Istanbul and Kandilli Observatories as the Astronomical Heritage of Türkiye

S. Fisek *[1,2,3] and S. Alis[1,2]

[1]Department of Astronomy and Space Sciences, Faculty of Science, Istanbul University, 34116 Istanbul, Türkiye
[2]Istanbul University Observatory Research and Application Centre, 34116 Istanbul, Türkiye
[3]Kandilli Observatory and Earthquake Research Institute, Geodesy Department, Astronomy Laboratory, Boğaziçi University, 34684 Istanbul, Türkiye

Abstract

This paper explores the historical evolution and scientific contributions of two cornerstone institutions of Turkish astronomy: the Kandilli Observatory and the Istanbul University Observatory. By examining their origins—ranging from the late Ottoman era to the early years of the Republic—this work highlights their roles in establishing modern astronomical research in Türkiye. The paper details their historical instrumentation, significant manuscript collections, and the continuous solar observation datasets that remain vital for global heliophysics research today. Furthermore, it discusses their current educational initiatives and their role in bridging Türkiye's rich astronomical heritage with future endeavors, such as the Eastern Anatolia Observatory (DAG).

Keywords: *Astronomical Heritage, Cultural Heritage, Science History*

1. Introduction

The foundations of modern astronomical research in Türkiye are deeply rooted in two primary institutions: the Kandilli Observatory and the Istanbul University Observatory. These two observatories hold great significance in terms of the nation's scientific heritage. It is important to emphasize that Kandilli was established prior to the foundation of the Republic, whereas the Istanbul University Observatory was founded shortly after. Together, these institutions laid the crucial foundations for the astronomical research that Türkiye carries out today.

To fully understand this scientific heritage, one must trace its origins back to the 16th century. In 1574, Murad III became the Sultan of the Ottoman Empire. During his reign, the empire's chief astronomer, Taqi al-Din, petitioned the Sultan to finance the construction of a great observatory that would rival Ulugh Beg's famous observatory in Samarkand. The Sultan approved the project, and its construction was completed in 1577, making it a contemporary of Tycho Brahe's Uraniborg Observatory. However, this pioneering institution was short-lived; according to some sources, the observatory was demolished by the Sultan's order because a comet observed in the sky during that period was superstitiously believed to be connected with certain unfortunate events. Today, the legacy of this early endeavor is honored by a quadrant displayed in the building located at the approximate site of the original observatory (Figure 1)[1].

Following this historical interruption, the foundations of modern institutional astronomy began to re-emerge during the late Ottoman Empire with the establishment of the Imperial Observatory. Initially founded with a primary focus on meteorology to predict weather events and storms, historical documents and published materials clearly indicate that there were also ambitions to expand its scientific role into astronomy. The observatory operated at various locations, primarily carrying out meteorological and seismological measurements (Benoist, 2009). However, following the unrest and uprisings of 1909, the building housing the observatory was damaged[2]. This pivotal event eventually led to the search for a new, permanent location, marking the beginning of a new era for what would become the Kandilli Observatory.

*sfisek@Istanbul.edu.tr, Corresponding author

[1]https://web.astronomicalheritage.net/show-entity?identity=184&idsubentity=1

[2]http://www.koeri.boun.edu.tr/eng/tarih_eng.htm

Figure 1. Commemorative quadrant model marking the approximate site of the first Ottoman observatory, founded by Taqi al-Din (1575-1580), reproduced in 2009 by the Turkish Astronomical Society (TAD), UNESCO National Commission of Türkiye, and Koç University to celebrate the International Year of Astronomy.

2. Kandilli Observatory

2.1. Origins and Relocation

The modernization of the observatory is inextricably linked to the appointment of Fatin Gökmen (known as Fatin Hoca) in 1910. Following the destruction of the Rasathane-i Amire during the political turbulence of 1909, the Ottoman administration sought to rebuild its scientific infrastructure (Benoist, 2009). Gökmen was tasked with selecting a site that would provide the atmospheric stability and isolation necessary for precise astronomical and geophysical measurements. He selected Icadiye Hill on the Asian side of the Bosphorus, utilizing an existing fire watchtower as the initial structural core of the new Kandilli Observatory. By 1911, the institution was operational, marking a shift from a purely meteorological station to a multi-disciplinary research center focused on astronomy and geophysics[3].

2.2. Astronomical Instrumentation

A cornerstone of Kandilli's scientific heritage is the purchase of a 20cm equatorial telescope from the German firm Carl Zeiss. Ordered in 1918 during the final stages of World War I, the telescope's delivery was significantly delayed by the post-war geopolitical environment and the subsequent transition from the Empire to the Republic. The instrument finally arrived in Türkiye in 1925, but the construction of a specialized dome to house it required nearly another decade. The telescope became fully operational in 1935. This instrument was not merely a tool for observation but a symbol of the young Republic's commitment to state-of-the-art astrophysical research, allowing for higher precision in celestial mechanics and solar studies.

Building upon this historical foundation, the observatory is currently expanding its observational capabilities. The institution operates a modern 35 cm aperture telescope, which is presently deployed on a mobile basis. Equipped with a CMOS camera, this instrument is actively utilized for a variety of research campaigns, primarily focusing on target of opportunity (ToO) and follow-up observations. In the near future, this telescope will be permanently housed in its own dedicated building. This strategic installation aims to ensure the continuity of regular, systematic night-time observations at Kandilli.

2.3. Observational Heritage

The most distinctive feature of Kandilli's astronomical activity is the unwavering continuity of its solar research. Systematic observations began in 1947, and remarkably, the historical Carl Zeiss telescope remains in active observational status today. A cornerstone of this scientific routine is the commitment to daily data collection: every single day with clear skies, researchers perform meticulous hand-drawings of sunspots and monitor solar activity.

[3] http://www.koeri.boun.edu.tr/new/en/history

Figure 2. (a) The Kandilli Observatory building during its construction phase. (b) The current appearance of the historical building. (c) Fatin Gökmen seen observing through the telescope. (d) An interior view of the dome, featuring the historical 20 cm aperture Carl Zeiss telescope.

This persistent effort has culminated in a digital and physical archive spanning over 80 years. In the context of "Astronomical Heritage," this dataset is not merely a relic of the past but a vibrant, growing resource. It serves as a critical baseline for modern solar physics, allowing for the cross-calibration of historical records with data from space-based observatories. By maintaining this daily ritual of observation, Kandilli ensures that its heritage remains a living component of global solar cycle research[4].

2.4. The UNESCO Manuscript Collection

One of Kandilli's most profound contributions to the history of science is its preservation of classical Islamic and Ottoman scientific thought. Under Fatin Gökmen's guidance, the observatory amassed a collection of 1,339 rare manuscripts dating from the 11th to the 20th century. This collection includes seminal works by scholars such as Ali Qushji, Al-Biruni, and Taqi al-Din, covering mathematics, astronomy, and geography. In recognition of its universal value, the collection was inscribed in the UNESCO Memory of the World Register in 2001[5]. This status formally acknowledges Kandilli not just as a site of observation, but as a global guardian of scientific history.

2.5. Transition to Boğaziçi University

In the wake of the 1983 university reorganization in Türkiye, the institution was integrated into Boğaziçi University, becoming the Kandilli Observatory and Earthquake Research Institute (KOERI)[6]. While the institute gained international renown for its seismological and tsunami warning capabilities, the Astronomy

[4] https://astronomi.bogazici.edu.tr/tr/archives
[5] https://www.unesco.org/en/memory-world/kandilli-observatory-and-earthquake-research-institute-manuscripts
[6] http://www.koeri.boun.edu.tr/new/en

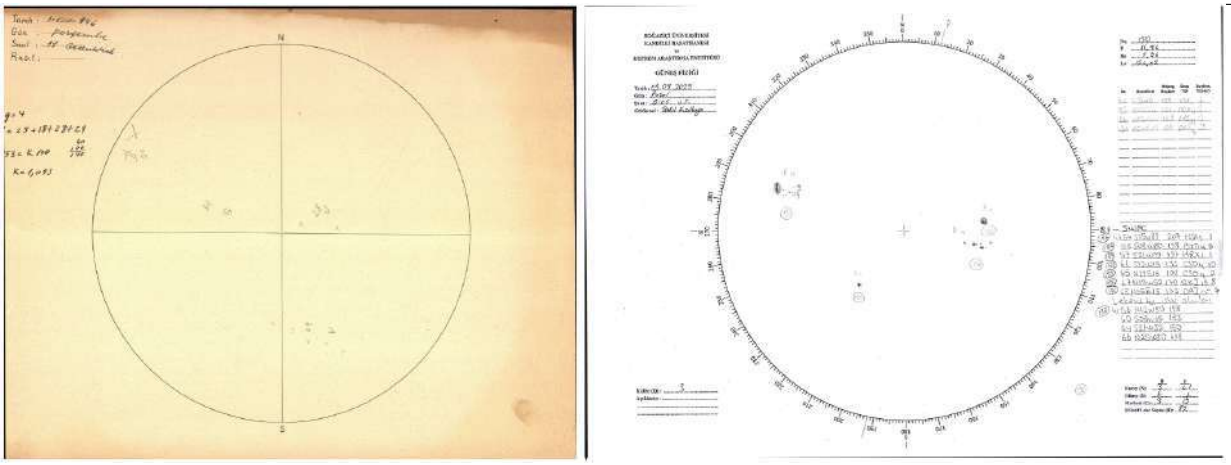

Figure 3. (left) The earliest known solar observation sheet, recorded in 1946. (right) A present-day example of a solar observation sheet, recorded in 2025 at the Kandilli Observatory.

Laboratory[7] remains the custodian of its astronomical legacy. Today, the laboratory balances its historical solar observation duties with new educational roles, housing a vast collection of historical astronomical instruments and serving as a key site for public outreach and scientific literacy.

3. Istanbul University Observatory

3.1. The University Reform in 1933

While Kandilli represents the transition of astronomical heritage from the Ottoman era, the Istanbul University Observatory stands as the first observatory and astronomy department established after the founding of the Republic. Its inception was intrinsically tied to the 1933 University Reform, a monumental step aimed at modernizing higher education and scientific research in Türkiye (Bilsel, 1943) which was initiated by Atatürk (Reisman, 2006). As part of these comprehensive academic developments, the Faculty of Science and the Department of Astronomy were established, marking the creation of the first astronomy department in the country. The observatory was subsequently constructed on the university's main campus, situated near its iconic main entrance gate, physically and symbolically placing astronomy at the heart of the new academic structure (Figure 5).

3.2. Migrated Scientists and the Legacy of Wolfgang Gleissberg

The intellectual foundation of the newly established department was profoundly shaped by the influx of European scholars. Specifically, German scientists of Jewish origin, who had fled Nazi persecution in the 1930s (Widmann, 1973), played a crucial role in the development of the astronomy department and the establishment of the observatory (Gunergun & Kadioglu, 2006). Erwin Finlay-Freundlich is the founder of the department and the observatory. Wolfgang Gleissberg, Erich Karl Weber, Hans Rosenberg, and Thomas Royds were scholars who worked at Istanbul University Observatory. Among these pioneering figures, Wolfgang Gleissberg is particularly notable. Gleissberg served Istanbul University for 24 years between 1934 and 1958, implementing rigorous academic standards and training a foundational generation of Turkish astronomers. The pedagogical impact of this era was far-reaching; graduates trained under Gleissberg and his colleagues later contributed significantly to the establishment and advancement of other astronomy departments and observatories across Türkiye (Alis, 2019). In 1982, an honorary doctorate was awarded to Gleissberg for his contributions to the Istanbul University Observatory and to the Astronomy Department at a ceremony organized in the Turkish consulate in Frankfurt (Menteşe et al., 2002).

3.3. The 1935 State Decree and Historical Instrumentation

The physical realization of the observatory required substantial governmental backing, underscoring the state's vision for scientific progress. In 1935, a state decree was issued authorizing the purchase of a major

[7] https://astronomi.bogazici.edu.tr/tr

Figure 4. Calendar of the Gregorian year 1527-1528 (933-934 Hijri) dedicated to Sultan Süleyman the Magnificent, No:333 in Kandilli's manuscripts collection.

telescope and the formal establishment of the observatory. This financial and administrative commitment was a difficult yet highly significant decision for the newly founded Republic, directly shaping the future of scientific research in the country. The primary instrument acquired was a multi-telescope mount featuring a 30 cm aperture astrograph at its center. In its early decades, this large astrograph was heavily utilized for night-time observations, equipped with a specialized chamber for capturing celestial data on photographic glass plates.

3.4. Continuous Scientific Operations

Although the 30 cm astrograph is no longer actively used for night-time observations, the observatory has successfully adapted its historical infrastructure to maintain its scientific relevance. Today, two other telescopes mounted alongside the historical astrograph remain in active service (Figure 5). These instruments are dedicated strictly to solar observation, specifically targeting the Sun's photosphere and chromosphere layers. Mirroring the rigorous data collection practices at Kandilli, solar observations at Istanbul University are carried out every day when the sky is clear. This ongoing operational status ensures that the facility functions not merely as a museum of early Republican science, but as an active observatory continuously contributing to long-term astronomical data collection[8].

Early systematic sunspot observations at the Istanbul Observatory were reported in internal observatory publications, reflecting the institution's commitment to continuous solar monitoring. Besides several individual solar events and focused analysis, the observatory published the sunspot observations systematically starting from the 1950s (e.g., The Sunspot Observations Made in 1955) (Yılmaz, 1956). The complete list of publications of the observatory can be found in Menteşe et al. (2002) which is published in Turkish but provides a comprehensive historical record[9].

Beyond solar observations with historical telescopes, the institution maintains a strong focus on academic training and contemporary night-time observations. Currently, to provide astronomy students in the department with practical night-time observational experience, a modern telescope IST40 with a 40 cm aperture is installed within the main building. Although primarily utilized for educational purposes to enhance students' observational skills, this telescope is also actively used for various targeted scientific observations (Devecioğlu et al., 2024, Eryılmaz et al., 2023, Ötken et al., 2025, Sağlam et al., 2022). Furthermore, to over-

[8] https://astronomi.istanbul.edu.tr/arsiv.php
[9] https://astronomi.istanbul.edu.tr/tanitim/tarihce/kurgunastro.pdf

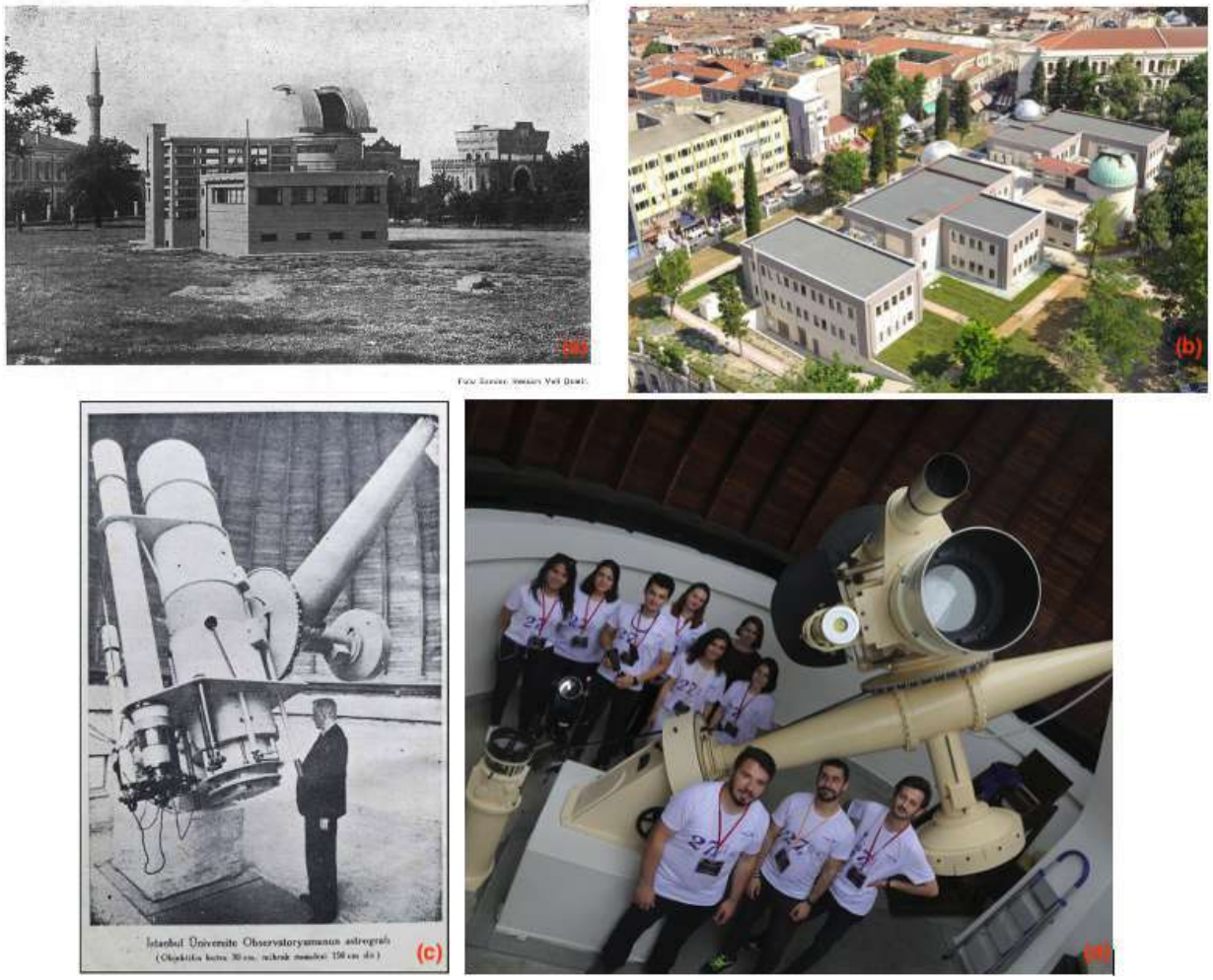

Figure 5. (a) A view of the observatory during its founding years at the main campus. (b) A present-day view of the Istanbul University Observatory and the Astronomy Department. (c) An observer seen with the historical telescope inside the dome. (d) Present-day astronomy department students alongside the historical telescope.

come the observational limitations imposed by light pollution, Istanbul University Observatory[10] operates an advanced 60 cm aperture telescope IST60 located in Çanakkale. This telescope is capable of functioning in both remote-control and fully robotic modes (Aliş et al., 2020), significantly expanding the department's modern research capabilities[11](Figure 7).

In addition to the optical telescope infrastructure, the Istanbul University Observatory has recently expanded its observational capabilities into the domain of high-energy solar physics through the establishment of the Space Weather Monitoring Center[12]. Developed within the scope of the National Space Program coordinated by the Turkish Space Agency (TUA)[13], this initiative represents the latest technological evolution of the institution's 80-year legacy of solar activity tracking. The core of this project is the Mirya-μ1 Cosmic Ray (Muon) Detector[14]. Following its initial testing and calibration at the Istanbul University facilities, the instrument was relocated to the Eastern Anatolia Observatory (DAG) campus in Erzurum. Positioned at an altitude of 3150 meters, this facility now operates as Turkey's first Space Weather Monitoring Station (Dag et al., 2025).

[10] https://gozlemevi.istanbul.edu.tr/en/_
[11] https://cdn.istanbul.edu.tr/FileHandler2.ashx?f=astrbolumu.pdf
[12] http://ist60.istanbul.edu.tr/mirya/info/
[13] https://tua.gov.tr/tr
[14] http://ist60.istanbul.edu.tr/mirya/

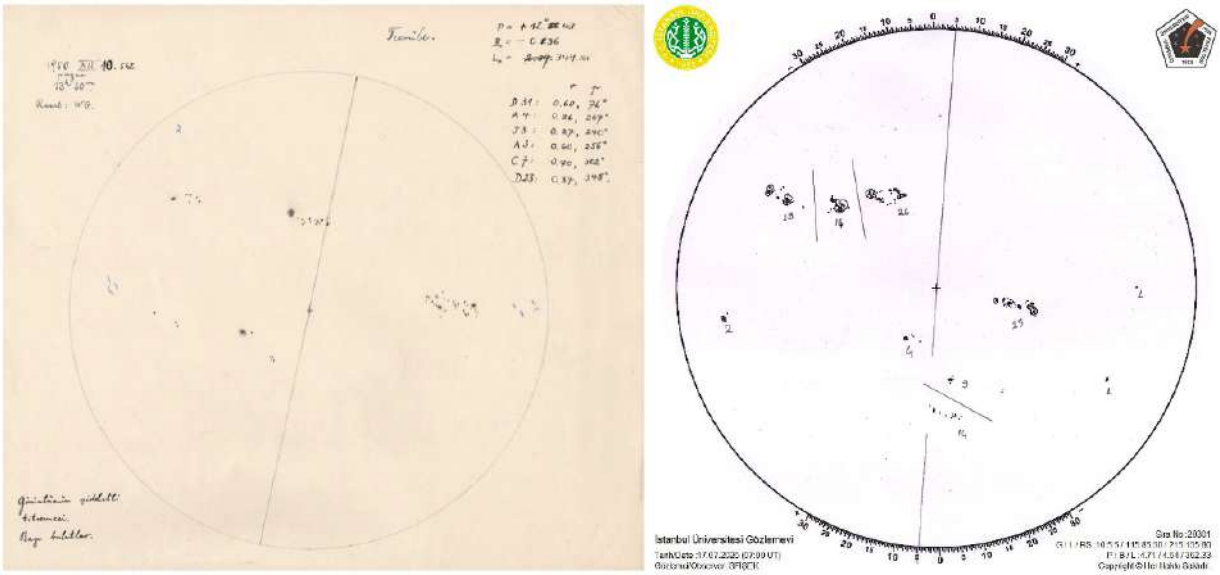

Figure 6. (left) A historical solar observation sheet, recorded in 1950. (right) A present-day example of a solar observation sheet, recorded in 2025 at the Istanbul University Observatory.

4. The Data Heritage: 80-Year Solar Archive

The fundamental scientific legacy of both Kandilli and Istanbul University Observatories extends far beyond their historical architecture and vintage instrumentation; it is rooted in their systematic and continuous data collection. Since the 1940s, both institutions have maintained a continuous series of solar photospheric observations (Figures 3 and 6). By recording daily sunspot counts, coordinates, and morphological classifications, these observatories have generated a very large and highly valuable longitudinal dataset. In the context of astronomical heritage, this archive serves as a critical baseline for analyzing long-term solar cycle variations, offering indispensable historical data for contemporary researchers investigating trends in solar minima and maxima over the past century.

While photospheric drawings constitute the core of the historical archives, both observatories have also contributed to the documentation of solar chromospheric activity. Although these observations were occasionally interrupted, systematic records obtained using Hα and Ca II filters complement the photospheric dataset and extend the temporal coverage of solar activity indicators. The transition from photographic plates to digital CCD imaging at Istanbul University Observatory represents not a change in scientific scope but an effort to preserve and sustain the continuity, consistency, and accessibility of this long-term solar archive in the modern era.

A crucial aspect of scientific heritage is its accessibility to the global research community. Neither institution treats its historical data as a closed, static museum exhibit. Instead, both the scanned historical photosphere observations and the ongoing daily digital observations are systematically cataloged and made publicly accessible on the websites of the two observatories[15] [16]. By adhering to open science principles, this digital archive represents a remarkable scientific data heritage that contributes significantly not just to the local scientific community in Türkiye, but to global.

5. Education and Public Outreach

Kandilli Observatory serves as a crucial interface between the scientific community and the general public, dedicating considerable resources to science communication. The institution opens its facilities to school and student visits on a weekly basis, providing structured tours of its seismology, meteorology, and astronomy laboratories. To enhance public scientific literacy, particularly regarding natural disasters, the observatory offers experiential learning through both on-site and mobile earthquake simulators. Furthermore, the institution maintains its astronomical public engagement by organizing specialized night-sky observation events during significant celestial occurrences and major institutional milestones, such as the activities held for its

[15] https://astronomi.bogazici.edu.tr/tr/archives
[16] https://astronomi.istanbul.edu.tr/arsiv.php

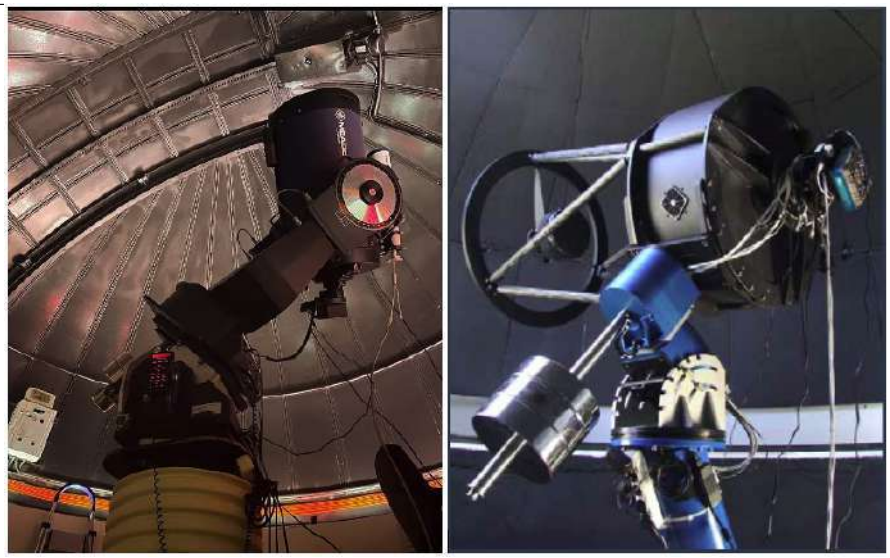

Figure 7. (left) An interior view of the dome featuring the IST40 telescope, located at the university main campus in Beyazıt, Istanbul. (right) An interior view of the dome featuring the IST60 telescope, located at the Ulupınar Observatory, Çanakkale.

150th anniversary.

Istanbul University Observatory operates a highly active public engagement and educational program, hosting more than one hundred visiting students every weekday. The institutional infrastructure supporting this outreach includes a digital planetarium (Alis et al., 2024), which houses a library of over ten specialized educational films. Visitors are also provided access to the historical dome and the departmental archives, specifically the Gleissberg Astronomy Collection. Named in recognition of Wolfgang Gleissberg's foundational contributions, this collection exhibits historical astronomical instruments, telescopes, mechanical clocks, calculators, etc. Additionally, since 2017, the observatory has successfully institutionalized a public engagement initiative known as "Observation Nights," held on the last Friday of every month, which integrates academic seminars with guided night-sky observations.

Beyond public outreach, Istanbul University Observatory's facilities serve as crucial tools for advanced scientific training. Undergraduate students in the astronomy department actively utilize both the planetarium and the telescopes for practical exercises, effectively bridging the gap between theoretical coursework and applied observational astronomy. Furthermore, the observatory functions as a key training center for the Turkish National Astronomy and Astrophysics Olympiad Team[17]. During specialized training camps hosted at the observatory, the team extensively utilizes the planetarium's advanced simulation capabilities to prepare for international competitions.

The operational sustainability of these extensive outreach and educational programs heavily relies on the human power provided by student clubs at universities. Established in 1991, the astronomy student club Amateur Astronomers Club (AAK, in Turkish Amatör Astronomlar Kulübü[18]) at Istanbul University has actively organized scientific and public events for over three decades. From an academic perspective, these organizations play a critical role in capacity building. They provide undergraduate students with essential practical experience in observational techniques, seminar organization, and science communication, thereby significantly boosting academic motivation. A prominent example of this long-standing tradition is the "May Fest", which has been held continuously since the club's founding in 1991. In 2026, the 35th festival will be organized from 6 to 8 May 2026. Ultimately, these student-driven initiatives function as a vital mechanism for carrying the nation's astronomical heritage forward, ensuring the continuous training of future scientists.

Regarding student engagement at the Kandilli Observatory, the situation is shaped by its specific institutional framework. Since Kandilli is structured as a post-graduate research institute, and given its physical distance from the main campus of Boğaziçi University on the European side of Istanbul, the daily presence of undergraduate students is naturally limited. Consequently, its student body consists predominantly of post-graduate researchers.

[17] https://olimpiyat.astronomi.org
[18] https://aak.istanbul

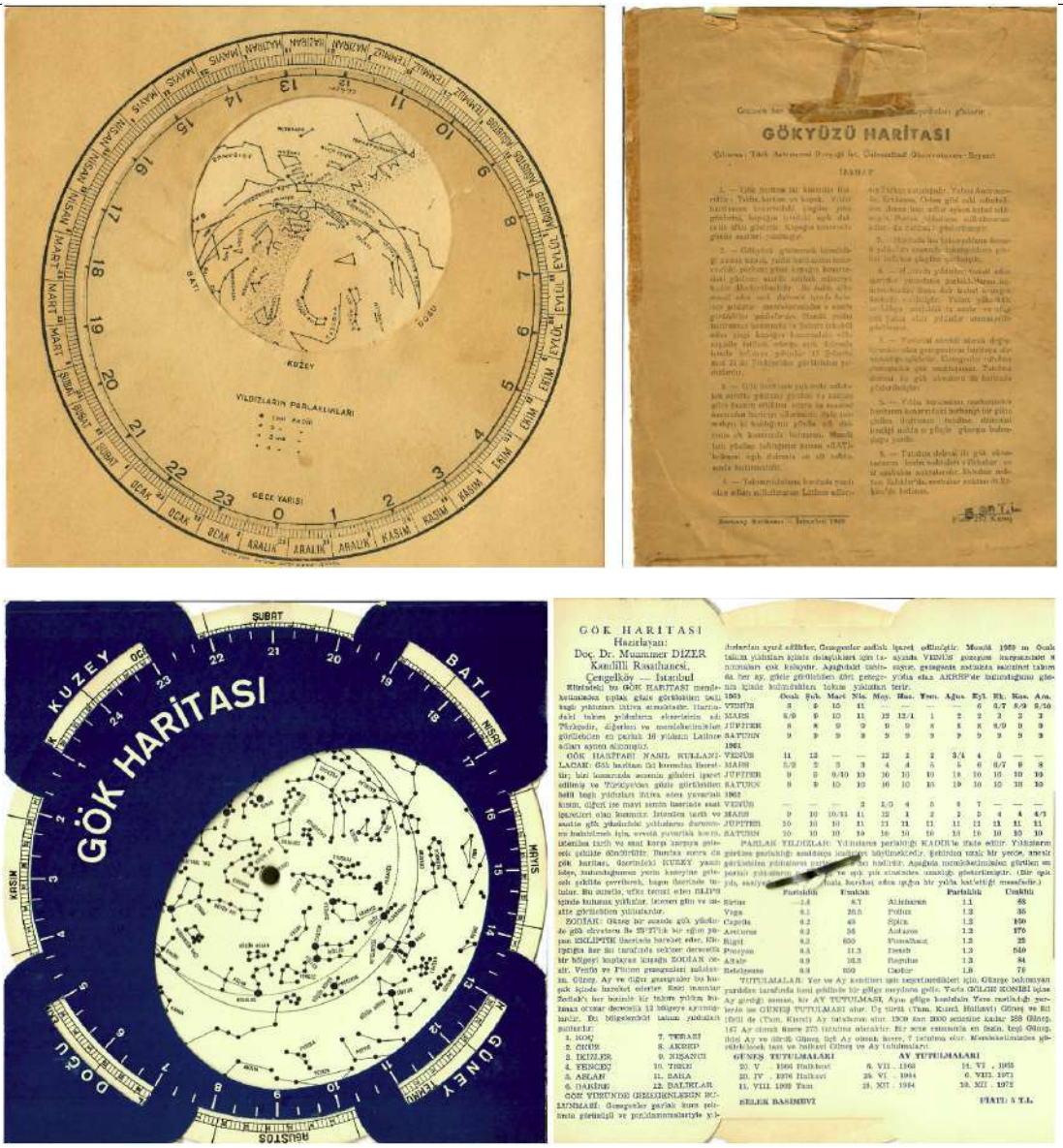

Figure 8. (top) The front and back covers of the sky atlas prepared in 1960 in collaboration with Istanbul University Observatory and the Turkish Astronomical Society. (bottom) The front and back covers of the sky atlas prepared by the Kandilli Observatory in 1960.

6. Conclusion

In conclusion, the astronomical heritage of Türkiye is not defined merely by the preservation of historical instruments or architectural landmarks, but by the sustained continuity of scientific inquiry. Kandilli and Istanbul University Observatories exemplify the concept of "living heritage," maintaining uninterrupted solar observation programs for more than eight decades while continuously adapting their scientific practices to evolving technological and educational contexts.

The preservation of this long-term solar archive represents both a major scientific asset and a methodological challenge. In particular, the extraction of quantitative information from decades of hand-drawn sunspot records has become an active area of research. Recent advances in machine learning and computer vision now enable the digitization and systematic analysis of these historical datasets, transforming archival material into high-precision, temporally extended data products. In this way, historical observations are being reintegrated into modern solar physics, effectively bridging past and present methodologies.

Equally central to the institutional identity of both observatories is their long-standing commitment to the democratization of scientific knowledge. This mission has historically been realized through the production of publicly accessible educational materials, including printed sky atlases. As illustrated in Figure 8, both Kandilli Observatory and Istanbul University Observatory independently prepared detailed sky maps around 1960, aimed at facilitating public engagement with astronomy. These efforts, carried out

doi: https://doi.org/10.52526/25792776-26.73.1-92

in part in collaboration with organizations such as the Turkish Astronomical Society (TAD)[19], reflect a sustained institutional philosophy in which public outreach and scientific literacy are regarded as integral components of astronomical practice. Today, this tradition continues through digital platforms that provide open-access data and educational resources.

By combining long-term data stewardship, public engagement, and the continuous training of new generations of researchers, these observatories have played a foundational role in shaping Türkiye's modern astronomical community. The academic culture and observational expertise cultivated over decades have directly contributed to the development of contemporary scientific infrastructure.

This legacy finds its most prominent modern expression in national-scale initiatives such as the Eastern Anatolia Observatory (Doğu Anadolu Gözlemevi, DAG), operating under the Türkiye National Observatories[20], and in the advancement of indigenous instrumentation projects, including the Mirya-μ1 detector. These developments demonstrate how historical institutions continue to inform and support cutting-edge astrophysical research.

Ultimately, Kandilli and Istanbul University Observatories serve as dynamic bridges between past and present, ensuring that the scientific vision, observational discipline, and human capital established in the early Republican era remain actively engaged in the advancement of 21st-century astronomy.

Acknowledgements

SF is grateful for the hospitality of the Byurakan Astrophysical Observatory staff. Authors acknowledge the support from the Istanbul University Observatory Research and Application Center and the Boğaziçi University Kandilli Observatory and Earthquake Research Institute.

References

Alis S., 2019, Astronomical Society of the Pacific Conference Series, 520, 95

Alis S., Saygaç A. T., Yelkenci F. K., 2024, Communicating Astronomy with the Public Journal, 34, 33

Aliş S., et al., 2020, Turkish Journal of Astronomy and Astrophysics, 1, 759

Benoist C., 2009, in Wolfschmidt G., ed., Cultural Heritage of Astronomical Observatories: From Classical Astronomy to Modern Astrophysics. pp 115–120

Bilsel C., 1943, İstanbul Üniversitesi Tarihi. Istanbul University Press, https://iupress.istanbul.edu.tr/book/istanbul-universitesi-tarihi/home

Dag M. K., Guver T., Gurkan G., et al. 2025, Advances in Space Research, 76, 1906

Devecioğlu E. E., Beyaz C., Toy Z., Eryılmaz M. İ., Dalkılıç Y., Bayram M. B., Başara S., 2024, Turkish Journal of Astronomy and Astrophysics, 5, 9

Eryılmaz M. İ., et al., 2023, Turkish Journal of Astronomy and Astrophysics, 4, 5

Gunergun F., Kadioglu S., 2006, Osmanli Bilimi Arastirmalari (Studies in Ottoman Science), 8, 135

Menteşe H. H., Esenoğlu H. H., Çalışkan H., 2002, Technical report, History of the Istanbul University Astronomy and Space Sciences Department (1933–2000), https://astronomi.istanbul.edu.tr/tanitim/tarihce/kurgunastro.pdf. İstanbul University Observatory, https://astronomi.istanbul.edu.tr/tanitim/tarihce/kurgunastro.pdf

Ötken S., Özel S., Bayram M. B., Kelkitli İ. Z., İçen M., Erol Z., Toy Z., Demirel B., 2025, Turkish Journal of Astronomy and Astrophysics, 6, 14

Reisman A., 2006, Turkey's Modernization: Refugees from Nazism and Atatürk's Vision. New Academia Publishing, Washington, DC

Sağlam M. T., et al., 2022, Turkish Journal of Astronomy and Astrophysics, 3, 8

Widmann H., 1973, Exil und Bildungshilfe: Die deutschsprachige akademische Emigration in die Türkei nach 1933. Peter Lang, Frankfurt am Main

Yılmaz F., 1956, Review of the Faculty of Science, University of Istanbul, Series C, 21, 110

Yılmaz F., 1969, İstanbul Üniversitesi Fen Fakültesi Mecmuası, Seri C, 34, 165

[19] https://www.tad.org.tr

[20] https://trgozlemevleri.gov.tr