During the first decades of the 20th century, Aiginitis' claims were confirmed through the studies of two astronomers, Milancovic and Croll. The scientific value of his work led to his appointment as regular astronomer of the Observatory of Paris; he also took up residence within the Observatory, an honour which was not bestowed frequently on astronomers.

While Aiginitis appeared destined for an illustrious career in France, back in Greece, Trikoupis' government invited him to return to Athens and assume the direction of the Observatory of Athens. Indeed, despite the pressure exerted on him by the director of the Observatory of Paris, Admiral Mouchez, Aiginitis returns to Athens in 1890.

Aiginitis set the following terms:

a) Indispensable scientific instruments were to be purchased, among which a telescope worth 170,000 French francs
b) Suitable buildings were to be constructed to house of the ancillary services of the Observatory
c) He would personally select the scientific personnel, and
d) He would receive a monthly stipend of 1,000 drachmas.

Eventually, following a flurry of negotiations, Aiginitis' terms were accepted. When the time had come, however, for him to assume his duties, a change in the government had taken place, the country's financial state was dire, and the subsidies he had been promised never materialized. Even his salary was never paid to him in full. Thus, Aiginitis was forced to take up teaching in the Military School of Army Cadets (1892) and at the University of Athens from 1896 onwards. The only money paid to the Observatory came from the University of Athens and amounted to 16,000 drachmas. With this money Aiginitis repaired the building and the instruments of the Observatory, which had become all but useless for carrying out proper scientific work. At the same time he worked on observing meteoroids, on making meridian observations to calculate the exact time, in order to rectify the Navy's and the merchant marine timekeepers.

The internal problems of the state though, as well as the calamitous war of 1897, left no room for state financing to the Observatory for the acquisition of new and greater telescopes. Aiginitis turned to the prosperous Greeks living abroad, asking them to continue Sinas' work, who had established the Observatory half a century earlier. As he used to say, the purchase of a large equatorial telescope required significant expenditure, but "this instrument is the soul of every Observatory".

Ever since 1891 many of the affluent Greeks living abroad, among which were the likes of Ionidis (see: Ionidis' reflecting telescope) and Stephanovik, have and continue to support the Observatory through their donations. A committee for the collection of funds was established under Prince George; this committee managed to raise 250,000 drachmas from the endowment of L. Doridis and the contributions of Sygros, Korgialenios, Stephanovik, Zarifis, and others. These funds went towards purchasing a piece of land (2765 cubits) on the hill of the Nymphs, close to the Observatory; the acquisition of a large equatorial refracting telescope, made by Gautier, with a diameter of 40cm, a meridian refracting telescope of a 16cm diameter (known as the Sygros telescope), also made by Gautier, and towards the procurement of other instruments. Moreover, three subsidiary buildings were constructed in order to cater for the ever growing needs of the Observatory. With the addition of these new instruments, the making of sound astronomic observations was made possible in the Observatory. Another great success for Aiginitis was that he secured £8,000 which was donated by his friend, Marinos Korgialenios, "for the purchase and installation of a big equatorial refracting telescope which will bear his name", provided that the executor of the donation would be Aiginitis himself. Unfortunately, this telescope was only purchased in 1970, due to the grim economic state that the country was reduced to following its defeat in Asia Minor (1922).

When Aiginitis' passed away in 1934, he was succeeded in his chair at the University (the Department of Astronomy was established in 1942) by Stavros Plakidis. Plakidis was born in Istanbul in 1893 and after graduating from the *Great School of the [Greek] Nation* (: Megali tou Genous Sholi) in 1911, he went on to study Mathematics at the University of Athens. In 1915 he was appointed assistant in the Department of Astronomy of the Observatory of Athens. In 1927 he was promoted to adjunct astronomer and in 1928, following Aiginitis' proposal, he was sent to further his studies as a Korgialeneios Award scholar in the UK, France and Germany, where he worked at the Observatories of Greenwich, Cambridge, Paris, Strasbourg and Heidelberg. In the UK he worked along A. Eddington, one of the famous astronomers of the time. Upon his return to Greece he was awarded Doctor of the University of Athens and was promoted to a regular astronomer's post at the Observatory. After the death of Aiginitis, he is elected Professor of the University of Athens, while he maintained his position as head of the Astronomy Department of the Observatory.

Meanwhile, a new problem arose. The Observatory was situated in the centre of Athens – a location both suitable and fitting at the time of its establishment. This location, however, became particularly unsuitable for astronomical research and more so for research in Astrophysics due to the subsequent vast expansion of the city and the concomitant increase of light-pollution. It quickly became apparent that an Observatory in another, more suitable position would be needed soon. After a relevant survey, in 1936 Professor Plakidis chose "Koufos" hill at Penteli, and the Penteli Astronomy Station was established there. The choice in question may today appear bizarre given the hill's small distance from the city centre (18 km). It is apparent that this choice was not the best possible. We need though to consider that in his search for a new location, Plakidis had to take into account the pressing factors of the Observatory's financial difficulties and the transportation problems of those times. Even so, until the end of the 1970s, it was still possible to make valuable photometric observations at the Observatory of Penteli.

All the instruments which belonged to the Astronomy Laboratory of the University of Athens, as well as Plakidis' privately owned equipment, were used to fit out the Astronomy Station at Penteli. In addition, in 1937 the Naval Hydrographic Service lent the Station an 80mm Zeiss refracting telescope.

The first telescopes, with which the Station was equipped, were a 16cm Bardoux refracting telescope and an 11cm Secretan telescope, both of which belonged to Professor Plakidis. At the same time, the Astronomy Laboratory of the University of Athens provided the Station with a 110mm Zeiss refracting telescope. Though small, these instruments were satisfactory as an experimental start, given that the largest telescope at the Observatory of Athens at that time was Doridis' refracting telescope, the diameter of which was 40cm.

Yet the regular course of the observations at the Astronomy Station at Penteli, as well as at Observatory on the hill of the Nymphs, was interrupted by the outbreak of World War II. On the morning of October 28th, 1940, following an order issued by the Minister of Education, the personnel of the Observatory dismantled the Doridis telescope and placed the objective lens, the micrometer, the photoelectric photometer and other sensitive components of the telescope in a cave close to the building of the Observatory which had been turned into a shelter for the Observatory's personnel. The Sygros telescope (used for determining time), the Ioannidis and the Ploessl telescope were the only instruments to remain operational.

Note that the Observatory was not fully operational during the 1940-1944 period, initially due to the obligatory conscription of its personnel and then because a unit of the Meteorological Service of the German Navy was installed in the building.

Conditions remained unsuitable for conducting scientific investigations even after the retreat of the Wehrmacht from Athens (6/9/1944). In the area around the Observatory, as in other parts of Athens, fighting erupted, a preamble to the Greek Civil War. The instruments and the books were rescued, yet the buildings were damaged in the firefights. After the end of the civil war (1949), the Observatory resumed its activities, but the economic depression, a result of four years of German occupation and the ensuing civil war, and the necessity to cater for the population’s immediate needs, did not allow any thought of purchasing new instruments, and made the acquisition of a new equatorial refracting telescope of ample dimensions rather unlikely.

Unexpectedly though, the Observatory managed to acquire the “Newall” equatorial refracting telescope, the diameter of which was 63cm, and its Focal length 8.86m. The acquisition happened following an appeal of Professor Plakidis to the University of Cambridge which decided to donate this telescope. (see: Newall refracting telescope)

A. ASTRONOMICAL INSTRUMENTS

1. Small telescope

Manufacturer: Lerebours
Year of manufacture: 1845
Lens diameter: 5cm approx.

This is one of the first instruments of the Observatory, part of the Sina’s donation, made in 1845. It is one of the five small telescopes which the first director of the Observatory, Vouris, brought from Vienna in September 1847; most likely it is one of the two small telescopes which Schmidt refers in his 1864 report, “On the Observatory of Athens”. Currently, it is sited in the dome of the Doridis’ telescope on the hill of the Nymphs.

2. Ploessl (Sinas’) Equatorial Refracting Telescope (type: Fraunhofer)

This instrument is accompanied by six eye lenses allowing 75x to 350x magnification.

Manufacturer: Ploessl, Vienna
Year of manufacture: 1845
Lens diameter: D=162mm
Type of lens: Achromatic
Focal length: f=250cm
Type of support: German equatorial (steel axis)

This is a true historic heirloom of the Observatory. It not only is one of the first instruments that the first Director of the Observatory, G. Vouris, brought from Vienna (and until 1901 the largest telescope of the Observatory) it is also the telescope through which Schmidt, over a period of many years, conducted the observations that led to the drawing of his celebrated topographical map of the Moon. This chart was published in 1876 by the Prussian Academy and contains 30,000 calderas, 2,000 of which were depicted for the first time.

The telescope was in use until 1958, though for long periods of time it remained inoperable due to technical problems and lack of spare parts. It was used for various astronomical observations: of the Sun (particularly during eclipses and for the observation of the Sun's maculae), planetary (in 1879-1880, Schmidt calculated the time of Zeus' circumvolution), observation of comets, and, towards the end of its lifecycle, for observations of solar atmosphere.

Currently, it is "resting" at the Observatory in Penteli -lacking a few inessential parts- directly underneath the mobile floor of the Newall telescope, the other historical telescope of the Observatory of Athens.

3. Starke Meridian Refracting Telescope

Meridian refracting telescope (meridian)

Manufacturer:	Starke, Vienna
Year of Manufacture:	1845
Lens Diameter:	D=94mm

This is one of the first instruments of the Observatory of Athens and formed part of the Sinas' donation. It was displayed in the Vienna exhibition of scientific instruments of 1845. In 1847 the first director of the Observatory, G. Vouris brought it, along with other scientific apparatus, to Athens.

This instrument was mainly used for the exact calculation of time, a daily task in the Observatory. Moreover, it was used to establish the exact latitude of the station.[1]

[1] The term "meridian telescope" or "meridian" is used of telescopes employed in the calculation of the coordinates of a heavenly body. It is comprised of a refracting telescope which bears in it five threads for exact micrometric observations. It revolves around a horizontal axis, vertical to the meridian; as a result, the telescope can only be moved along the level of the meridian. The upper part of the dome has an opening placed so as to allow the observation of all heavenly bodies that lie at the level of the equator, from North to South.The observer, through the simultaneous use of a stellar timekeeper, can determine the exact time at which a stellar body transits the meridian. Next to this instrument, there used to be an angular scale, so that the zenith or polar distance of the body could be ascertained.

When Aiginitis became director of the Observatory, he exerted considerable pressure, which resulted in the Parliament approving the allocation of subsidies amounting to 16,000 drachmas for repairs of the building and the apparatus and for the purchase of new instruments and furniture. Part of this sum was used to acquire a micrometer with micrometric screws for the telescope from the Paris-based optics manufacturing house Gautier. This addition was the most important in a series of improvements made to the instrument in order to render it more functional.

From 1905 onwards, the Starke telescope in essence fell into disuse, since the study on the constants of the Gautier meridian telescope (Sygros meridian), were concluded and this telescope completely substituted the Starke in all measurement tasks. Currently, Starke telescope is fixed in the building of the Observatory on the hill of the Nymphs, still in good condition.

4. The Sygros Meridian Binocular Telescope (Gautier House)

Sygros Meridian telescope.

Manufacturer: P. Gautier, Paris

Diameter: D=15cm

Focal length: f= 2m

It was acquired in 1899 with the money collected by the Fund Raising Committee, which was established in 1896, with the purpose of purchasing various instruments for the Observatory. Andreas Sygros covered the expenses for the acquisition and the installation of the telescope in question.

The Committee obtained the amount of 50,000 golden francs from Sygros, a sum which was used for the purchase of a meridian telescope, its supporting instruments and for the construction of the necessary infrastructure (the buildings that would house it). The order was made to Gautier House in France and its value reached 26,600 golden francs. Loevy, the

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To determine the exact time, the observer needed to consult the astronomical charts of the time, to learn the exact time at which a specific star crosses the meridian of the Greenwich Observatory. He would then place the meridian at the appropriate polar distance (also provided by the charts), so that the star passes through the visual field of the telescope. Next he would wait for the star to enter the visual field and at the time the star moved behind the thread micrometer, the observer would take down the time indicated in the Kessel pendulum. For example, if the time at which the star crossed the Greenwich meridian was 12:00:00 midnight, while in Athens this occurred at 2:00:11, this meant that the pendulum was 11 seconds ahead and that it should be rectified.

director of the Observatory of Paris, who was Aiginitis' close friend, supervised the manufacture of the telescope. The celebrated architect Ziller designed the meridian room and the construction work commenced in December 1896. At the same time, a stellar pendulum, a chronographer and timekeeper for seconds were also ordered to equip the meridian room.

With regard to the type and use of the meridian, the same applies as with the Starke meridian, which it replaced in 1905. Moreover, it is worth noting this it is one of the few instruments of the Athens Observatory, which remained functional throughout World War II and the German occupation, given that it was used for the calculation of time.

In 1963, the Committee on Scientific Surveys of NATO donated the amount of 25,000 USD for the modernisation of the meridian, but this project was cancelled as being too costly.

The telescope ceased to be used prior to 1978, as developments in technology and the progress of telecommunications led to simpler and more precise methods for the calculation of time. Currently, it is sited, in good condition, in the room it has resided in for the past 103 years. Along with the Doridis telescope and the Starke meridian telescope, these instruments undoubtedly constitute the historical heritage of the Observatory of Athens, located on the hill of the Nymphs.

5. Browning Equatorial Reflecting Telescope (Ionidis')

Manufacturer: Browning of London

Year of Manufacture: 1882

Diameter: D=20cm

Focal length: f= 2m

The telescope belonged to Ionidis, a Greek living in London, who donated it to the Observatory in 1891. The telescope was equipped with an astrostat (a mechanism, which moves the telescope so as to compensate for the daily movement of the Earth), as well as a micrometer for double stars. The astrostat had been manufactured according to London's latitude and was converted, with a small cost, for use in the latitude of Athens. It was installed in March 1891 in the only available mobile dome of the Observatory, that of the Ploessl telescope, which was temporarily put out of use due to its "visual weakness and its other imperfections and deficiencies." It was used for various observations, such as stellar and lunar eclipses, the study of the planets, as well as in searches for new comets.

In a measurement conducted in 1950, it was determined that the telescope was capable of observing stars of a 14.2 size. In 1963 the telescope was disassembled so that a triple Heliographer could be put in its place. Currently, the mirror and the tube of the telescope are found in the Penteli Station, while the base and the rest of its accessories are missing.

6. Doridis' Equatorial Refracting Telescope (Gautier House), 40mm

Manufacturer: P. Gautier, Paris

Year of Manufacture: 1899

Lens Diameter: D=40cm

Focal length: f=5.08m

Theoretical limit of resolving power: 0''.3

This is, undoubtedly, one of the classic scientific instruments of the Observatory. It was used continuously from 1901; nowadays, however, the sky over Attica is rather unaccommodating, and thus its use has been restricted to demonstrations for the public. Until 1960, when the Newall telescope was acquired, Doridis' telescope was the largest one in the Observatory.

The telescope was purchased with funds from the Doridis endowment and after many adventures it was placed in a building that was erected especially for it, approximately 150m south of the main building of the Observatory. It was initially installed in the dome of the Ploessl telescope, but the need to construct a new dome soon became obvious (this was constructed in 1905). The Doridis telescope was used for a number of observations. Some of them were simple observations, as well as photographic ones, stellar and lunar eclipses, planets and their transits, comets, asteroids, double stars, artificial satellites, as well as long-term variable stars. During the first half of the 1970s, it was used extensively for the study of solar atmosphere.

In the morning of October 28th, 1940, when Italy declared war on Greece, the personnel of the Observatory disassembled the telescope and moved its most sensitive components (the lens, the micrometer, the photoelectric light-meter) in a small cave close to the building of the Observatory, which had been converted into a shelter for the Observatory's personnel. We do not know the exact date of its reassembly, but it is certain that for a long time, probably throughout the occupation period, it remained dismantled.

Another series of adventures awaited it though after the end of World War II, during the period of the ensuing civil war. On December 4th, 1944, in an engagement between the two combating sides an employee of the Observatory, Anastasios Diamantopoulos, was killed. The mark left by a bullet fired on that day is still visible on the base of the telescope.

In a 1950 article, it is mentioned that the stellar size that could be observed with the telescope in question is 15.2. This is indicative of the quality of the atmosphere over Athens at that period – it suffices to note that today the magnitude that can be observed with the Newall (the lens of which has a 63cm diameter as compared to the 40cm of Doridis' telescope) can with difficulty reach 13, on a clear night.

After 1968, Doridis' telescope gradually fell into disuse; this was due to the increasing light-pollution over Athens, but also because the Newall telescope superseded it. Some of the last observations were made in 1970 and were aimed at the Sun, since it is the only heavenly body the observation of which is not significantly affected by the atmospheric pollution.

7. Newall Equatorial Refracting Telescope

Manufacturer: T.Cooke & Sons, York & London

Date of Manufacture: 1869

Lens Diameter: 62.5 cm

Focal length: 8.86m

Indubitably, the Newall telescope is the most impressive instrument of the Observatory of Athens, and at the same time, one of the most historic ones, since it is 134 years old. It was named after Robert Stirling Newall (1812-1889), an amateur astronomer, who, due to his successful entrepreneurial activities in the field of steam engines and telegraphic wires, became rather affluent. He was introduced to amateur astronomy by his brother-in-law, Hugh Lee Pattinson, F.R.S, who was an amateur astronomy aficionado. It was probably during this period that the idea to manufacture the telescope, which is currently sited at the Penteli Station, occurred to him.

In 1862, Newall discovers by change two large-sized crystals made of crown and flint glass, produced by Chance of Birmigham. He bought these and entrusted T. Cooke and Sons with the construction of the biggest refracting telescope of its time.

Cooke was born in 1807 in Allerthope, Yorkshire. He was born to a poor family and, having first to overcome many difficulties, managed to study mathematics and optics. At the age of 22 he manufactured his first achromatic lens. This success led him to establish a small optics firm in York.

His meticulous, high-quality work made him famous. It was natural that Cook would accept Newall’s challenge and take up the task of constructing such a telescope, which would be the largest in the world. Cooke promised that he would have it ready within twelve months. He faced, however, tremendous difficulties, and in 1865 only the telescope's lenses were ready. While the whole project suffered many setbacks, Cooke passed away in 1868. The telescope was completed a year later by his sons.

The lens is 25 inches in diameter (62.5 cm). Its tube is cigar-shaped and it is approximately 9 meters long. The whole construct weighs 9 tons. It is equipped with three finder telescopes, two of which have a 10cm diameter and the third one a 15cm diameter. The instrument is so evenly balanced that, despite its weight, it can easily be moved by the observer. Its base is of German type, with hefty counter-weights, aiming circles and offers the ability to make fine adjustments of height and azimuth for its exact orientation.

Unfortunately, for a variety of reasons, Newall himself did not used the telescope much. His son, Hugh Frank Newall, soon rectified this situation. Wishing to see the telescope to fully utilised he made an offer to the University of Cambridge. He offered to assume the necessary cost, and to work for five years without payment as the main observer responsible for the telescope, provided that the University would provide him with a plot close to the telescope where he could build his residence. The University accepted his terms and the telescope moved to Cambridge at the end of 1891.

From that year onwards and until 1911, Newall conducted a remarkable series of observations, mainly spectroscopic ones, with brilliant results. F.J.M. Stratton continued his work after 1911 and the telescope knew days of glory until 1930, when it gradually became outdated as more advanced instruments appeared. Thus by the 1950s, it was hardly used and its future appeared gloomy. Its dome was defective by construction and due to its prolonged usage, it was rather hard to use. Given the situation, the management of the Observatory at Cambridge decided to donate the telescope to any Observatory that would be interested in having it.

The National Observatory became aware of this in 1955 and a team of scientists was sent to Cambridge in order to evaluate the Newall. The Greek scientists decided that the telescope, though not utilised systematically, did not appear disused. On the contrary, its appearance indicated that its maintenance was continuous. Its mechanical parts were in extremely good condition.

In terms of optics, the telescope was one of the best in its kind, a fact certified by leading scientists of the time. And if the Newall telescope was old, the chance to acquire it could not be ignored as it was one of Europe's most powerful refracting telescopes, and would therefore become a valuable asset. Given the financial condition of the Greek State and the gigantic expenditure that would be required for the purchase of a new telescope of comparable dimensions, we should consider the donation of the Newall telescope as a valuable and unhoped-for acquisition.

Thus in 1957, the final decision to accept the donation was taken and the area of the "Koufos" hill was designated for the installation of the Newall telescope. Then, a fundraise was held in order to cover the cost of its disassembly and its transportation to Greece. The telescope was shipped to Piraeus, reaching the port in the summer of 1957 and was subsequently transported in 11 massive boxes to Penteli, where it was stored pending the construction of the dome which would house it. It was decided that the construction works for the building of the telescope would be financed with funds from the budget of the Ministry for Education. The architect B. Kassandras drew up the architectural plan in accordance with the recommendations of Prof. Plakidis. The construction of the building started on September 14^{th}, 1957 and the works on the dome on May 4^{th}, 1958.

The building that was erected contains, on the ground floor, two offices for the personnel on either sides of the main entrance; further inside one finds rooms reserved for various purposes, as well as small lecture room. At the centre of the ground floor stands a 5m tall concrete pyramid, on which the telescope rests. The observations are facilitated by a mobile floor, which can move vertically for approximately 5m, assisted by an electric mechanism installed in the concavity of the pyramid and by six makeweights, which slide into concavities in the wall. The rotating hemispheric dome that crowns the building has a 14m diameter. Special electrical motors power its rotation, the opening and shutting of the wicket (4m in width), as well as the movement of the floor. These motors are operated from any point within the dome via a remote control situated on a movable table. At the end of 1958, the Newall telescope had been reassembled and was ready for use.

Indeed, a number of observations were made in the years to follow. We could mention comet, asteroid and variable star observations, as well as observations for the determination of the brilliance and the position of artificial satellites. Many photographs were also taken: the Sun's atmosphere, the surface of Zeus and Aphrodite (Planets Programme, part of the international co-operation programme of Committee 16 of the International Astronomy Association).

From 1970 onwards, the Newall telescope was not used for key observations any more, mainly due to the growing light-pollution over Athens, but also due to the fact that a new station was built, the Station at Kryoneri, which boasted a larger and more modern telescope. During the past years, it has been mainly used to provide educational demonstrations to the public.

8. Zeiss Equatorial Reflecting Telescope, 110mm

Manufacturer: Carl Zeiss
Year of Manufacture: not known, approx 1900
Diameter: D=110mm

This telescope came to Greece in 1923, as part of the World War I war compensations offered by the German government, and belonged to the Physics laboratories of the University of Athens, which subsequently gave it to the Observatory in 1939. It was immediately placed at the Penteli station. The telescope was returned to the University of Athens sometime during the 1970s - the exact date is uncertain.

The telescope had come from Germany lacking many parts, yet the astronomers of the Observatory managed to use it in a series of observations: magnetic observations of the Sun, the study of its maculae and their relation to the magnetic phenomena; photometric observations of the Moon; photometric observations of variable stars for a prolonged period of time; and finally, optical observations of Mars, Zeus, Saturn, the Moon and the Sun, as well as of asteroids. Moreover, lunar and solar eclipses were observed, while the telescope also travelled to Spetses in 1961 in order to photograph a total solar eclipse.

9. Jacob-Mertz Equatorial Refracting Telescope (Mitsopoulos')

Manufacturer: Jacob-Mertz House, Munich, Germany
Year of Manufacture: unknown, second half of the 19th century.
Lens Diameter: D=80mm

M. Mitsopoulos, Professor of Geology and Palaeontology, donated the telescope to the Astronomy Laboratory in 1939. The telescope is equipped with a tripod made of ebony and a brass parallax axes system. For a number of years it was used for solar observations. Currently, it is situated at the Penteli Station.

10. Bardoux Equatorial Refracting Telescope

This is Plakidis' equatorial refracting telescope, which was placed at the disposal of the Observatory from 1936 onwards to cater for the needs of the newly established Penteli Station.

Manufacturer:	Bardoux, France
Year of Manufacture:	sometime between 1910 and 1915
Diameter:	D=162mm
Focal length:	f=2, 10m
Resolving power:	0''.66

The telescope was initially installed in the newly built dome of the station in 1938. In the following year, it was transferred to a wooden shelter, since the 110mm Zeiss replaced it. There are no further mentions its usage. The arrival of the Zeiss telescope, the fact that the Bardoux telescope belonged to Plakidis, as well as that World War II broke out, possibly lead to its gradual fall into disuse.

Only the lens and tube of the telescope currently exist (these are found at the Penteli Astronomy Station), while the base of the telescope and several of its accessories are still missing.

11. Carl Zeiss 80mm Meridian Reflecting Telescope

Manufacturer:	Carl Zeiss
Year of Manufacture:	unknown
Diameter:	D=80mm
Focal length:	f=110cm
Serial Number:	9736

This telescope is found at the Penteli Astronomy Station. It is an instrument that belonged to the Hydrographic Service of the Greek Navy and was given to the Penteli Station, along with other apparatus, as a loan, when the Station was established in 1937.

It is robustly built (it is the only telescope of its size in the Observatory which has a metal tripod) and its relatively small size made it the telescope of choice for in field missions. It could rightly receive the title of the most globetrotting of the Observatory's instruments.

It was indeed used for missions in 1936 (Lavrio), 1952 (Sudan), 1961 (the Dalmatian coast) and 1966 (Spetses), always for the observation of solar eclipses. Moreover, it was used for the observation of planets, the Moon and eclipses.

12. Zeiss Asiola Terrestrial Binoculars

Manufacturer: Carl Zeiss – Asiola

Year of Manufacture: unknown

Serial Number: 2559

Lens Diameter: D=60mm

These were possibly owned by an old employee of the Observatory, or a came from non-recorded donation of a private individual to the Observatory. The sole reference mentioning these binoculars is linked to the long-term observations of irregular variable stars made in 1956 from the hill of the Nymphs. Anyway, these are a pair of terrestrial binoculars and not a telescope suitable for astronomic observations. Currently these are to be found at the Penteli Astronomy Station.

13. Filar micrometer and photometer

Fibril micrometer manufacturer: Gautier, Paris

Photometer manufacturer: unknown

Year of manufacture of the fibril micrometer: 1891

Year of manufacture of the photometer: approximately 1930, it was donated by Dr. J.S. Hall

When Aiginitis became director of the Observatory, he exerted substantial pressure which resulted into the Parliament approving the amount of 16,000 drachmas for repairs on the building and the instruments and purchase of new scientific apparatus and furniture. A portion of the aforementioned amount was used to purchase a micrometer with micrometric screws for the Starke meridian telescope; these were bought from Gautier optics stores, a chain in Paris. At present, these are to be found at the Penteli Astronomy Station.

14.Theodolite

Manufacturer: unknown

Year of manufacture: 1905

Dimensions: length=24cm, width=28cm

Base diameter:9cm

This is a portable instrument, used in astronomy, topography and geodesic work, as well as for the measurement of angles on a horizontal and vertical level. It is found at the Penteli Station. It comprises of a binocular which ‘aims’ at the object, of which the angle against the horizon or the meridian is to be measured, and from two discs bearing measurements; one of them is horizontal and the other one vertical for the calculation of the relative angles. It is also equipped with a compass. The horizontal position of the instrument is secured by two vertically placed glass rings, which contain liquid and vesicles, like those of spirit level. One of these is attached to the binoculars. Three screws on the base of the instrument control the adjustment of its horizontal position.

15. Theodolite for the observation of artificial satellites

Manufacturer: David White Company, Wisconsin
Year of manufacture: about 1958
Type: ML-47-C

It is found at the Penteli Station from October 1958 onwards. It was donated to the Observatory, along with another theodolite, by the US Air Research and Development Command through the American Embassy in Athens to be used for the observation of artificial satellites.

Its use is similar to that of the theodolite described above. The reading of the angles is made possible through two magnifying glasses that are also equipped with a small lamp for night use, a feature particularly useful for the observation of artificial satellites. The lamps are powered by two 1.5V batteries. We ought to mention the solid manufacture of the instrument, indicative of the quality of military equipment.

16. Kessels Pendulum

This is a pendulum clock with a Kessels stellar time resistance system. Along with the Berthoud and Fenon pendulums (the latter from 1900 onwards) for a number of decades these were the basic instruments used in the calculation of time in Greece.

Manufacturer: Kessels, Vienna
Year of Manufacture: 1845

This is one of the first instruments of the Observatory. It was part of Sina's donation made in 1845. G. Vouris, the first director of the Observatory, brought it to Greece in the September of 1847.

The Kessels pendulum, along with the Berthoud, were used for the determination of time (along with the Starke, and later on the Sygros meridians), as well as for the making adjustments on all the timekeepers, both civilian and military (i.e. timekeepers used on the Greek Navy's vessels).

In 1909 it was placed in the dome of the Doridis equatorial telescope (which had just been built) and was used for equatorial observations. It can still be found at that place. The fate of the Kessels pendulum ever since been linked with the Doridis telescope and it thus fell into disuse in the 1970s.

17. Dallmeyer Photographic Chamber

Manufacturer:	Dallmeyer
Diameter:	D=5.5cm
Focal length:	f=34cm
Diaphragms:	f/6-f/64
Type of lens:	Dallmeyer Stigmatic

The Ottawa Canada Observatory (Dominion Observatory) donated it to the Observatory, along with another chamber in 1951. It is currently found at the Penteli Station.

The chamber is affixed on the tube of the Observatory's telescopes in order to take photos that capture the visual field of the telescope. It is not attached on the ocular, that is, it does not take pictures through the telescope, but through its own lens. The chambers were used during solar and lunar eclipses. Their compact size renders them appropriate for use in field missions, such as the 1961 expedition at Hvar island, off the coast of Dalmatia, whose scope was the observation of a total eclipse of the Sun.

18. Birefrengent micrometer

Manufacturer:	Société d'Études et de Construction d' Appareillages Scientifiques et Industriels, Bordeaux
Year of Manufacture:	1956

It was initially destined for the Doridis telescope, on which it operated for three years, but it was subsequently mounted on the Newall telescope. It was used for observations of double stars and the collection of data from the atmosphere of Venus. It is currently placed at the Penteli Station.

19. Dipleidoscope

Manufacturer: Ploessl, Vienna
Year of Manufacture: Possibly 1845

This is possibly one of the first instruments of the Observatory, and formed part of the Sina donation (1845. Currently, it is found at the dome of the Doridis telescope, on the hill of the Nymphs.

20. Model of the Solar System

This is a rudimentary model of the Earth-Sun-Moon system. A candle is placed in the centre to represent the Sun and with the help of a crank the whole system rotates, simulating the movements of the three bodies. The shadow of the Moon falls on the Earth and vice versa, thus demonstrating how eclipses occur. Unfortunately, no inscription on the model and no reference in the bibliography indicate the manufacturer, the year of manufacture or the how it came to the Observatory. Currently, it is found in the dome of the Doridis telescope, on the hill of the Nymphs.

21. Case with a micrometer and ocular lenses

Manufacturer: Casella
Year of manufacture: about 1860

Six ocular lenses with a 75x up to 350x magnification are mentioned.

Probably was used together with the Zeiss 80mm telescope, which was on loan to the Observatory since 1937 from the Hydrographic Service of the Navy and was finally donated to the Observatory in 1961.

22. Octant

Manufacturer: Hughes of London
Year of Manufacture: unknown

Currently, it is found at the Penteli Station. Unfortunately, there is no relevant reference in the available bibliography as to its provenance or use in the Observatory. Its case bears the contact details of a nautical instruments house in Marseilles, from where it was probable purchased. It belonged to Palaskas, director of the first Greek naval school.

23. Nautical timekeeper

Manufacturer: Ulysse Nardin, Switzerland
Year of Manufacture: 1968
Serial Number: 9895

Along with the sextant, the nautical timekeepers were once essential equipment for determining the position (latitude) of ships. This was calculated by the difference between the observed time of transit of an orb from the meridian of the specific place and the time indicated by the timekeeper, which was Greenwich Time. They were always placed in a special case for protection against humidity and the readings are taken through a glass-covered hole, without opening the case. Aided by a special mechanism, they rotate freely, so that they always remain horizontal. When the timekeeper is not used, a wedge is placed to prevent unnecessary movement. Currently, it is stored at the Penteli Station.

24. Timekeeper

It is found in the dome of the Doridis telescope at the hill of the Nymphs.
Maker: Fenon of Paris.
Year of Manufacture: 1896

This is an instrument that was purchased with the funds gathered by the committee for the collection of donations, which was established in 1896. Along with the Fenon stellar pendulum of the Sygros meridian circle (for the meridian room) and a second time keeper (unaccounted for), the purchase order for the specific piece of equipment was placed with the director of French National School of Horology at Besancon. The timekeeper is used for the exact measurement of the time spent on an astronomy observation.

The timekeeper comprises of a winding mechanism, which moves a paper tape cylinder at a stable angle speed. A pin linked to a pulsating tuning fork traces a sinuous curve on the cylinder, the wavelength of which corresponds to the known wavelength of the tuning fork. With the push of a button (shown on the right side of the second picture), the operator of the timekeeper activates the second pin, and thus the pin traces a straight line, parallel to the first one. By pressing the button once more, the pin stops. By measuring the wavelengths between the two ends of the segment, written by the second pin, the operator can determine the time lapse between the activations of the button; the accuracy of the process depends on the frequency of the tuning fork (which is often more than a hundredth of a second).

B. Meteorological instruments

25. Self Registering Barograph

Manufacturer: Jules Richard, Paris
Year of Manufacture: unknown
Dimensions: Height: 15cm, Width: 11cm

It is found at the Penteli Astronomy Station. This instrument belonged to the Hydrographic service of the Navy and was loaned (and later on donated, along with other instruments) to the Penteli Station when it was founded, in 1937.

A special mechanism, employing a pin, records the barometric pressure on a millimetre paper wrapped around a revolving drum. The rotation of the drum is made possible through the use of a winding mechanism, and once winded it can operate for a week.

26. Fortin Mercury Barometer

Year of Manufacture: 1899

The Observatory obtained eleven such barometers in 1899 for its meteorological stations all over Greece. The other ten are unaccounted for. Twenty empty tubes for these instruments were purchased in 1902, to be used as replacement parts. This instrument is placed in the dome of the Doridis telescope on the hill of the Nymphs.

C. Other Instruments

27. Precision Scales

Manufacturer: unknown
Year of Manufacture: 1899

The Observatory acquired two such scales in 1899. One of these instruments is missing. The remaining set of scales is currently found at the Penteli Astronomy Station.

28. Clinometer

Manufacturer: unknown
Year of manufacture: unknown

It is used for measuring angles of inclination or slope. Today it is found at the Penteli Astronomy Station.

Comments-conclusion

Reading this presentation of Athens'Observatory historic scientific instruments one could reasonably wonder whether these instruments were used in the most productive way; that is, were these employed in innovative research programmes? Did these contribute to the making of scientific discoveries? If not, why?

The reply to the first two questions is a plain no. Apart from individual observations of heavenly bodies, the only systematic research projects carried out until 1950 were Schmidt's lunar map, and the calculation of the exact time with the Starke and Sygros meridians and the Kessel, Berthoud and Fenon pendulums. The map of the Moon was certainly a project that brought international recognition to the Observatory while the calculation of time, irrespective of how important this may be in the context of an organised state, is evidently a routine task.

It is telling that the Doridis telescope -which along with the Sygros meridian circle were the only two instruments of the Observatory featuring state-of-the-art technology at the time of their acquisition- was never used in any organised observation project. It could, for example, have been exploited for the charting of the night sky (the way it was manufactured rendered it suitable for stellar photography), a project co-ordinated by the Paris Observatory.

After 1950 and until the end (1960s) of the period examined herein, the Observatory participated in three research projects: the artificial satellites programme, the Planets programme and the programme for the observation of the Sun. The first two cannot be considered as pioneering. At any rate, these were organised observation programmes with well-defined objectives. The most interesting programme, from a research point of view, is that for the observation of the Sun, which is perhaps the most appropriate scientific research to be conducted in a country as sun-drenched as Greece! The situation has changed during the past 30 years and the Observatory has been organising or participating in a series of scientific projects.

But what were the reasons behind the Observatory's meagre scientific output during this period? We may attempt to provide a few suggestions:

1. The Observatory, contrary to what its name suggests, was not -and still is not- wholly devoted to research in the field of Astronomy, but also -and perhaps more significantly- to those of Meteorology and Seismology. That is to say that after its establishment it was obliged to allocate part of its resources and personnel to meteorology and seismology tasks, which were more 'useful' to Greek society than the 'remote' and 'theoretical' pursuits of astronomy. This prioritising resulted in limiting systematic astronomic observation to the absolutely essential tasks (i.e. the calculation of time). The map of the Moon was the product on one man's singular passion and not the result of a sustained scientific research effort.
2. If the Observatory's sole mission had been astronomical observation, its resources (human, equipment and funds) would have proved woefully inadequate. The appeals of its directors for subsidies to overcome its chronic and severe functional problems are revealing. We must also stress that G. Vouris was, in essence, the entire personnel of the Observatory. This was also true in the cases of Schmidt and Kokkidis. There were no experienced or specialised personnel, able to conduct precise and systematic observations. Even during Aiginitis' direction, the assistants were usually Navy officers on secondment. Under those circumstances, it seems remarkable that even this poor scientific work was carried out.

3. The finances of the Greek State did not allowed for the organisation of an Observatory along the lines of its European counterparts. The unfortunate war of 1897, the Balkan wars, World War I and the devastation which followed Greece's defeat in Asia Minor, threw Greece in such a state that no thought of subsidising research in Astronomy could be entertained seriously. The adventures of the Korgialenis' endowment are characteristic, as is the fact that Plakidis expressed his contentment when the Observatory acquired the Newall telescope, an 80-year old instrument!

4. A less obvious, and yet significant, reason is that the procurement of certain instruments (especially the larger telescopes) was more an issue of status, both for the Observatory and the Greek State, rather than a need that resulted from the demands of specific scientific projects.

5. Finally, it is evident that although Aiginitis was clearly the most organising and effective Director of his time, he was not an experienced observer – let us not forget that his thesis was of a theoretical orientation. As a result, he did not conduct any systematic observations, despite the fact that, at that period more than ever, the instruments available to him and the organisation of the Observatory favoured such activities.

At any rate, it ought to be noted that the suggestions contained herein are estimations, which need to be pursued further.

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