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The Foucault Pendulum of the Phanar Greek Orthodox College in Istanbul: The First in Istanbul?

İstanbul Fener Rum Ortodoks Lisesi'nin Foucault Sarkacı: İstanbul'da Bir İlk mi?

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ABSTRACT

Foucault's pendulum is one of the most important scientific achievements of the French physicist Léon Foucault. The performance of the experiment in 1851 was the first tangible proof of the Earth's rotation. The relative technical simplicity and beauty of the experiment led to many repetitions of it, the manufacture of related pendulums by scientific instrument manufacturers, and the permanent or temporary installation of such pendulums in educational institutions for teaching as well as aesthetic reasons.

The Phanar Greek Orthodox College in İstanbul is the oldest operating school of the city's Greek community. After many moves during the first four centuries of its operation, the College found a permanent home in an impressive privately owned building in Fener in 1881. The building hosts a rich collection of scientific instruments, acquired mainly in the last quarter of the 19th century by French manufacturers and at the beginning of the 20th by Germans and Austrians. In 1912 special changes were made to the building to house a Foucault pendulum which was manufactured by the German company Max Kohl. This paper presents the history of this device, which is one of the first (perhaps the first) used in the Ottoman Empire.

Keywords: Foucault pendulum, Phanar Greek Orthodox College, Max Kohl, Istanbul, Physics, Greek School

ÖZ

Foucault sarkacı, Fransız fizikçi Léon Foucault'nun en önemli başarılarından biridir. Bu alet ile 1851 yılında gerçekleştirilen deney, Yer'in döndüğüne ilk somut kanıtı getirmiştir. Deneyin teknik basitliği ve güzelliği çok kere tekrarlanmasına ve bilimsel alet yapımcıları tarafından çok sayıda sarkacın üretilmesine sebep olmuştur. Böylelikle sarkaçlar, gerek öğretim amaçlı olarak gerekse estetiği sebebiyle eğitim kurumlarında kalıcı veya süreli olarak yer bulmuştur.

İstanbul'daki Fener Rum Ortodoks Lisesi, Rum toplumunun bu şehirde faaliyette bulunan en eski okuludur. Kuruluşunu izleyen ilk dört yüz yıl içinde çok kez yer değiştiren okul, 1881'den beri Fener semtinde, özel mülk olan

heybetli binasında eğitim vermektedir. Okulun çok zengin bir bilimsel alet koleksiyonu vardır. Aletlerin büyük kısmı 19. yüzyılın son çeyreği Fransız ve 20. yüzyıl başı Alman ve Avusturyalı üreticilerinin elinden çıkmıştır. Aralarında, Alman şirketi Max Kohl tarafından üretilen ve 1912'de satın alınan bir Foucault sarkacı vardır. Aletin gelmesiyle okulun binasında özel değişiklikler yapılmıştır. Bu çalışma, Osmanlı İmparatorluğu'ndaki ilk sarkaç olabileceğini düşündüğümüz aletin hikâyesini sunmaktadır.

Anahtar sözcükler: Foucault sarkacı, Fener Rum Erkek Lisesi, Max Kohl, Istanbul, Fizik, Rum okulu.

The Foucault Pendulum

The Foucault pendulum is a device that demonstrates the rotation of the Earth. It was invented by French physicist Léon Foucault (1819-1868) and presented in 1851[1] in the Panthéon in Paris.[2] The experiment involved suspending a long pendulum with a heavy weight (bob) at the end from a fixed point. When the pendulum was set in motion, it swung back and forth in a straight line, but over time, the plane of the swing appeared to rotate clockwise or counterclockwise, depending on the hemisphere in which it was located. This is because the swing plane of the pendulum was not affected by the rotation of the Earth, which causes the apparent rotation of the plane as it is seen by an observer on Earth.[3]

To conduct the experiment, a tall, free-standing structure was needed, such as a tower, or the inside of a large dome. The pendulum should be long enough to allow for a clear rotation of the swing plane over time, typically no more than 10m in length, in order to oscillate for hours without significant loss of amplitude. [4] The weight at the end of the pendulum should be heavy enough in order to maintain high kinetic energy and the oscillation for a long period of time, but be light enough to have reduced volume and consequently a reduced cross-sectional area in the direction of motion to avoid excessive air resistance.

It is important that the swing of the pendulum is carried out on a vertical plane. To ensure this happens, it is necessary to bring the bob to rest at some point out of balance by means of a thread, which is then burned to start the oscillation. The plane of the swing can be marked with chalk or another visible material to track its rotation over time. To maximize the effect, the pendulum should be allowed to swing for several hours or even a full day. The rotation of the swing plane is more pronounced at locations closer to the poles. At the equator, there is no rotation of the swing plane.

After Foucault conducted the experiment, it was repeated in Reims, Amiens, Cologne, St Jacques and elsewhere. The educational value of the experiment led to the installation of

1 Léon Foucault, "Démonstration Physique du Mouvement de Rotation de la Terre au Moyen du Pendule," *Comptes Rendus de l'Académie des Sciences* 32 (1851): 135-138.

2 William Tobin and Brian Pippard, "Foucault, his Pendulum and the Rotation of the Earth," *Interdisciplinary Science Reviews* 19, 4 (1994): 326-337.

3 For further information on the reason the Foucault pendulum is considered to be an experimental demonstration of Earth's rotation see Alicia Ault, "How Does Foucault's Pendulum Prove the Earth Rotates?," *Smithsonian Magazine*, accessed April 24, 2023, https://www.smithsonianmag.com/smithsonian-institution/how-does-foucaults-pendulum-prove-earth-rotates-180968024/
For an early mathematical theory about Foucault pendulum see: Rev. J. Challis, "A Mathematical Theory of M. Foucault's Pendulum Experiment," *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science* 3, 19 (1852): 331-334.

4 H. Richard Crane, "The Foucault Pendulum as a Murder Weapon and a Physicist's Delight", *The Physics Teacher* 28, 5 (1990): 268. Foucault used a pendulum with a length of 67m and a bob with a weight of 28kg.

pendulums in universities and schools everywhere[5] and made this pendulum an essential tool for physics teachers.[6] For the same reasons many instrument makers included some version of the Foucault pendulum in their catalogs.

During the 20th century shorter versions of the pendulum, usually driven electrically to maintain their amplitude, were installed in museums and educational settings.[7] Two well-known Foucault pendulums still working today are in the UN Headquarters in New York, a gift from the Netherlands in 1955[8] and the other one is in an exhibit in the Deutsches Museum in Munich.[9]

The Phanar Greek Orthodox College and its Collection of Scientific Instruments

The Phanar Greek Orthodox College (Fener Rum Erkek Lisesi in Turkish and Πατριαρχική Μεγάλη του Γένους Σχολή in Greek) was founded shortly after the fall of Constantinople, in 1454, by the Patriarch George Gennadios Scholarios. After many adventures, the College acquired its own building at the top of a hill in the Fener district of İstanbul in 1882. Expenses were met by donations from the renowned banker of the time Georgios Zarifis (1810-1884) and the Vatopedi Monastery on Mount Athos. The impressive building, by architect Constantinos Dimadis (?-1901), has a characteristic color which it owes to the red bricks from which it is built, and which make it a unique piece of architecture.[10] This is why the school is well known, especially among the locals, as the "Red School".

Until the 19th century, the curriculum of the College was clearly oriented to classical education (ancient Greek and Latin literature, theology, philosophy) since most of the enrolled students were to become clergymen. The social and economic changes in the Greek community during the Ottoman Empire gradually caused changes in the curriculum from the start of the 19th century and then a little faster after 1850.[11]

5 For an example, see Westropp Roberts, "A Foucault Pendulum at Dublin," *Nature* 51 (1895): 510-511.

6 Crane, "The Foucault," 264-269.

7 For some examples see: Haym Kruglak, Larry Oppliger, Rene Pittet, and Stanley Steele, "A Short Foucault Pendulum for a Hallway Exhibit," *American Journal of Physics* 46 (1978): 438-440; Byron E. Leonard, "A Short Foucault Pendulum for Corridor Display," *The Physics Teacher* 19 (1981): 421-423.

8 "United Nations Gifts," accessed January 12, 2023, https://www.un.org/ungifts/foucault-pendulum ; "UN Photo Digital Asset Management System," accessed January 12, 2023, https://dam.media.un.org/CS.aspx?VP3=DamView&VBID=2AM94S7SH9_C&PN=1&WS=SearchResults&FR_=1&W=1280&H=577

9 "Foucault's Pendulum – See the Earth Rotate," accessed January 12, 2023, https://www.deutsches-museum.de/en/museum-island/exhibitions/foucaults-pendulum

10 Σάββας Τσιλένης, "Η Μεγάλη του Γένους Σχολή στην Κωνσταντινούπολη και ο αρχιτέκτονάς της Κωνσταντίνος Δημάδης", *The World of Buildings* 16 (1998): 100-112.
Σάββας Τσιλένης, "Το κτίριο της Μεγάλης του Γένους Σχολής και ο δημιουργός της Κ. Δημάδης" (Proceedings of the Fourth Conference Πατριαρχική Μεγάλη του Γένους Σχολή. Ιστορία και προσφορά, Εταιρεία Μελέτης της καθ' ημάς Ανατολής, Αθήνα, 2004: 323-366);
Mine Esmer, Ömer Dabanlı, Ruba Kasmo, Lana Kudumovic, Aynur Çiftçi, and Selcen E. Cesur, "Mekteb-i Kebir ya da Kırmızı Mektebi Belgelemek," *Mimar.ist* 22, 74 (2022): 72-82.

11 For example, the course of physics was introduced in the academic year 1851-1852.

This slow but steady change is clearly highlighted through the creation of a rich collection of more than 300 scientific instruments for teaching physics and chemistry.[12] The instruments were acquired in less than twenty years through donations, like that of twenty-two instruments by the imperial architect Hadji-Stefanis Gaitanakis in the academic year 1865-1866.[13] The next year another ninety instruments were bought with money raised by various donations. In the academic year 1878-1879 the College bought about sixty second-hand instruments from Ελληνικό Λύκειο, a Greek private school in Péra (Beyoğlu), İstanbul facing serious economic problems. [14] In the academic year 1880-1881[15], the construction of a new building at the College was accompanied with the collection of a significant amount of donations for a new physics laboratory. This led to the purchase of 142 new instruments from various French makers. [16]

The collection continued to be enriched through the first half of the 20th century as well. Around 1910-1913 the College bought a few instruments made mainly by the German company "Max Kohl" (among which were the instruments in question in this study), but also by the Austrian company "W.J. Rohrbeck's Nachfolger". Finally, a set of instruments from the USA Company CENCO were donated to the College in 1949-1950 by Stefanos Stefanidis, a Greek shipping tycoon living in New York.[17] The value of the donation was equal to 20.000 Turkish pounds (*kuruş* or *liras*)

Changes to the Building and Purchase of Instruments During the Academic Year 1912-1913

The director of the College, Mihail Kleovoulos, in his report about the College's activities during the academic year 1912-1913, stated that during this year improvement works were carried out in the College's building, among which some related to the so-called "dome of the Observatory" as well as the experimental physics classroom.[18] We believe that among the work carried out in the dome was the installation of a hook in one of the horizontal wooden

Τάσος Γριτσόπουλος, *Πατριαρχική Μεγάλη του Γένους Σχολή*, Vol.2, (Αθήνα: 2004), 176.

12 Panagiotis Lazos, George N. Vlahakis and Constantine Skordoulis, "Instruments and Laboratories in the Schools of the Greek Community of Istanbul, 1850–1960," in *Scientific Instruments between East and West*, ed. Neil Brown, Silke Ackermann, and Feza Günergun (Leiden: Brill, Brill, 2020), 168-86.

13 Ευστάθιος Κλεόβουλος, *Λογοδοσία περί του σχολικού έτους 1856-1866 της εν Κωνσταντινουπόλει Μεγάλης του Γένους Σχολής,* (Εν Κωνσταντινουπόλει: Τύποις Ανατολικού Αστέρος, 1866), 30.

14 Γρηγόριος Παλαμάς, *Έκθεσις της πνευματικής και υλικής καταστάσεως της Μ. Του Γένους Σχολής, κατά το σχολικός έτος 1878-1879*, (Εν Κωνσταντινουπόλει: Τύποις Ανατολικού Αστέρος, 1879), 145-150.

15 Γρηγόριος Παλαμάς, *Έκθεσις της πνευματικής και υλικής καταστάσεως της Μ. Του Γένους Σχολής, κατά το σχολικόν έτος 1880-1881*, (Εν Κωνσταντινουπόλει: Πατριαρχικό Τυπογραφείο, 1881), 168-174.

16 Γρηγόριος Παλαμάς, *Έκθεσις της πνευματικής και υλικής καταστάσεως της Μ. Του Γένους Σχολής, κατά το σχολικόν έτος 1879-1880,* (Εν Κωνσταντινουπόλει: Πατριαρχικό Τυπογραφείο, 1880), 114.

17 *Έκθεσις των πεπραγμένων εν τη Μ. Σχολή κατά το σχολικόν έτος 1949-50*, (Φανάριον, 1950), 5-6.

18 Μιχαήλ Κλεόβουλος, *Έκθεσις των πεπραγμένων εν τη Πατριαρχική Μεγάλη του Γένους Σχολή κατά το σχολικόν έτος 1912-1913*, (Εν Κωνσταντινουπόλει: Τύποις Αδελφών Γεράρδων, 1914), 31. It is noted that the experimental physics classroom is located directly under the "dome".

beams (Image 1) and the construction of a hatch connecting the floor of the “dome” to the ceiling of the experimental physics classroom (Image 2).

Image 1. The hook for suspending the pendulum (Photo: D. Papinis)

The red line on image 3 represents the distance between the hook in the dome and the floor of the experimental physics classroom. This distance is 12.1m therefore the length of the Foucault pendulum should be something less than that. Apart from changes in the building, Kleovoulos wrote in the same paragraph that necessary additions were made to the collection of physics instruments and the natural history museum. No further information is given on the type of additions. However, we certainly believe that a part, if not the whole, of the approximately twenty-five instruments and devices manufactured by Max Kohl (see Appendix), surviving in the College were purchased then.

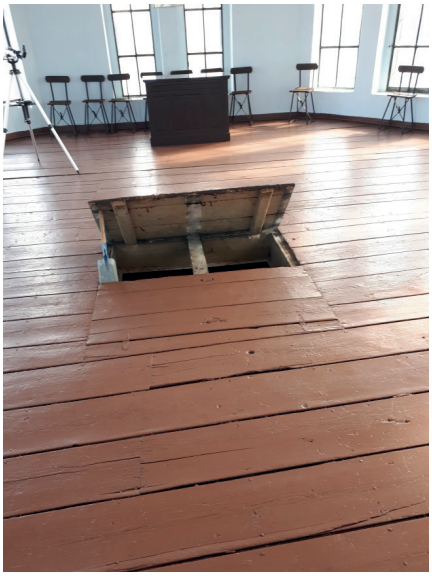

Image 2. The hatch for the pendulum (Photo: D. Papinis)

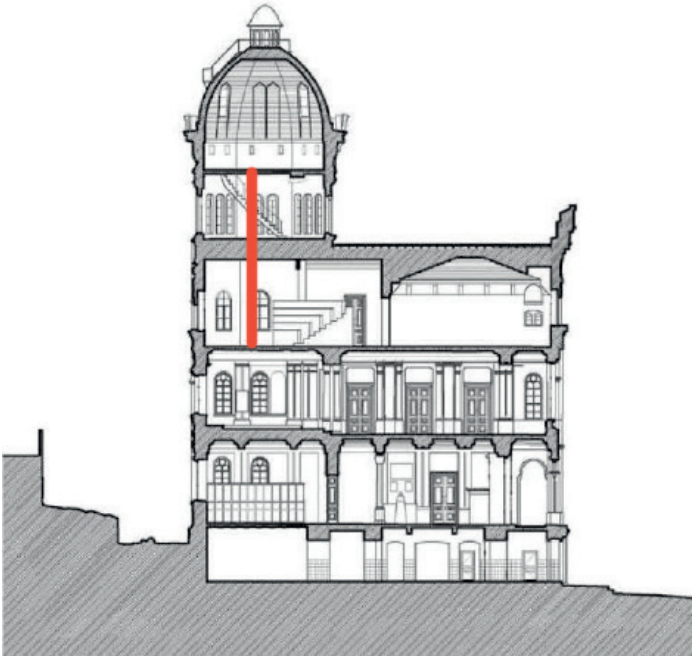

Image 3. The position of the Foucault pendulum in the College building.[19]

19 Esmer, Dabanlı, Kasmo, Kudumovic, Çiftçi, and Cesur, "Mekteb-i Kebir ya da Kırmızı Mektebi Belgelemek," 75.

The Pendulums of the College's Collection

Among these instruments there are two related to Foucault's pendulum.[20] The first is not really a Foucault pendulum, as it has a short thread length and a small mass; it's rather a model to demonstrate the principle of operation of the device. It is a simple pendulum, made of ivory with a metal spike as a pointer and it is suspended from a metal frame on a base that can be rotated (Image 4). The rotation is achieved through a centrifugal machine (Image 5). The base has a horizontal disk with the geographical points N, O[21], S and W (Image 6). The rotation of the base represents the rotation of the Earth and when the pendulum is set to oscillate it is observed that the plane of its oscillation remains constant and independent of the rotation of the base. Essentially, the arrangement demonstrates the behavior of Foucault's pendulum at one of the Earth's two geographic poles. Both the pendulum and the centrifugal machine are manufactured by Max Kohl (Image 7).

Image 4. Small pendulum for demonstrating the principles of Foucault's experiment from the collection of the College (Photo: P. Lazos).

20 Perhaps it is a coincidence, but the University of Athens also acquired a Foucault pendulum and a Weinhold's apparatus for Foucault's pendulum made by Max Kohl Company one year later, during the academic year 1913-1914. *Κατάλογος των βιβλίων και οργάνων των φροντιστηρίων και εργαστηρίων του Εθνικού Πανεπιστημίου, Τόμος Β'* (Εν Αθήναις: Εκ του τυπογραφείου Παρασκευά Λεώνη, 1914), 289, 291.

21 The letter O stands for Ost, indicating the German route of the device.

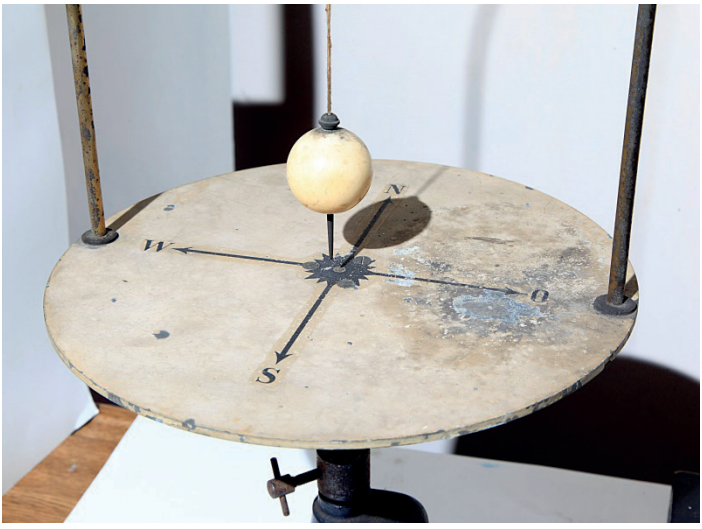

Image 5. The disk of the pendulum with the geographical points (Photo P. Lazos).

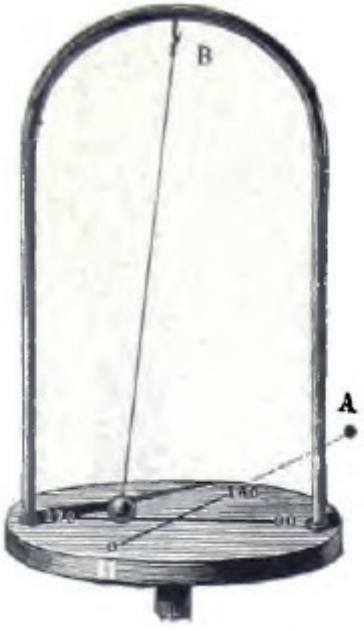

Image 6. Pendulum for Foucault's experiment.[22]

22 Max Kohl, *Physikalische Apparate, Preisliste 21* (Chemnitz, 1905), 203. The code number of the apparatus in the catalog is 22003.

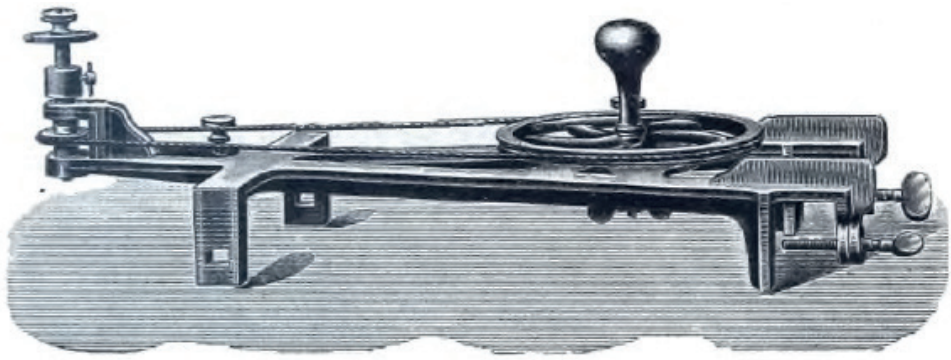

Image 7. Large centrifugal machine to be used in horizontal and vertical direction.[23]

The second device, known as Weinhold's apparatus[24] for Foucault's pendulum, is an actual Foucault pendulum. It consists of the pendulum and a metal base with adjustable height and three leveling screws, which bears the name of the manufacturer (Image 8). The Max Kohl company's catalog described the set as follows: "A cast-iron ball of 10 cm in diameter, attached to a long thin steel wire with cardanic suspension of steel, swings over a round plate which may be raised and lowered by a lever. The ball is fitted with a pencil immersed into coloured glycerine which, in swinging draws a line on the plate, when the latter is raised. The center of gravity of the ball has been ascertained in a mercury-bath.[25] Weight of the ball about 4 kgs, plate lined with paper."[26] (Image 9).

23 Kohl, *Physikalische Apparate, Preisliste 21*, 200-201. The code number of the apparatus in the catalog is 21979.

24 Adolf F. Weinhold, *Physikalische Demonstrationen* (Leipzig: Von Quandt & Handel, 1881), 97-102.

25 For the experiment to succeed, it is important that the point of suspension be exactly over the ball's center of gravity. To assure that the ball floats on mercury and then the upper point of the ball is selected for the suspension.

26 Kohl, *Physikalische Apparate, Preisliste 21*, 198.

Image 8. The Weinhold's apparatus for Foucault's pendulum from the collection of the College (Photo P. Lazos).

Image 9. Weinhold's apparatus for Foucault's pendulum made by Max Kohl.[27]

27 Kohl, *Physikalische Apparate, Preisliste 21*, 198. The code number of the apparatus in the catalog is 21960.

Who Ordered and Installed the Pendulum?

There is no evidence about who was responsible for purchasing these instruments or installing the pendulum. It is, however, difficult to make such a purchase without the technical and educational support of a physics teacher. It is, therefore, considered necessary to present some facts about the College's teachers that could have been engaged in the pendulum installation. Theoretically, the teacher of physics and mathematics at the Phanar Greek Orthodox College at the time when the instruments were purchased was Cornilios Spatharis (1869-1914) (Image 10).

Image 10. Cornilios Spatharis.[28]

He was the son of Andreas Spatharis, teacher of mathematics and physics who served the College for thirty-six years. However, Cornilios Spatharis was constantly absent from 1908 due to a serious illness. He was replaced by his good friend Athanasios Ioannou in physics and by Georgios Lianopoulos in mathematics. Cornilios Spatharis graduated from the Phanar Greek Orthodox College in 1886 and studied at the Sorbonne University where the famous Jules Henri Poincaré (1854-1912) was among his professors. When his father fell ill, Cornilios returned to İstanbul to replace him both at the Phanar Greek Orthodox College and at the Ioakimio Girls' School. He stopped teaching in 1908 when he contracted tuberculosis. After traveling to Crete and Switzerland for treatment, he settled in 1913 in

28 *Ημερολόγιο του έτους 1906*, (Εν Κωνσταντινουπόλει: Εθνικά Φιλανθρωπικά Καταστήματα εν Κωνσταντινούπολει, 1905), 32.

Odessa, where his sister Emilia lived, and began teaching at the local Greek School for boys.[29] He died in May 1914.

Athanasios Ioannou (Image 11) was a physicist. He was born in Kayseri in 1868. He graduated the Phanar Greek Orthodox College in 1886, together with Cornilios Spatharis, and then he returned to his hometown, and he taught physics and mathematics until 1890 in the Rodokanakios Priestly School.[30] Then, he studied physics at the University of Athens, where he prepared a doctoral thesis[31]. When Ioannou returned to İstanbul, besides Phanar Greek Orthodox College, he taught mathematics, physics and chemistry at Zografeio Greek High School, where he also served as director in 1913-1914 and 1916-1922.[32] He was a member of the Greek Philological Association of Constantinople from 1894 while he wrote textbooks on arithmetic, experimental physics and organic and inorganic chemistry. Ioannou was in charge of the physics laboratory of Zografeio Gymnasium, and he had significant experience in experimental physics (Image 12). He died in Athens in 1956.

Image 11. Athanasios Ioannou.[33]

29 Σταύρος Θ. Ανεστίδης, *Πατριαρχικής Μεγάλης του Γένους Σχολής Πάνθεον. Δεκαεπτά Προσωπογραφίες*, (Αθήνα: Σύνδεσμος των εν Αθήναις Μεγαλοσχολιτών, 2019), 165.

30 Αθανάσιος Ιωάννου, Μαθήματα Χημείας Ανοργάνου και Οργανικής (Εν Κωνστανινούπολει, Εκ του τυπογραφείου Κ. Μακρίδου και Ι. Αλευρόπουλου,¨ 1921), 6.

31 Αθανάσιος Ιωάννου, *Πραγματεία περί της ατομικότητας των στοιχείων, Εναίσιμος επί διδακτορία διατριβή* (Εν Αθήναις: Εκ του τυπογραφείου των καταστημάτων Ιωάννου Νικολαϊδου, 1894).

32 Βασίλειος Βετσόπουλος, "Οι δάσκαλοί μου της Πόλης," *Αρχείον Θράκης* 161 (1969): 200-202.

33 *Ημερολόγιον Ελπίς του 1914, Εκδιδόμενον επιμέλειαι των μαθητών του Ζωγράφειου Γυμνασίου* (Εν

George Lianopoulos was a mathematician. Until his death in 1922, he worked almost continuously for 50 years at the Theological School of Halki (Heybeliada Ruhban Okulu), where he taught mathematics, physics, geology and cosmography.[34] In 1909, in recognition of his service, his former students collected the necessary amount of money, so that his son could continue his studies after High School.[35] Lianopoulos also taught physics and mathematics at the Commercial School of Halki, and mathematics at the Phanar Greek Orthodox College.

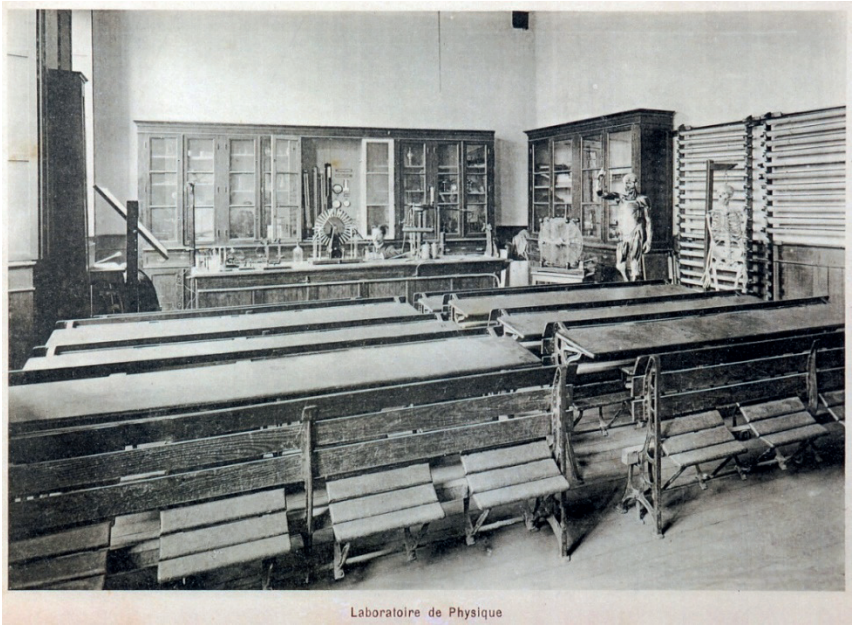

Image 12. Athanasios Ioannou in the physics laboratory of Zografeion Greek High School, 1907-1908.[36]

Since Lianopoulos was mainly a math teacher with limited experience in experimental physics, we think that the pendulum was probably chosen and installed either by Spatharis, who perhaps had seen such a pendulum during his studies in France, or by Ioannou. It remains unknown if the pendulum was permanently suspended in place or if it was removed every time after the experiment was carried out.

The Pendulum in the Lessons - Then and Now

There are no written records about how and when this Foucault pendulum was used in the College, but it is certain that it was not idle. According to oral testimony of Fanis

Κωνσταντινουπόλει: Τυπογραφικά Καταστήματα Δ. Πρωτόπαππα, 1914), 39.

34 Απόστολος Μέξης, *Η εν Χάλκη Ιερά Θεολογική Σχολή. Ιστορικά σημειώματα (1844-1935)* (Κωνσταντινούπολη, 1933), 120-121, 133.

35 Μέξης, *Η εν Χάλκη Ιερά Θεολογική Σχολή. Ιστορικά σημειώματα (1844-1935),* 158.

36 *Lycée Zographeion, Constantinople (Péra) 1907-1908* (İstanbul, 1908).

Vasageorgis, a student at the College who graduated in 1960, the pendulum was used for a demonstration in the academic year 1959-1960 by Konstantinos Pappas, a 1957 Phanar graduate and mathematics teacher for a short time at the College. The bob was fixed in a not vertical position by means of a thread. After having the bob completely motionless the thread was burned and the oscillation started. If the disc was raised up to a certain height, the bob could draw a line of glycerin on it. After the first passing of the bob over the disc, the disc was lowered, and the lesson continued. About half an hour later the disc was raised again, and a new line was drawn. Then the students were asked to observe the last line of glycerin, that obviously formed an angle with the first line, and this would trigger a conversation between the teacher and the students about the Earth's rotation.

Pappas must have seen this demonstration by Emilios Karousos, teacher of physics and mathematics until the late 1950s.[37] It seems that after Karousos's retirement the demonstrations stopped.

At the beginning of the new millennium the ceiling of the experimental physics classroom was repaired, and the hatch opening was totally covered. Now only the upper part is visible in the "dome". As a result, it is no longer possible to set up the pendulum in its initial position. We believe that the reinstallation of the pendulum would serve a dual purpose. First, it would highlight the rich cultural and material history of the College. In addition, the use of the Foucault pendulum in today's teaching process could be useful to give students an insight into the Earth's rotation. It is true that the effectiveness of the pendulum in teaching is a matter of intense debate.[38] However, we think that the simultaneous use of the two devices that the College has would be a useful strategy for demonstrating the rotation of the Earth in an easy comprehensible way.

Concluding Notes: Was this Pendulum the First in İstanbul?

This is both an interesting question and a difficult one to be answered definitively. It is certain that this pendulum was the only one in the Greek schools in İstanbul. We have not located any relevant reference to any other institution in İstanbul, without of course being able to exclude the existence of such a pendulum. Moreover, we were informed there "is no sign of any Foucault pendulum […] or of any such experiment in the written records or archives" in the Kandilli Observatory.[39] However, there "are still few locations in the

37 Παναγιώτης Λάζος, "Ο φυσικομαθηματικός Αιμίλιος Καρούσος (1886-1970), 45 χρόνια προσφοράς," in *Η Λογιοσύνη της Πόλης. Εκπαιδευτικοί και λογοτέχνες της σύγχρονης περιόδου*, ed. Ευαγγελία Αχλάδη and Σάββας Τσιλένης, 67-83, Σισμανόγλειο Μέγαρο - Γενικό Προξενείο της Ελλάδας στην Κωνσταντινούπολη & Εταιρεία Μελέτης της καθ' ημάς Ανατολής, 2023.

38 For an argument in favor of the use of the pendulum in teaching see Crane, "The Foucault," 264-269. For an argument against it, see John Oprea, "Geometry and the Foucault Pendulum," *The American Mathematical Monthly*, 102, 6 (1995): 515.

39 Mustafa Aktar (Professor of Geophysics, Boğaziçi University Kandilli Observatory and Earthquake Research

Observatory (old warehouses, etc.) which are not fully explored and where remains of larger instruments may exist".

An exhaustive investigation of the subject is beyond the scope of this article. We believe, however, that this open question deserves further research as well as the wider question of what the situation in the Ottoman Empire was.[40]

APPENDIX - Max Kohl, A Pioneer in the Manufacture of Teaching Scientific Instruments

Max Hans Robert Kohl (1853-1908) founded a precision engineering company in the German city of Chemnitz in 1876. The company was successful and in just two years employed nineteen employees. The production concerned devices and systems for scientific purposes and mainly for use in laboratories of educational institutions, such as schools and universities.

The company moved several times as its business grew, finally settling in 1898-1899 in a large privately owned factory with a basement, four floors and an attic, employing more than 200 employees.[41]

Max Kohl served concurrently as an unpaid alderman of the city of Chemnitz from 1905 until he died of diabetes in 1908.[42] The company continued to operate without interruption, now taking a joint-stock form. At its peak in the first half of the 1910s, it employed 500 employees, while a second five-story building was built next to the first, for carpentry and assembly work.

An important reason for the company's great success was the publication of luxurious, multilingual and voluminous trade catalogs with rich illustrations and thousands of devices and instruments.[43] The catalogs also contained several pages of positive comments from professors, teachers, scientists and ordinary people who had bought or tried the company's products. The geographical spread of these people is impressive, as they literally come from all over the world, which highlights the spread of the company's network.

Institute, İstanbul), email message to author, May 6, 2023.

40 In modern Turkey there are at least two Foucault pendulums, one in the Ege University Observatory (ca. 1965) and one in the Çanakkale Onsekiz Mart University (ÇOMÜ) (ca. 2002). Zeri Eker, Osman Demircan, Halil Kirbiyik, and Selcuk Bilir, "Astronomy in Modern Turkey," in *Organizations, People and Strategies in Astronomy* Vol 2, ed. Andre Heck (Duttlenheim: Venngeist, 2013), 205, 208.

41 "Max Kohl Chemnitz – Mit Geschick und Sorgfalt zum Erfolg," Chemnitz-Gestern-Heute.De, accessed February 14, 2023, https://chemnitz-gestern-heute.de/max-kohl-chemnitz/.

42 Jasmin Mohammad, "Max Kohl" in: Sächsische Biografie, hrsg. vom Institut für Sächsische Geschichte und Volkskunde e.V., accessed February 14, 2023, https://saebi.isgv.de/biografie/Max_Kohl_(1853-1908)

43 Paolo Brenni, "The Evolution of Teaching Instruments and Their Use Between 1800 and 1930," *Science & Education* 21 (2012):191–226. DOI: 10.1007/s11191-010-9326-z. Brenni wrote that the catalogs "seemed to be attained by elephantiasis."

The company faced financial difficulties after the First World War and the financial crisis of the interwar period but managed to cope, although reducing staff and production. Ultimately, it was the Second World War that marked the end of the company's career as, although the building infrastructure remained relatively unscathed, the engineering equipment was transferred to the Soviet Union as part of war reparations. In 1949 the company was absorbed by the East German state company VEB Buchungsmaschinenwerk Karl-Marx-Stadt.

Nowadays, a large number of the company's designs are preserved in universities, schools and museums around the world. Among them are the three secondary Greek schools of İstanbul, namely the Phanar Greek Orthodox College, the Zografeio Greek High School (Özel Zoğrafyon Rum Lisesi) and the Zappeion Greek School for Girls. Today, all these schools operate as co-educational institutions.

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BIBLIOGRAPHY / KAYNAKÇA

Printed Sources / Basılı Kaynaklar

Brenni, Paolo. "The Evolution of Teaching Instruments and their Use Between 1800 and 1930." *Science & Education* 21 (2012):191–226.

Challis, J. "A Mathematical Theory of M. Foucault's Pendulum Experiment." *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science* 3, 19 (1852), 331-334.

Crane, Richard H. "The Foucault Pendulum as a Murder Weapon and a Physicist's Delight." *The Physics Teacher* 28, 5 (1990): 264-269.

Eker, Zeki, Osman Demircan, Halil Kırbıyık, and Selçuk Bilir. "Astronomy in Modern Turkey." In *Organizations, People and Strategies in Astronomy,* Vol. 2. Edited by Andre Heck, 195-216. Duttlenheim: Venngeist, 2013.

Esmer Mine, Ömer Dabanlı, Ruba Kasmo, Lana Kudumovic, Aynur Çiftçi, and Cesur E. Selcen. "Mekteb-i Kebir ya da Kırmızı Mektebi Belgelemek." *Mimar.ist* 22, 74 (2022): 72-82.

Foucault, Léon. "Démonstration physique du Mouvement de Rotation de la Terre au Moyen du Pendule." *Comptes Rendus de l'Académie des Sciences* 32 (1851): 135-138.

Kohl, Max. *Physikalische Apparate, Preisliste 21*. Chemnitz, 1905.

Kruglak, Haym, Larry Oppliger, Rene Pittet, and Steele Stanley. “A Short Foucault Pendulum for a Hallway Exhibit.” *American Journal of Physics* 46 (1978): 438-440.

Lazos, Panagiotis, Vlahakis, N. George, and Constantine Skordoulis. “Instruments and Laboratories in the Schools of the Greek Community of Istanbul, 1850–1960.” In *Scientific Instruments Between East and West.* Edited by Neil Brown, Silke Ackermann, and Feza Günergun, 168-86. Brill, 2020.

Leonard, E. Byron. “A Short Foucault Pendulum for Corridor Display.” *The Physics Teacher* 19 (1981): 421-423.

Lycée Zographeion, Constantinople (Péra) 1907-1908. İstanbul, 1908.

Oprea, John. “Geometry and the Foucault Pendulum.” *The American Mathematical Monthly* 102, 6 (1995): 515-522.

Roberts, Westropp. “A Foucault Pendulum at Dublin.” *Nature* 51 (1895): 510-511.

Tobin, William and Brian Pippard. “Foucault, His Pendulum and the Rotation of the Earth”. *Interdisciplinary Science Reviews* 19, 4 (1994): 326-337.

Weinhold, F. Adolf. *Physikalische Demonstrationen*. Leipzig: Von Quandt & Handel, 1881.

Ανεστίδης, Σταύρος Θ.. *Πατριαρχικής Μεγάλης του Γένους Σχολής Πάνθεον. Δεκαεπτά Προσωπογραφίες*. Αθήνα: Σύνδεσμος των εν Αθήναις Μεγαλοσχολιτών, 2019.

Βετσόπουλος, Βασίλειος. “Οι δάσκαλοί μου της Πόλης”. *Αρχείον Θράκης* 161 (1969): 200-202.

Γριτσόπουλος, Τάσος. *Πατριαρχική Μεγάλη του Γένους Σχολή*, Vol.2. Αθήνα: PUBLISHER?, 2004.

Έκθεσις των πεπραγμένων εν τη Μ. Σχολή κατά το σχολικόν έτος 1949-50. Φανάριον, 1950.

Ιωάννου, Αθανάσιος. *Πραγματεία περί της ατομικότητας των στοιχείων, Εναίσιμος επί διδακτορία διατριβή*. Εν Αθήναις: Εκ του τυπογραφείου των καταστημάτων Ιωάννου Νικολαΐδου, 1894.

Ιωάννου, Αθανάσιος. *Μαθήματα Χημείας Ανοργάνου και Οργανικής*. Εν Κωνσταντινουπόλει: Εκ του τυπογραφείου Κ. Μακρίδου και Ι. Αλευρόπουλου, 1921.

Κατάλογος των βιβλίων και οργάνων των φροντιστηρίων και εργαστηρίων του Εθνικού Πανεπιστημίου, Τόμος Β’. Εν Αθήναις: Εκ του τυπογραφείου Παρασκευά Λεώνη, 1914.

Κλεόβουλος, Ευστάθιος. *Λογοδοσία περί του σχολικού έτους 1856-1866 της εν Κωνσταντινουπόλει Μεγάλης του Γένους Σχολής.* Εν Κωνσταντινουπόλει: Τύποις Ανατολικού Αστέρος, 1866.

Κλεόβουλος, Μιχαήλ. *Έκθεσις των πεπραγμένων εν τη Πατριαρχική Μεγάλη του Γένους Σχολή κατά το σχολικόν έτος 1912-1913*. Εν Κωνσταντινουπόλει: Τύποις Αδελφών Γεράρδων, 1914.

Λάζος, Παναγιώτης. “Ο φυσικομαθηματικός Αιμίλιος Καρούσος (1886-1970), 45 χρόνια προσφοράς.” In *Η Λογιοσύνη της Πόλης. Εκπαιδευτικοί και λογοτέχνες της σύγχρονης περιόδου*, edited by Ευαγγελία Αχλάδη and Σάββας Τσιλένης, 67-83. Σισμανόγλειο Μέγαρο - Γενικό Προξενείο της Ελλάδας στην Κωνσταντινούπολη & Εταιρεία Μελέτης της καθ’ ημάς Ανατολής. 2023.

Μέξης Απόστολος. *Η εν Χάλκη Ιερά Θεολογική Σχολή. Ιστορικά σημειώματα (1844-1935)*. Κωνσταντινούπολη, 1933.

Παλαμάς, Γρηγόριος. *Έκθεσις της πνευματικής και υλικής καταστάσεως της Μ. Του Γένους Σχολής, κατά το σχολικός έτος 1878-1879*. Εν Κωνσταντινουπόλει: Τύποις Ανατολικού Αστέρος, 1879.

Παλαμάς, Γρηγόριος. *Έκθεσις της πνευματικής και υλικής καταστάσεως της Μ. Του Γένους Σχολής, κατά το σχολικόν έτος 1879-1880*. Εν Κωνσταντινουπόλει: Πατριαρχικό Τυπογραφείο, 1880.

Παλαμάς, Γρηγόριος. *Έκθεσις της πνευματικής και υλικής καταστάσεως της Μ. Του Γένους Σχολής, κατά το*

σχολικόν έτος 1880-1881. Εν Κωνσταντινουπόλει: Πατριαρχικό Τυπογραφείο, 1881.

Τσιλένης, Σάββας. "Η Μεγάλη του Γένους Σχολή στην Κωνσταντινούπολη και ο αρχιτέκτονάς της Κωνσταντίνος Δημάδης". *The world of Buildings* 16, (1998): 100-112.

Ημερολόγιο του έτους 1906. Εν Κωνσταντινουπόλει: Εθνικά Φιλανθρωπικά Καταστήματα εν Κωνσταντινούπολει, 1905.

Ημερολόγιον Ελπίς του 1914, Εκδιδόμενον επιμέλειαι των μαθητών του Ζωγράφειου Γυμνασίου. Εν Κωνσταντινουπόλει: Τυπογραφικά Καταστήματα Δ. Πρωτόπαππα, 1914.

Electronic Sources / Elektronik Kaynaklar

Ault, Alicia. "How Does Foucault's Pendulum Prove the Earth Rotates?" *Smithsonian Magazine*. Accessed April 24, 2023. https://www.smithsonianmag.com/smithsonian-institution/how-does-foucaults-pendulum-prove-earth-rotates-180968024/

Chemnitz-Gestern-Heute.De. "Max Kohl Chemnitz – Mit Geschick und Sorgfalt zum Erfolg." Accessed February 14, 2023. https://chemnitz-gestern-heute.de/max-kohl-chemnitz/

Deutsches Museum. "Foucault's Pendulum – See the Earth Rotate." Accessed January 12, 2023. https://www.deutsches-museum.de/en/museum-island/exhibitions/foucaults-pendulum

Mohammad, Jasmin. "Max Kohl" in: Sächsische Biografie, hrsg. vom Institut für Sächsische Geschichte und Volkskunde e.V. Accessed February 14, 2023. https://saebi.isgv.de/biografie/Max_Kohl_(1853-1908)

United Nations. "United Nations Gifts." Accessed January 12, 2023, https://www.un.org/ungifts/foucault-pendulum

United Nations Photo Digital Asset Management System. Accessed January 12, 202. https://dam.media.un.org/CS.aspx?VP3=DamView&VBID=2AM94S7SH9_C&PN=1&WS=SearchResults&FR_=1&W=1280&H=577