NAZARİYAT

Modern Astronomy in Ottoman Madrasa Circles in the First Half of the 19th Century

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Abstract

The use of telescopes for scientific purposes has significantly changed our knowledge of the structure of the Solar System. By the mid-19th century, two new planets, a dozen asteroids, and dozens of satellites had been added to the five planets known since ancient times. The Ottoman scientific circles did not turn their back on these developments in the West but reflected them in their works. However, the main thesis about the transfer of current knowledge is that this transfer had mainly been done by modern educational institutions at a speed not too high. This claim is expressed more powerfully when considering the madrasa environment in particular. The literature states that the first work from a madrasa to mention the two new planets of Uranus and Neptune that were discovered in the modern period is Ḳonevī's (d. *circa* 19th century) *Tanqīḥ al-ashkāl*, written after 1857. This means a delay of 76 years for Uranus and at least 11 years for Neptune. This article aims to demonstrate that the first works to mention Uranus and Neptune did not originate from modern educational institutions and that the delay regarding the transfer of information did not occur as mentioned in the literature. This study shows that the first work to mentions Uranus was *Tashīl al-idrāk*, written by Ḳuyucakḳlızāde (d. 1263/1847) in 1831 and originating from a madrasa and that the first work to mention Neptune was Ḥayātīzāde's (d. 1267/1851) *Afkār al-jabarūt*, written in 1847, again originating from a madrasa, and published in 1848. Thus, this study hopes the exiting hypothesis in the literature, which has a great deal of support, will start to be questioned based on these examples.

Keywords: History of science, History of astronomy, Astronomy, Cosmology

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I. Introduction

Astronomy which is accepted as the first known exact science for its use of mathematics as a method of analysis, is classified in three disciplines for the classical and modern (pre-20th century) periods: observational astronomy (positional astronomy), theoretical astronomy (celestial mechanics), and cosmology.

Observational astronomy examines the apparent motions of celestial bodies on the celestial sphere. The apparent motions of celestial bodies vary with respect to an observer's location. For example, one star may be unobservable in some latitudes, or some circumpolar stars (those that stay above the horizon) may only be observed in certain latitudes. Celestial spheres should be redrawn for each latitude to compensate for latitude-based variations in the star layouts. The apparent motions analyzed according to the latitude of the observer are not affected by the changes that took place in cosmology, just like nothing changed by accepting the heliocentric (sun-centered) universe over the geocentric (Earth-centered) universe. Positional astronomy operates strictly in accordance with a geocentric universe. For this reason, it has remained practically unchanged throughout history apart from instrumental developments like the use of spherical trigonometry.

The aim of the second field, the theoretical astronomy is to produce a mechanism that maintains a one-to-one correspondence with the locations of celestial bodies and their apparent motions. This mechanism might correspond to a clock-like mechanical devise consisting of cogwheels located in a closed box. The input given from the face of the box is processed by the mechanism inside the closed box to produce output. The produced output is subjected to a test using positional astronomy. Because observation is superior to theory in astronomy, observations are taken as the basis when contradictions occur between the observation and output; as a result, the model is either modified or the mechanism is abandoned.

To produce a mechanism, arithmetic models are used like those in Mesopotamian astronomy, or geometrical models are used as in Ancient and Hellenistic Greece as well as in the successive Islamic and Western astronomies. Mechanisms differ from each other in terms of their modeling, such as the shape and format of the gears used in production. These mechanisms roughly involve the geometrical models presented in the classical and modern periods:

1. *The Model of Concentric Spheres* was developed by Eudoxus (d. 337 BC), used by Aristotle (d. 322 BC), and later revitalized by Andalusian astronomers.

2. *The Ptolemaic Model* has the basic geometrical features presented by Apollonius (d. 190 BC); its studies were initiated by Hipparchus (d. 120 BC) and evolved by Ptolemy (2nd century AD).

3. *The Kepler Model* was developed by Kepler (d. 1630) and gained a physical presence through scientists like Newton (d. 1727), Laplace (d. 1827), and Lagrange (d. 1813).

Two of the models mentioned above predict circular orbits for celestial bodies, while the last model assumes elliptical orbits. The fact that celestial bodies in reality move in elliptical orbits but are located in circular orbits for metaphysical purposes caused conflicts between observation and theory, as mentioned above. The history of theoretical astronomy up to Kepler had actually been the history of the efforts put forth to eradicate these conflicts. In spite of the various instruments developed for this purpose, such as the *Urdi Lemma* and *Tusi Couple,* the mechanism always experienced problems because the produced models were incongruent with the observed world. With the Kepler model, the mechanism had been adapted to actual motions in space; as a result, the problems that had lasted over a thousand years were solved. For this reason, the beginning of the 17th century when Kepler presented his laws is accepted as a milestone for modern theoretical astronomy.[1]

As the last field, cosmology is a sub-branch of astronomy that examines the structure of the universe as a whole and the distribution of celestial bodies throughout the universe. Three basic models of the universe had been presented prior to modern cosmology: The first was the geocentric model of the universe, which positioned the Earth at the center of the universe. This cosmology had been accepted as the standard model until the Copernican model and was supported by Aristotle who developed its mathematical and physical aspects. For this reason, this first basic cosmological model is known as Aristotle's Cosmology. The second model is the Geo-Heliocentric Model of the Universe developed by Heraclides Ponticus. According to this model, the Sun and Moon move around the Earth while the other celestial bodies orbit around the Sun. This model, which was later reconsidered by Tycho Brahe (d. 1601), was not accepted as an interim solution. The third and final model is the heliocentric model established by Aristarchus of Samos. According to this model, the Sun is located at the center of the universe. The relevant model was almost forgotten until resurrected Nicolaus Copernicus (d. 1543) in his *De Revolutionibus Orbium Coelestium* published in 1543 just before his death. The reappearance of the heliocentric model is considered the beginning of modern science due to the scientific and philosophical developments it led to.

Throughout history, the most important developments in astronomy probably began with the use of the telescope. The telescope had initially been developed for commercial purposes, but after a short while started being used in the sciences.

1 S. James Press and Judith M. Tanur, *The Subjectivity of Scientists and the Bayesian Approach* (New York: John Wiley & Sons, 2001), 23.

Other observational instruments in which the human eye is used as the basic tool of observation were replaced by instruments based on telescopes, which can magnify an area it is aimed at thousands of times. As a result, the limits for observing the universe had broadened dramatically, and with the observations from newly included areas, the universe began to be understood to not have an invariable structure as assumed in Aristotelian cosmology. With the initial usage of the telescope and the laws Johannes Kepler, a strong Copernican, presented under his name, the archaic Aristotelian cosmology and the Ptolemaic celestial mechanics that had constituted the theoretical framework of this cosmology, despite divergences from this cosmology on certain points, gave way to Copernican cosmology and Kepler's celestial mechanics that had been generated from Copernican cosmology despite problematical correlations.

This new age, which began with the discovery of the moons of Jupiter, can be called an age of discoveries. In fact, near the mid-19th century, two planets, approximately two dozen satellites, and about ten asteroids had been added to the family of the Solar System, in addition to the discovery of countless stars.

Ottomans' first direct encounter with modern astronomy took place in 1662 with Teẕkireci Köse Ibrāhīm Efendi's (d. *circa* 17th century) *Sajanjal al-aflāk fī ghāyat al-idrāk*.[2] The transfer of knowledge that occurred mostly through translations initially remained limited to practical astronomy but had started gaining a theoretical nature by the end of the 18th century, particularly with the establishment of schools of engineering. In this era, in which textbooks on modern astronomy were predominantly being written, astronomy continued to be taught in madrasas, the traditional educational institutions. Thus, students were being taught through re-conceptualizations in two educational establishments.

Very few studies are found on the course of modern astronomy in the Ottoman Empire. The general tendency in current studies is to arrange studies chronologically and give encyclopedic information about their contents. The most important study to digress from this point of view belongs to Robert Morrison.[3] In the introduction of his article, Morrison presents a short summary on how the Ottomans had received modern astronomy using Turkish sources; later on he mentions Ḳonevī's *Tanqīḥ al-ashkāl ʿalā Tawḍīḥ al-idrāk* (written in 1857) and defends the thesis that this work was the first work in madrasa circles to introduce recently discovered planets, satellites,

2 Ekmeleddin İhsanoğlu, "Batı Bilimi ve Osmanlı Dünyası: Bir İnceleme Örneği Olarak Modern Astronomi'nin Osmanlı'ya Girişi (1660-1860)", *Belleten* LVI/217 (1992): 729.

3 Robert Morrison, "The Reception of Early-Modern European Astronomy by Ottoman Religious Scholars", *Archivum Ottomanicum* 21 (2003): 187–195.

and asteroids. He compared the numerical values given by Ḳonevī with present-day values and gave information on the designation of Uranus and Neptune. Morrison's article maintained its importance despite containing some reading errors.[4]

Just as in Morrison's example,[5] the general opinion regarding the study of the Ottoman history of science is that the scientific developments that had taken place in Europe were introduced to the empire through modern educational institutions. However, the validity of this idea comes into question with regard to the field of astronomy. The first treatises to refer to the recently discovered planets had been written by *mudarri*s [educators in madrasas] and members of madrasas, not by teachers of Western-style educational institutions. The first treatise to refer to Uranus as far as this study has been able to determine is *Tashīl al-idrāk tarjama-i tashrīḥ al-aflāk* written by Ḳuyucaḳlızāde Muhammed Atıf in 1247/1831. Meanwhile, Neptune was first mentioned in *Afkār al-jabarūt fī tarjamat asrār al-malakūt*, written by Ḥayātīzāde Sayyid Şeref Halīl and published in 1265/1848. Although Ḳonevī's treatise lost its identity as a pioneering work, it has maintained its importance for including references to each of the other works, presenting a continuity of knowledge and showing what sort of compositions had been made while writing the treatise.

The most reasonable way to determine the output and correctness of the transfer of astronomical information in the 19th-century Ottoman Empire is to compare the information provided in the studies with current Western resources. Hence, neither the developments nor discussions of that era get overlooked, and the treatises can be examined with respect to the conditions of the period in which they'd been written. Using any other method will result in errors like judging the past with current data. For instance, current sources mention that only two of Uranus' satellites had been discovered by 1850. However, the assertion of the time was that William Herschel (d. 1822), the discoverer of this planet, had also observed six satellites for Uranus; this was accepted. For a long time, Uranus was acknowledged as having six satellites.[6] Meanwhile, current resources record the number of known satellites discovered at that period to have been two.[7] If the sources of the era are not taken into consideration, the opinion will form that the three authors had provided false information.

4 Morrison made some mistakes while reading the names of the asteroids. He latinized Ṣarara (Ceres) as Al-Ṣarrara and Falada (Pallas) as Al-Qilāda, 192.

5 Morrison, "The Reception of Early-Modern European Astronomy", 195.

6 Alexander von Humboldt, *Cosmos: A Sketch of a Physical Description of the Universe*, Vol. IV (Londra: Harrison & Sons, 1852), 526–527.

7 Patrick Moore, *The Data Book of Astronomy* (Bristol & Philadelphia: Institute of Physics Publishing, 2000), 193.

Discussions on the nomenclature of recently discovered celestial bodies constitute another important subject. As will be seen later on, the name given to a celestial body changes with respect to geography and time; in fact, different names have even been used in the same geography. For this reason, the names that are chosen when denoting celestial bodies contain valuable information on where and when its sources had been written.

Before analyzing the treatises, dwelling on the discoveries and names given to the celestial bodies recently added to the Solar System will be beneficial for better understanding this subject.

II. The Discovery and Designation of Uranus

Uranus, which is located just outside visible range, has actually been observed many times throughout history, but it was identified as a star. This is because the telescopes of the observing astronomers prior to Herschel lacked sufficient distinguishing power to show Uranus' motion relative to the stars. The first astronomer to have observed Uranus is British astronomer John Flamsteed (d. 1719). Flamsteed observed Uranus in 1690 in the area of the constellation Taurus; however, he had identified it as a star and cataloged it under the name 34 Tauri. Flamsteed observed Uranus again in 1712 and 1715. His successor James Bradley (d. 1762) repeated these observations in 1748, 1750, and 1753. Tobias Mayer (d. 1762), who'd sighted Uranus in 1756, also tabulated it as a star. French astronomer Pierre Charles Le Monnier (d. 1799) observed Uranus 10 times between 1764-1771 (six times just in 1769);[8] nevertheless, Uranus showed no motion relative to the stars as it was located at its apogee. As a result, he identified it as a star.

William Herschel discovered Uranus to be a planet in March, 1781. How to designate this planet kept public opinion engaged for a very long time. Many names were recommended. Herschel, who was also the official astronomer for the kingdom, suggested the name "Georgium Sidus" as a tribute to the currently reigning King George III (d. 1820). This suggestion, however, didn't find much support outside Britain. Johann Elert Bode (d. 1826), the famous science author, named this planet Uranus, which means the Titan of the heavens, the husband of Mother Earth, the father of Saturn, and the grandfather of Jupiter, according to mythology. Hence, the designation of the planets would reflect the family structure in mythology. At

8 Philip S. Harrington, *Cosmic Challenge: The Ultimate Observing List for Amateurs* (Cambridge: Cambridge University Press, 2011), 72.

the same time, French astronomer Joseph Jérôme Lefrançois de Lalande (d. 1807) considered the plausibility of naming the planet after its discoverer Herschel. While Lalande's suggestion was accepted in France, other countries adhered to Uranus.[9]

After the discovery of Uranus, the idea other planets might be a part of the Solar System led many amateur and professional astronomers to turn their telescopes toward the unexamined areas of the universe. The discovery of asteroids is a product of these endeavors.

III. The Discovery and Designation of Asteroids

The Titius-Bode law, named after the two who proposed it, is a hypothesis claiming a mathematical correlation exists between the distance a planet in the Solar System has from the Sun. The Titius-Bode law predicted the presence of a planet 19.6 astronomical units (AU) from the Sun. The calculations done after the William Herschel had discovered Uranus showed the planet to be located 19.2 AU away from the Sun.[10] This resulted in verifying the Titius-Bode law. The Titius-Bode law predicted another planet to exist between Mars and Jupiter at 2.8 AU from the Sun. Consequently, observations focused on the area between Mars and Jupiter to explore this predicted planet. In 1801, the keeper of the Palermo Observatory Giuseppe Piazzi (d. 1826) discovered a small planet 2.77 AU away from the Sun. The relevant planet was named Cerere Ferdinandea. Cerere Roma is the Italian version of Ceres, the goddess of agriculture, grains, and soil. Ferdinandea was given to honor Ferdinand, the King of Sicily (d. 1825) and patron of the observatory. The international community accepted the name as Ceres.[11]

By 1807, three small planets (Pallas, Juno, and Vesta) had been discovered in the same region. Nevertheless, all these so-called planets had point sources like stars but didn't emit light like other objects. However, they differentiated from stars due to their apparent motion. Herschel called these small planets asteroids, which means star-like in Greek.[12] Another asteroid was discovered in 1845 (Astraea) and three more (Hebe, Iris, and Flora) in 1847.

9 Owen Gingerich, "The Naming of Uranus and Neptune", *Astronomical Society of the Pacific* 352 (Ekim 1958): 9–15.

10 J. E. van Zyl, *Unveiling the Universe: An Introduction to Astronomy* (London: Springer-Verlag, 2012), 73.

11 Clifford J. Cunningham, *Discovery of the First Asteroid, Ceres: Historical Studies in Asteroid Research* (Springer, 2016), 57.

12 Clifford J. Cunningham, *Studies of Pallas in the Early Nineteenth Century: Historical Studies in Asteroid Research*, 2nd ed. (Springer, 2017), 251.

The following table illustrates the names, discovery dates, and discoverers of asteroids up to the end of 1848.[13]

Table 1. The Names, Discovery Dates, and Discoverers of Asteroids.

Name	Discovery Date	Discoverer
Ceres	January 1, 1801	Giuseppe Piazzi
Pallas	March 28, 1802	Heinrich Wilhelm Olbers
Juno	September 1, 1804	Karl Ludwig Harding
Vesta	March 29, 1807	Heinrich Wilhelm Olbers
Astraea	December 8, 1845	Karl Ludwig Hencke
Hebe	July 1, 1847	Karl Ludwig Hencke
Iris	August 13, 1847	John Russell Hind
Flora	October 18, 1847	John Russell Hind
Metis	April 25, 1848	Andrew Graham

These asteroid discoveries meant that the Titius-Bode law had been tested and passed successfully. The next goal for astronomers was to specify if the planet the law predicted actually existed. This was the main motivational source for the discovery of Neptune.

IV. The Discovery and Designation of Neptune

According to Newton's law of gravity, objects are attracted to each other directly proportional to their masses and inversely proportional to the square of the distance between them. As a result, the orbits of planets are not perfect geometrical shapes, and this is particularly valid for those near another object that can cause deviations due to its mass. In astronomy, deviations that occur in an orbit due to the force of gravity are called perturbations. The orbital parameters of Uranus were determined by means of modern celestial mechanics, the foundations of which had been laid by Kepler and Newton and further developed by Laplace and Lagrange. However, the calculations didn't match up with the observations. Uranus wasn't located in the orbit designated by the theoretical calculations. This was considered to be a result of perturbation. Independent from one another, John Couch Adams (d. 1892) from

13 Thomas Wm. Hamilton, *Dwarf Planets and Asteroids: Minor Bodies of the Solar System* (Houston: Strategic Book Publishing and Rights Co., 2014), 9–12.

Britain and Urbain Le Verrier (d. 1877) from France calculated the location of the planet that would cause the perturbation. Adams completed his calculations in September 1845. He approached George Airy (d. 1892), Britain's royal astronomer, with his research; however, Airy didn't conduct any observations, as he considered searching for new planets to be a desperate struggle.[14] The French astronomer Le Verrier, without knowledge of Adams' studies, finalized his preliminary investigation on November 10, 1845 and comprehensive calculations on June 1, 1846 then released these to the public.[15] When the news of Le Verrirer's calculations reached Britain, Airy requested the Cambridge Observatory to start observations, which began on July 29 of that year.[16] However, Adam's calculations gave the orbit parameters, not the location of the new planet;[17] for this reason, it couldn't be signified as a planet despite making two observations. Meanwhile Le Verrier applied to the Paris Observatory, asking for observations to be conducted, but was rejected. He asked for help from the Berlin Observatory at the earliest possible opportunity. He sent the results he'd reached to Johann Gottfried Galle (d. 1910), the one in charge of the Berlin Observatory. Galle obtained the letter on September 23, and by conducting observations that night with his assistant Heinrich Louis d'Arrest (d. 1875), he discovered Neptune just after midnight.[18] Hence, the backbone of the Solar System was completed on September 24, 1846.

The discovery of Neptune by Urbain Le Verrier opened discussions on how to designate the planet. Le Verrier suggested Neptune as a name on September 30; however, under the encouragement of François Arago (d. 1853), he abandoned Neptune and offered his name, Le Verrier, on October 5. However, Neptune was accepted internationally due to it being embraced by the British Board of Longitude.[19] This case can be seen clearly from the letter dated December 17, 1846 sent by Wilhelm von Struve (d. 1864), a member of the Saint Petersburg Academy of Sciences, to the newspaper *Athenaeum*.[20] French almanacs continued to use the names Herschel for Uranus and Le Verrier for Neptune. The May 1847 issue of *The American Journal*

14 Theo Koupelis and Karl F. Kuhn, *In Quest of the Universe*, 4th ed. (Jones & Bartlett Publishers, 2004), 314.

15 James S. Trefil, *A Scientist at the Seashore* (New York: Dover Publications, 2005), 46–47.

16 Ken Croswell, *Planet Quest: The Epic Discovery of Alien Solar Systems* (Oxford: Oxford University Press, 1999), 42.

17 Michael A. Seeds and Dana E. Backman, *Foundations of Astronomy* (Boston: Cengage Learning, 2017), 568.

18 Croswell, *Planet Quest*, 43.

19 Gingerich, "The Naming of Uranus and Neptune", 9–15.

20 *Athenaeum* 1008 (1847): 199.

of Science and Arts indicated the new planet to have been designated as Neptune with the decision of the British Board of Longitude and Le Verrier.[21] In this way, the uncertainty of its designation had came to and end, and the French also began using the names Neptune and Uranus.

Before the discovery of all of these planets using telescopes, the quantitative growth of the Solar System had been through the discovery of planetary satellites. After the archaic celestial bodies, the first objects to be added to the cosmological order were moons. These were the only new things to have been discovered by the beginning of the 17th century.

V. The Discovery of Planetary Satellites

Jupiter's satellites are important in the history of science as they were the first celestial bodies to be discovered with a telescope. Its satellites were independently explored, first by Kepler's student, the German astronomer Simon Marius (d. 1625) followed a couple days later by Galileo Galilei (d. 1642). While Marius did give his name to the satellites, these are known as the Galileo satellites because he had published their discovery first.[22] The following table contains the names, discovery dates and discoverers of Jupiter's moons.

Table 2. Designations, Discovery Dates, and Discoverers of Jupiter's Satellites[23]

Name	Discovery Dates	Discoverers
Ganymede	December 29, 1609 January 7, 1610	Simon Marius Galileo Galilei
Callisto	December 29, 1609 January 7, 1610	Simon Marius Galileo Galilei
Io	December 29, 1609 January 8, 1610	Simon Marius Galileo Galilei
Europa	December 29, 1609 January 8, 1610	Simon Marius Galileo Galilei

21 *The American Journal of Science and Arts* III (May 1847): 441.

22 Alexander von Humboldt, *Cosmos: A Sketch of a Physical Description of the Universe*, Vol. II (London: Hippolyte Baillere, 1848), 355–356.

23 von Humboldt, *Cosmos*, II, 355–356.

By the 19th century, Saturn had been discovered to have seven satellites. This number was upgraded to eight in 1848 with the discovery of Hyperion.[24]

Table 3. Designations, Discovery Dates, and Discoverers of Saturn's Moons

Name	Discovery Dates	Discoverer
Titan	March 25, 1655	Christiaan Huygens
Iapetus	October 25, 1671	Giovanni Domenico Cassini
Rhea	December 23, 1672	Giovanni Domenico Cassini
Tethys	March 21, 1684	Giovanni Domenico Cassini
Dione	March 21, 1684	Giovanni Domenico Cassini
Enceladus	August 28, 1789	William Herschel
Mimas	September 17, 1789	William Herschel
Hyperion	September 16, 1848	William Bond George Bond William Lassell

Herschel, who had also discovered Uranus, claimed to have observed six of Uranus's moons: the second and fourth in 1787, the first and fifth in 1790, and the third and sixth in 1794. Uranus's second and fourth satellites are currently known as Titania and Oberon, respectively. The first and sixth satellites of Uranus were claimed to be observed, but later signified to not have been moons. However, Uranus' third and fifth satellites had yet to be observed.[25] Herschel's scientific influence had caused the continued acceptance of the satellites he claimed to have observed. William Lassell (d. 1880) discovered Uranus' satellites known as Ariel and Umbriel in 1851.

Table 4. Designations, Discovery Dates, and Discoverers of Uranus' Satellites[26]

Names	Discovery Dates	Discoverers
1	January 18, 1790	William Herschel
2 (Titania)	January 11, 1787	William Herschel
3	March 26, 1794	William Herschel

24 James A. Hall III, *Moons of the Solar System: From Giant Ganymede to Dainty Dactyl* (New York: Springer, 2016), 106–107.

25 Alexander von Humboldt, *Cosmos: A Sketch of a Physical Description of the Universe*, vol. IV (London: Harrison and Sons, 1852), 526–527.

26 Hall III, *Moons of the Solar System*, 152.

4 (Oberon)	January 11, 1787	William Herschel
5	February 9, 1790	William Herschel
6	February 28, 1794	William Herschel
Ariel	October 24, 1851	William Lassell
Umbriel	October 24, 1851	William Lassell

During that time, only one satellite was discovered for Neptune on October 10, 1846 by William Lassell. It is called Triton.[27]

The Ottoman Empire was receptive to modern astronomy, which had started with heliocentric cosmology naturally been accelerated by Kepler in the theoretical field and by Galiei in the observational field. The transfer of knowledge, which had started 100 years after Copernicus, had grown exponentially and reached its peak under the particular influence of modernization efforts.

VI. The Ottoman Empire's Reception of Modern Astronomy

The first known treatise based on this new astronomy in the Ottoman Empire was Teẕkireci Köse Ibrāhīm Efendi's *Sajanjal al-Aflāk fī ghāyat al-idrāk* written between 1660-1664 as a translation of French astronomer Noël Durret's (d. 1650) *Novæ motuum cælestivm ephemerides Richelianæ: annorum 15, ab anno 1637 incipientes, ubi sex anni priores e fontibus Lansbergianis, reliqui vero e numeris Tychoni-Keplerianis eruntur, quibus accesserunt*.[28] Although Ben-Zaken stated this book to have been presented to the Ottoman palace in 1638, possibly by the French ambassador of the time,[29] the earliest edition of the treatise had been published in Paris in 1641. This work more likely had reached the palace after that date.

The second treatise on modern astronomy in the Ottoman Empire was Abū Bakr b. Bahrām al-Dimashqī's (d. 1102/1691) geographical work *Nuṣrat al-Islām wa-l-surūr fī taḥrīr Aṭlas Mayor*.[30] The original treatise was called *Atlas Maior*, but Willem Blaeu (d. 1638) and his son Johannes (d. 1673) had published the treatise under various names in Amsterdam between 1662-1665. al-Dimashqī started the

27 Hall III, *Moons of the Solar System*, 172.

28 İhsanoğlu, "Batı Bilimi ve Osmanlı Dünyası", 729.

29 Avner Ben-Zaken, "The Heavens of the Sky and the Heavens of the Heart: The Ottoman Cultural Context for the Introduction of Post-Copernican Astronomy", *The British Journal for the History of Science* 37/1 (March 2004): 10.

30 Adnan Adıvar, *Osmanlı Türklerinde İlim*, 4. print (Istanbul: Remzi Bookstore, 1982), 154.

translation of the 11-volume Latin treatise in 1675 and completed it in 1685. The treatise does not include the entire work; however, it does contain an appendix written by al-Dimashqī.[31]

Yirmisekiz Mehmed Çelebi (d. 1732), the first permanent ambassador of the Ottoman Empire, visited a Parisian observatory during his 11-month assignment in 1720. He had the opportunity to conduct observations of the Moon by means of the telescope found there.[32] Among Mehmed Çelebi's attendants were his son Saʿīd Paşa and Ibrāhīm Müteferriḳa (d. 1745), who would go on to establish a printing press in Istanbul after his return.

Kātib Çelebi's (d. 1657) treatise *Cihānnumā* was among the treatises Ibrahim Muteferrika published using the printing press. Ibrahim Muteferrika appended a section titled *Tazyīl al-tābiʿ* at the end of a 1732 publication of this treatise published in 1732.[33] In this appendix, Müteferriḳa comprehensively explained the Ptolemy, Brahe, and Copernicus systems but adopted a cautious attitude in deciding among them.[34] Meanwhile, a year later in 1660, Ibrāhīm Müteferriḳa translated the star catalogue *Harmonia Macrocosmica Sev Atlas Universalis Et Novus, Totius Universi Creati Cosmographiam Generalem, Et Novam Exhibens* (also known as *Atlas Coelestis*) from the Dutch astronomer Andrea Cellario (d. 1665) and published it under the name *Majmūʿat hay'at al-qadīm wa-l-jadīd*. This treatise contains detailed explanations for all three systems.

ʿOs̱mān b. Abd al-Mannān, a translator in Belgrade, translated Bernhardus Varenius's (d. 1650) geographic work *Geographia Generalis: In qua affectiones generales Telluris explicantur* which had first been published in 1650 through the incentive of Belgrade's governor, as *Tarcama-i Kitāb-ı Cografya* in 1752.[35] However, the astronomy-related parts of this treatise had been provided as summaries.

The translation of two other *zīj*s [treatise] also occurred in the 18th century. Both of the translations belong to Kalfazāde İsmail Çınārī, who at the same time was a *muwaqqit* [person at a mosque responsible for when the call to prayer is made]. The first was in 1767 and called *Raṣad-i qamar*; it was a translation of the Moon Tables

31 Adıvar, *Osmanlı Türklerinde İlim*, 154–155.

32 Hüner Tuncer, "Yirmi Sekiz Çelebi Mehmet Efendi'nin Fransa Sefaretnamesi (1132–1133 H./1720-21 M.)", *Belleten* LI/199 (1987): 131–151.

33 Adıvar, *Osmanlı Türklerinde İlim*, 170.

34 Adıvar, *Osmanlı Türklerinde İlim*, 171.

35 Adıvar, *Osmanlı Türklerinde İlim*, 188.

from the work *Théorie de la lune* by Alexis Claude Clairaut (d. 1765).[36] Clairaut had published this work in 1754, in which he presented his observations as tables using the model he had developed for solving the apogee[37] problem of the Moon. These are the tables Ismāʿīl Çınārī translated.

The second work Çınārī Efendi translated was the work from French astronomer Jacques Cassini (d. 1756) published in 1740 as *Tables astronomiques du soleil, de la lune, des planètes, des étoiles fixes et des satellites de Jupiter et de Saturne*. The translation was completed in 1772 under the name *Tuḥfe-i Behīc-i Raṣīnī Terceme-i Zīc-i Ḳasinī*.[38]

Seyyid Ali Efendi (d. 1809), who had been sent to Paris in 1797 as the ambassador for the Ottoman Empire, stated in his memoires that he had visited the Paris Observatory and observed the Moon using a telescope.[39] Astronomy lectures were called *ʿilm-i hay'a* at the Engineering Schools of Mühendishāne-i Baḥrī-i Hümāyūn (1773) and Mühendishāne-i Barrī-i Hümāyūn (1795) in particular, which taught using a modern curriculum.[40] These courses are first given by Ḥüseyin Rıfḳı Tamānī (d. 1817).[41] Sayyid Ali Efendi, the subsequent chief instructor there, translated the treatise *al-Fatḥiyya* by ʿAlī al-Qūshjī to Turkish under the name *Mir'āt-i ʿālem*; he additionally referred to the Brahe and Copernicus systems in the preface.[42] The following chief instructor of Mühendishāne was Isḥāḳ Efendi (d. 1836), who gave wide coverage to astronomy in his work *Mecmūʿa-i ʿulūm-i Riyāżiyye*, written between 1831-1834.[43]

Meanwhile, Müneccimbaşı Ḥüseyin Ḥüsnī Efendi (d. 1840) translated Jérôme Lalande's (d. 1807) treatise *Tables astronomiques de M. Halley pour les Planétes & les Cometés, réduites au nouveau stile & au méridien de Paris, augmentées de plusieurs Tables nouveiles de différens Auteurs pour les satellites de Jupiter & les Etoiles fixes, avec des explications détaillées & l'historie de la Cométe de 1759* under the name *Terceme-i Zīc-i Laland*.[44] Lalande had corrected the errors pertaining to the orbit of Halley's comet in his treatise.

36 İhsanoğlu, "Batı Bilimi ve Osmanlı Dünyası", 758.

37 Apogee: The point which a celestial body rotates around it and it's the farthermost to the other celestial body.

38 Adıvar, *Osmanlı Türklerinde İlim*, 200.

39 Emre Dölen, "Tanzimat'tan Cumhuriyet'e Bilim" *Tanzimat'tan Cumhuriyet'e Türkiye Ansiklopedisi*, vol. I (İstanbul: İletişim Publications, 1985), 165.

40 Ekmeleddin İhsanoğlu, "Osmanlı Devleti'ne 19. YY.'da Bilimin Girişi ve Bilim-Din İlişkisi Hakkında Bir Değerlendirme Denemesi", *Toplum ve Bilim* 29/30 (Spring/Summer, 1985): 80.

41 İhsanoğlu, "Batı Bilimi ve Osmanlı Dünyası", 761.

42 İhsanoğlu, "Batı Bilimi ve Osmanlı Dünyası", 762–763.

43 İhsanoğlu, "Batı Bilimi ve Osmanlı Dünyası", 763.

44 Yavuz Unat, "Zîc", *DİA* (*TDV İslâm Ansiklopedisi*), XLIV, 398.

The astronomy lectures were popularized in these recently established educational institutions; astronomy courses were also given in the Rüşdiye schools initiated in 1838 and the *i'dādī* schools initiated in 1869.[45]

Cerīde-i Ḥavādiṣ, the first Turkish semiofficial newspaper, gave wide publicity to astronomy in its columns compared to the other sciences. In one article published in 1843, the Earth is stated to rotate around the Sun in an elliptical orbit. Another article published in 1845 discussed whether life exists on the Moon.[46]

This interest in modern astronomy inevitably affected madrasas, the Ottoman Empire's centers for knowledge production. The *Mudarris*es *[Madrasa teachers]* followed contemporary events and didn't hesitate to reflect the emerging developments on their works. The first known person to exemplify this type of ulama was Ḳuyucaḳlızāde Muḥammed 'Āṭıf.

VII. Ḳuyucaḳlızāde Muḥammed 'Āṭıf and *Tashīl al-idrāk*

Not much is known about Ḳuyucaḳlızāde's life. He was a member of a family of the *'ulama'* class from the Kuyucak district in Nazilli (town in Western Turkey). After his duty as *mudarris*, he officiated as a *qadi* [Islamic judge] in İzmir in 1238/1822 and later in Damascus. He was assigned as Qadi of İstanbul on Rabi al-thani 14, 1262/ April 11, 1846 and passed away there on Rabi al-awwal 11 1263/February 27, 1847.

Muḥammed 'Āṭıf is known for six treatises; however his work relevant to the current study was the translation he'd made as Qadi of Damascus of a work used in Ottoman madrasas as a textbook, *Tashrīh al-aflāk*[47] written by Bahā' al-Dīn al-'Āmilī (d. 1031/1622). He titled the translation *Tashīl al-idrāk Tarjama-i Tashrīh al-aflāk* in 1247/1831. Three known copies of this work are known to exist. The libraries housing these copies and the dates they were written are as follows:[48]

Kandilli Observatory Library, no. 127/l (Author's edition, 1247/1831); Istanbul University, Library of Rare Books, TY 6545 (Copied on 5th Muharram 1252/22th April 1836);

Kandilli Observatory Library, no. 135 (copied in 1258/1842).

45 Dölen, "Tanzimat'tan Cumhuriyet'e Bilim", 166.

46 Orhan Koloğlu, "Osmanlı Basını ve Bilim", *Tanzimat'tan Cumhuriyet'e Türkiye Ansiklopedisi*, vol. I (İstanbul: İletişim Publications, 1985), 158.

47 Cevat İzgi, *Osmanlı Medreselerinde İlim: Riyâzî ve Tabiî İlimler* (İstanbul: Küre Publications, 2019), 360.

48 Ekmeleddin İhsanoğlu, Ramazan Şeşen, Cevat İzgi, Cemil Akpınar and İhsan Fazlıoğlu (Haz.), *Osmanlı Astronomi Literatürü Tarihi*, vol. II (İstanbul: IRCICA, 1997), 589–590.

The 3rd edition had been copied from the first edition, which at the time was still the author's copy. The copyist is uncertain. No alterations or edits were made to the copy. The second copy, however, whose copyist is uncertain, differs from the other copies to an extent. In the course of copying, the main frame of the text was preserved; however, significant additions were made to the section on modern cosmology and to the values for orbital periods. The number of planetary satellites given in the other copies have been corrected. Hence, two versions of the treatise can be mentioned in terms of content. For this reason, the term first version is plausibly used for the first and third copies and second version for the second copy.

In the first section of the treatise on geocentric and heliocentric cosmology, Ḳuyucaḳlızāde refers to a recent discovery of a new planet called Herschel:

Recently, an English astronomer named Herschel observed a planet that completes its rotation in approximately eighty-four solar years, designating it with his name as Herschel and regarding it as one of the major celestial bodies.[49]

This astronomical topic takes place in Volume IV of the 1834 treatise *Mecmūʿa-i ʿulūm-i riyāżiyye*, the famous treatise from Hoca Isḥāḳ Efendi. The majority of science historians regard this treatise as the most competent source for modern sciences of the era. This treatise refers to Uranus as well.[50] The quoted passage above can also be found in the author's edition dated 1831; hence, Ḳuyucaḳlızāde couldn't possibly have utilized *Mecmūʿa-i ʿulūm-i riyāżiyye* while writing *Tashīl al-idrāk*. Therefore, *Tashīl al-idrāk* becomes the first known treatise to mention Uranus.

Both the first and the second versions of the treatise contain an image describing the heliocentric system of the universe.[51] Another planet is located beyond Saturn in the first version, but its name isn't written. This oversight is removed in the second version, and the planet is identified as Herschel.

As can be seen from Table 1, four of the asteroids that are fundamental members of the Solar System, are not mentioned in the book although they had been discovered by the time the work had been written.

The book suggested various equivalents for the term of satellite such as *Sātallītā*, *Sayyārāt-i Thānawiyya*, *Sayyārāt-i Saghīra*, and *Aqmār*,[52] which means *Ḳamercik*[53] [little

49 Ḳuyucaḳlızāde Muḥammed ʿĀṭıf, *Tashīl al-idrāk tarjama-i Tashrīḥ al-aflāk*, Kandilli Observatory Library 127/1, 5a–b.

50 Hoca Isḥāḳ Efendi, *Mecmūʿa-i ʿulūm-i riyāżiyye*, vol. IV (Istanbul: Matbaa-i Āmire, 1250), 212.

51 Ḳuyucaḳlızāde *Tashīl al-idrāk*, 11a (Kandilli); 23b (Istanbul University Library of Rare Books TY 6545).

52 Ḳuyucaḳlızāde, *Tashīl al-idrāk*, 23a (Istanbul University).

53 Ḳuyucaḳlızāde, *Tashīl al-idrāk*, 11a (Kandilli).

moon] in the first version and *shāṭir* [butler] in the second version. Among these equivalents the most remarkable one is *Sātallītā*. This term is understood to derive from the word *satellite*, which means orbiter in English and French. This shows that the author or the copier didn't use foreign sources just to collect computational data but also had performed more extensive research and knew at least one Western language at a level proficient enough for reading a scientific text.

The first version of the treatise only uses the name Herschel in reference to Uranus;[54] the second version, however, uses both Herschel and Ūrānūs.[55] As stated previously, Herschel had originally been the name France used for Uranus, while other countries had preferred Uranus. This situation reveals that other sources had been used alongside the French ones while writing the second version.

The first and second versions of *Tashīl al-idrāk* present the orbital periods of the planets in the Solar System and of the Moon.[56] These approximations are the same in both versions for all the celestial bodies except the Moon. The first version provides a value of 28 days for the Moon's orbit, and the second version states it as 27 days. The orbital period of the Moon is about 27.3 days. For this reason, the second value given for the Moon's orbital period is more correct. Table 5 lists the values given in the treatise. The second value given for the Moon is shown in parentheses. I have appended the designations of the planets given inside parentheses.

Table 5. Orbital Periods of the Planets and the Moon According to Ḳuyucaḳlızāde

Name	Orbital Period
ʿUṭārid (Mercury)	Approximately 3 Months
Zuhra (Venus)	Approximately 8 Months
Qamar (Moon)	28 (27) days
Mirrīkh (Mars)	Approximately 2 years
Mushtarī (Jupiter)	Approximately 12 years
Zuḥal (Saturn)	Approximately 30 years

Ḳuyucaḳlızāde also presented the number of satellites the different planets have.[57] The different versions present consistent values for Jupiter (four satellites); the first

54 Ḳuyucaḳlızāde, *Tashīl al-idrāk*, 5a-b (Kandilli).

55 Ḳuyucaḳlızāde, *Tashīl al-idrāk*, 23a (Istanbul University).

56 Ḳuyucaḳlızāde, *Tashīl al-idrāk*, 10b–11a (Kandilli), 22b–23a (Istanbul University).

57 Ḳuyucaḳlızāde, *Tashīl al-idrāk*, 11a (Kandilli), 23a (Istanbul University).

version shows six for Saturn, while the second version shows five. The first version references for Uranus while the second version states Uranus to have seven. Table 6 provides this information in detail.

Table 6. The Number of Satellites Planets Have According to Ḳuyucaḳlızāde

Planet	Number of Satellite
Mushtarī (Jupiter)	4
Zuḥal (Saturn)	6 (5)
Hershel (Uranus)	(7)

The number of the satellites Jupiter is shown to have is compatible with the sources of the period. Nevertheless, an insufficient number of satellites is given for Saturn. As can be seen from Table 3, Saturn's seven satellites had been discovered by the time the treatise was written. Accordingly, the first version is missing one satellite and the second version is missing two. The two additional satellites had been discovered in 1789, hence in terms of internal consistency, the fact that the manuscript is missing two satellites instead of one is sensible. This gives the impression that the mistake in the first version was corrected in the second version. As a result, the source used for Saturn's satellites must be written before 1789. As for Uranus, either the number of the satellites had been erroneously transferred to the work or a source had been used that provided false information. As stated in Table 4, Herschel claimed to have observed the satellites of Uranus between 1787-1794. Starting from this point of view, the source used for providing the number of satellites Uranus has must pertain to 1794 or later. This means that more than one source had likely been used for counting the number of Uranus' satellites.

According to Ḳuyucaḳlızāde, other stars are sunlike and have planets around them.[58] This statement means that each star with its planets forms a structure similar to the Solar System. From this, one can conclude that Ḳuyucaḳlızāde considered the number of solar systems in the universe to equal the number of stars. The fact that this theory, which had been first stated by Giordano Bruno (d. 1600) in the modern era, is found in the work of a scholar with a classical education is spectacular. Ḳuyucaḳlızāde's book was not a marginal, neglected treatise. As will be seen, any *mudarris* like Ḳonevī actively teaching in an Anatolian madrasa was probably aware of this treatise and used it as a reference while writing their own works. This shows that this treatise had some kind of recognition in the madrasa environment. The

58 Ḳuyucaḳlızāde, *Tashīl al-idrāk*, 11a (Kandilli), 23a (Istanbul University).

historians of science frequently talk about tensions between the defenders of modern science and the religious circles (i.e., ulama). This view may not be as set in stone as is assumed. The fact that a fringe element of modern science was expressed comfortably and not excluded from madrasas, which continued to transmit the classical sciences institutionally, is very important. However, another *mudarris*, Ḥayātīzāde Seyyid Şeref Halīl, also had daring opinions for his time: He believed the Solar System had many celestial bodies waiting to be discovered.

After Ḳuyucaḳlızāde, the second most significant name to originate from a madrasa is Ḥayātīzāde Seyyid Şeref Halīl. However, a brief mention of ʿAbbāsḳulu Ağa Bākīhanlı (d. 1846) and his work *Asrār al-malakūt*, which Ḥayātīzāde translated, will be useful before moving on to Ḥayātīzāde.

VIII. ʿAbbāsḳulu Ağa Bākīhanlı (Ḳudsī from Baku) and *Asrār al-malakūt*

Born in 1208/1794, ʿAbbāsḳulu Ağa was a member of a notable Azerbaijan family. The author, also a poet, uses the pseudonym of Ḳudsī from Baku in his poems and is thus also known by this name. He received a decent education as a child, and Russia invited him to Tbilisi in 1235/1820. ʿAbbāsḳulu Ağa, who served in the Russian Army as a top official for many years, had learned Russian and become acquainted with the European sources that had been translated to Russian. While the author was serving in the Russian military between 1839-1840, he wrote the treatise *Asrār al-malakūt* in Arabic; this treatise predominantly involves the subjects of mathematical geography and astronomy. ʿAbbāsḳulu visited Istanbul (Shawwal 12, 1262/October 3, 1846) toward the end of his life, at which time Sultan Abdülmecid (d. 1861) accepted him as the Russian ambassador. During a meeting with the Sultan (Shawwal 14, 1262/ October 5, 1846), he presented his work *Asrār al-malakūt*. An elaborate article appeared in regard to this topic in the newspaper *Allgemeine Zeitung München* (issue dated October 30, 1846). After this visit, the author went on a pilgrimage to Mecca by way of Egypt. After performing his religiously obligatory Hajj, he came down with the plague on his return and passed away at the end of 1262/1846.

The treatise ʿAbbāsḳulu Ağa had presented to the Sultan was appreciated and by command of the Sultan was translated to Turkish by one of the *mudarris*es of the time, Ḥayātīzāde Seyyid Şeref Halīl. Because no copy of *Asrār al-malakūt* is currently available, the page numbers quoted in Ḥayātīzāde's translation *Afkār al-jabarūt fī tarjamat Asrār al-malakūt* will be given for the page number in the original treatise.

IX. Ḥayātīzāde Seyyid Şeref Halīl and *Afkār al-jabarūt*

Ḥayātīzāde Seyyid Şeref Halīl was born in 1211/1796 in Elbistan. His father was Hayātī Aḥmed Efendi, a poet at the time. He took his primary education from his father and studied Arabic with him. Due to his father being assigned as a *mudarris* of Istanbul, he had five years of education there. After this, the family returned to Elbistan. In 1260/1844, he wrote *Nukhba*, an exegesis to Sünbülzāde Vehbī Efendi's work, and presented it to the Sultan. Some sources claim he was assigned as a visiting hodja of madrasa in that same year (1262/1846).[59] While performing this duty, he became the qadi of Baghdad from in 1266/1850 until 1267/1851. That same year he passed away in his hometown.

When Ḥayātīzāde started translating ʿAbbāsḳulu Ağa's work *Asrār al-malakūt* under the name *Afkār al-jabarūt fī tarjamat Asrār al-malakūt*, he was serving as a *mudarris* in the Ḥācī Niʿmetullah Madrasa of Istanbul's Uskudar district.[60] When the translation concluded is not known; from the collection of biographies[61] dated Shaban 5, 1264/July 7, 1848, one can conclude that the book, which was being published and sent to the minister of Takvimhāne, had been completed prior to this date. The treatise was published by Dār al-Ṭıbaʿāt al-ʿĀmira Printing House between Muharram 1-10, 1265/November 27-December 6, 1848.

Afkār al-jabarūt cannot be described as simply a translation. Ḥayātīzāde had transformed the small-sized *Asrār al-malakūt* into a voluminous treatise with the explanations and annexes he added. He pursued the following path while translating: After translating one or two sentences from the treatise, he would explain these in detail and add any current updates. He defined terms alongside the author in some parts of the treatise and suggested specific ideas to prove his opinions.

When reading the treatise from start to finish, the translation process can be easily seen. The author indicates dates when adding recent developments to the treatise. For example, the discovery of Neptune was narrated as follows:

Monsieur Luveriye, a Frenchman in essence and a member of the University in Paris, tried to examine the reasons for some of the perturbations occurring in the orbit of the planet Herschel/Ūrānūs. He tried to examine the condition and movement of the planet, and consequently found the occurring perturbations to be a result of the effect of the rotation and movement of an unknown and undiscovered planet. In accordance with modern astronomy and calculus; working laboriously, he found

59 DABOA, İ.DH., Box 116, Case No 5856.

60 DABOA, A.DVN., Box 45, Case No 59.

61 DABOA, A.MKT., Box 138, Case No 12.

this planet's position relative to the planet Herschel's orbit as well as its magnitude, movement, orbiting period and distance from the Sun working. He announced this situation to his other colleagues who also study modern astronomy. They examined and verified this subject; hence Monsieur Luveriye's observations were confirmed, and the aforementioned planet was denominated with his name. He was awarded the first rank of Legion D'honneur Medal by the State of France. Hence, the number of discovered planets being twelve in terms of the method of modern astronomy has been written and summarized in the copies of Taḳvīm-i Veḳāyi', published eight months prior to the newspapers of France and other countries. The planet Luveriye is more distant from the Sun relative to other planets in terms of the studies and arguments of the aforementioned observer, its distance from the Sun is [1,250,000,000] French miles, or 38 times the distance of the Earth from the Sun. While rays of light reach from the Sun to the Earth in eight minutes, they reach this star in five hours. Sound waves, which travel a distance of 163 miles per hour, take 543 years to reach this star. This planet is 230 times larger than Earth and nine times smaller than Sun in magnitude and has a orbital period around the Sun that is 217 times that of the Earth, or 217 years. In brief, the case of this planet has been explained on the first day of the holy Rajab of this 1263rd year AH [June 15, 1847]: The number of planets has reached 12, and the number of the satellites has reached 18, maybe 19.[62]

Although this section is the first passage to refer to Neptune in the history of Turkish science, it's a summary of an article that had been published in *Taḳvīm-i Veḳāyi'* (issue 308), dated dhu-l-qi'da 24, 1262/November 13, 1846. Considering that Neptune had been discovered on September 23, 1846, *Taḳvīm-i Veḳāyi'* can be understood to have been closely following scientific developments. A section in certain issues of *Taḳvīm-i Veḳāyi'* announced current scientific developments using translations from French newspapers in particular under the heading "*Funūn*". The official newspaper of the era being so responsive to scientific developments is remarkable for how it reflects the government's perspective on science.

Similarly, the discovery of a sixth asteroid, Hebe, is found in the treatise:

On the eight day of the month Ramadan (August 20, 1847), it's written in the copies of the 348th issue of Taḳvīm-i Veḳāyi' that an observer named Hensek [Karl Ludwig Hencke] from the community of the Prussia State's city of Deryesan [Driesen] discovered a planet [Hebe] in the beginning of the July according to the Gregorian calendar [July 1, 1847] in addition to the explored and examined planets

62 Ḥayātīzāde Seyyid Şeref Halīl, *Afkār al-jabarūt fī tarjamat Asrār al-malakūt* (Istanbul: Dār al-Ṭibā'at al-'Āmira, 1265), 166–167.

so far. The aforementioned planet has also been observed in the observatories of Berlin and Paris. This planet, being discovered between Mars and Jupiter before, was counted as one of the five inferior planets and a part of a big fragmented star as other publicly known stars as a result of the examinations and predictions of the observers. The magnitude, the orbital period of this star, and its relation to the other planets has yet to come to light. However, French newspapers have written that it's 25,000 times smaller than the Earth, 540 times smaller than the Moon, and smaller than the planet Vestā discovered 40 years ago. Accordingly, the number of the planets has reached 13, in which case how one can judge that no other planet will discovered apart from these known ones.[63]

From this summary of the news in *Taḳvīm-i Veḳāyiʿ*, the author can be understood to have followed daily current developments and included them in his treatise. However, he didn't eliminate outdated information with back corrections while doing this. This preference enables one to follow the development of the treatise easily.

Ḥayātīzāde differentiated planets from satellites in his treatise. The term planet corresponds to the terms *Sayyāra-i Aṣliyya* and *Sayyāra-i Awwaliyya*, while the term satellite corresponds to the terms *Sayyārat al-Sayyāra*, *Sayyāra-i ghayr al-aṣliyye*, *Sayyāra-i Thānawiyya*, *Aqmār al-Sayyāra*, *Peyk*, *Qamar*, *Solaḳ*, *Tawābiʿ al-Sayyār*, *Darāy al-Kawākib*, and *Saṭāllīd*.[64] Of these, the term *Saṭāllīd* resembles most the term *Sātellītā* from Ḳuyucaḳlızāde.

According to Ḥayātīzāde, satellites numbered 18 or 19, with one for the Earth, four for Jupiter, seven or eight for Saturn, and six for Uranus.[65] The number of satellites is given in the following table.

Table 7. The Number of Planetary Satellites According to Ḥayātīzāde

Planet name	Number of satellites
Arḍ (Earth)	1
Mushtarī (Jupiter)	4
Zuḥal (Saturn)	7 (8)
Hershel (Uranus)	6
Total	18 (19)

63 Ḥayātīzāde, *Afkār al-jabarūt*, 167–168.

64 Ḥayātīzāde, *Afkār al-jabarūt*, 160.

65 Ḥayātīzāde, *Afkār al-jabarūt*, 161.

The orbital periods for the satellites of Jupiter, Saturn, and Uranus are provided in the treatise's epilogue. The mentioned values are compatible with current information. The satellites are designated in numerical order. When examining Western sources of the period, one can see the general tendency to have been this. The names in the following table given in parentheses under Satellite Name are their names in the literature, which I've added to allow for comparisons.

Table 8. Orbital Periods of Jupiter's Satellites According to Ḥayātīzāde[66]

Satellite Name	Orbital Period
First (Io)	1 day 18 hours 28 minutes 36 seconds
Second (Europa)	3 days 13 hours 17 minutes 54 seconds
Third (Ganymede)	7 days 3 hours 59 minutes 36 seconds
Fourth (Callisto)	16 days 18 hours 5 minutes 7 seconds

Table 9. Orbital Periods of Saturn's Satellites According to Ḥayātīzāde[67]

Satellite Name	Orbital Period
First (Tethys)	1 day 21 hours 18 minutes 26 seconds
Second (Dione)	2 days 17 hours 44 minutes 51 seconds
Third (Rhea)	4 days 12 hours 23 minutes 11 seconds
Fourth (Titan)	15 days 22 hours 41 minutes 16 seconds
Fifth (Iapetus)	79 days 8 hours 53 minutes 42 seconds
Sixth (Enceladus)	1 day 8 hours 53 minutes 8 seconds
Seventh (Mimas)	22 hours 57 minutes 22 seconds
Eighth	Not observed yet

66 Ḥayātīzāde, *Afkār al-jabarūt*,162.

67 Ḥayātīzāde, *Afkār al-jabarūt*, 163.

Table 10. Orbital Periods Uranus' Satellites According to Ḥayātīzāde[68]

Satellite Name	Orbital Period
First	5 days 21 hours
Second (Titania)	8 days 17 hours
Third	10 days 23 hours
Fourth (Oberon)	13 days 11 hours
Fifth	36 days 2 hours
Sixth	107 days 17 hours

The author mentions Uranus being designated as the name while giving information about it. He explained that the French had called it Hershel, the Germans and Russians had called it Ūrān/Ūrānūs (meaning celestial), and the English had called it Cūrc.[69] This information is compatible with the knowledge given in the section about Uranus. The treatise also contains a brief note about Lablās' (Laplace) studies on the orbit of Ūrānūs.[70]

Ḥayātīzāde included the theory he felts most drawn to in his treatise on the theories on the origins of asteroids, which at the time were a lively debate and whose certainty had not yet been attained. This theory pertains to Albert and Lahrānc [Lagrange]. According to these scientists, asteroids were formed as a result of a disruption of the planet located in its orbit for some unknown reason.[71]

When designating asteroids, some differentiations are found between *Asrār al-malakūt* and *Afkār al-jabarūt*. 'Abbāsḳulu Ağa uses the names Vestā, Yūnānā, Ṣarara, and Falada for asteroids.[72] Yūnānā is the Russian equivalent for Juno. Ṣarara is the Arabic version of the name Cerere given to it by Giuseppe Piazzi, who also had discovered Ceres.

Ḥayātīzāde doesn't use these designations in his treatise. He uses the names from the literature exactly the same or by making them suitable to Ottoman language rules. He takes the names Vestā and Pallas verbatim, while using Juno instead of

68 Ḥayātīzāde, *Afkār al-jabarūt*,164.
69 Ḥayātīzāde, *Afkār al-jabarūt*,164.
70 Ḥayātīzāde, *Afkār al-jabarūt*,165.
71 Ḥayātīzāde, *Afkār al-jabarūt*, 166.
72 Ḥayātīzāde, *Afkār al-jabarūt*,165.

Yūnūn and Ceres instead of Serīs.[73] The names ʿAbbāsḳulu Ağa and Ḥayātīzāde used to designate asteroids are given in Table 11.

Table 11. Comparison of the Names ʿAbbāsḳulu and Ḥayātīzāde Gave Asteroids

ʿAbbāsḳulu Ağa	**Ḥayātīzāde**	**Discovery Date**
Vestā	Vestā	1807
Yūnānā	Yūnūn	1804
Ṣarara	Serīs	1801
Falada	Pallas	1802

Ḥayātīzāde shared a table at the end of the section he devoted to modern cosmology that includes the diameters of the planets, their rotation periods around their own axes, their orbital period around the Sun, the width of the planets' orbits, and their average distance from the Sun.[74] All of these values in the table except for Neptune are quoted directly from ʿAbbāsḳulu Ağa's work.[75] The average distance from the Sun Ḥayātīzāde gives for Neptune and the information about its orbital period around the Sun appear to be taken from the newspaper *Takvīm-i Vekāyi*ʿ, however, the value given as 1,250,000,000 miles for the average distance from the Sun in the newspaper was copied as 1,225,000,000 miles in the table. Additionally, the value of 5,204 hours given for the rotation period around Neptune's own axis is not given in the newspaper. This value, whose source is unknown, is excessively long for planetary axial rotation period. The names of the planets are given in parentheses for convenience.

73 Ḥayātīzāde, *Afkār al-jabarūt*,165.

74 Ḥayātīzāde, *Afkār al-jabarūt*,171.

75 Ḥayātīzāde, *Afkār al-jabarūt*,170.

Table 12. Various Parameters of the Celestial Bodies According to ʿAbbāsḳulu and Ḥayātīzāde

Diameter	Axial Rotation Period	Orbital Rotation Period Around the Sun	Orbital Width	Average Distance from the Sun	Planet Location According to Distance from the Sun
600 miles	24 hr 5 min 30 sec	88 days	50.000.000 miles	7,800,000 miles	el-ʿUṭārid (Mercury)
1,650 miles	23 hr 21 min	225 days	82.000.000 miles	14,700,000 miles	al-Zuhra (Venus)
1,720 miles	24 hr	1 year	125.000.000 miles	20,000,0000 miles	el-Arḍ (Earth)
950 miles	24 hr 39 min 21 sec	1 year 322 days	200.000.000 miles	30,800,000 miles	el-Mirrīkh (Mars)
Not currently known	Not currently known	3 years 240 days	300.000.000 miles	47,900,000 miles	el-Vestā (Vesta)
Not currently known	Not currently known	4 years 11 days	340.000.000 miles	54,200,000 miles	el-Yūnūnā (Juno)
Not currently known	Not currently known	4 years 221 days	350.000.000 miles	56,200,000 miles	es-Ṣarara (Ceres)
Not currently known	Not currently known	4 years 222 days	350.000.000 miles	56,300,000 miles	el-Falada (Pallas)
19,000 miles	9 hr 55 min 50 sec	11 years 327 days	663.000.000 miles	105,000,000 miles	al-Mushtarī (Jupiter)
17,700 miles	10 hr 16 min 40 sec	29 years 174 days	1.216.000.000 miles	193,000,000 miles	al-Zuḥal (Saturn)
7,500 miles	~7 hr	84 years 28 days	Not currently known	386,900,000 miles	al-Hershel (Uranus)
	5,204 hr	217 years		1,225,000,000 miles	el-Luveriye (Neptune)

Ḳonevī has been accepted for a long time as the author of the first madrasa textbook to provide information on modern cosmology. However, he chronologically comes after Ḳuyucaḳlızāde and Ḥayātīzāde, while occurring between the two in terms of accuracy of the information in his treatise.

X. ʿAbdullah Allah Şükrī b. Abdulkerim al-Ḳonevī and *Tanqīḥ al-ashkāl*

Not much is known about Ḳonevī's life. The most important source of information about the author is the work *Osmanlı Müellifleri* from Bursalı Mehmed Ṭāhir (d. 1925).[76] In the treatise, Ḳonevī's three recognized works are described briefly. A document from 1267/1850 recorded in the Presidency of Ottoman State Archives (Meclisi Vala [MVL], Box 99, Case number 27) shows that Ḳonevī gave a petition regarding the one-fourth share of the *zāwiya* [Islamic religious school/monastery] of Elikesik Han, which is currently located in the Seljuk region of the city of Konya. When considering that *zāwiyas* are also educational institutions, Ḳonevī,[77] having been a *mudarris*, may have also worked in this *zāwiya* at that time.

As stated in *Osmanlı Müellifleri,* the author is known to have had three treatises written in Arabic:[78] *Tawḍīḥ al-idrāk ʿalā sharḥ al-Tashrīḥ al-aflāk*, *Tanqīḥ al-ashkāl ʿalā Tawḍīḥ al-idrāk*, and *Risāla fi-l-rubʿ al-mujayyab*.

Risāla fi-l-rub al-mujayyab is a short letter about how to use *rubʿ al-mujayyab*, which is located in the back of the *rubʿ* board [sine quadrant] used for designating the horizontal coordinates of celestial bodies and calculating the trigonometrical values of the angles.

Tawḍīḥ al-idrāk ʿalā sharḥ al-Tashrīḥ al-aflāk is the exegesis Ḳonevī wrote in 1857 to Bahāʾ al-Dīn al-ʿĀmilī's *Tashrīḥ al-aflāk*. This treatise, which is one of the most important Ottoman theoretical astronomy texts in the later periods, handled subjects like the movements of the planets and stars in terms of the Ptolemaic model, as well as solar and lunar eclipses. Additionally, its epilogue discusses how to determine the qibla by extracting the meridian.

Ḳonevī wrote a side note to this gloss titled *Tanqīḥ al-ashkāl ʿalā Tawḍīḥ al-idrāk*. While *Tawḍīḥ al-idrāk* had been written classically, *Tanqīḥ al-ashkāl* included modern astronomy alongside the classical. The author's copy of *Tanqīḥ al-ashkāl* is missing,

76 Bursalı Mehmed Tahir, *Osmanlı Müellifleri*, Vol. III (Istanbul: Matbaa-i Āmire, 1342), 285.

77 Morrison, "The Reception of Early-Modern European Astronomy", 189.

78 Ihsanoğlu vd., *Osmanlı Astronomi Literatürü Tarihi*, II, 598–599.

but two copies of the work are still available. The first is a lithographic copy and the other is a handwritten copy. The lithographic copies are registered in the following libraries as:[79]

Istanbul Millet Library, Ali Emiri Arabi 2470/2;

Istanbul Millet Library, Ali Emiri Arabi 2471/2;

Köprülü Library, Fazıl Ahmed Pasha 958/2;

Suleymaniye Library, Izmir 968/2;

Suleymaniye Library, Shehid Ali Paşa 1819M/2;

Suleymaniye Library, Tahir Aga Tekke 592/2;

Suleymaniye Library, Tırnovalı 1227/2.

The handwritten copy is registered in Diyarbakır with the number 1715/2. In the lithographic editions, the copying was done by Muḥammed al-Kutāhī, while Aḥmed al-Ḥalīmī al-Efremī, a *mudarris* from Qāsim Pādishah Madrasa (currently located in Mardin and known as Qāsimiyya Madrasa) was the copyist of the handwritten edition.

The lithographic edition has no copy date. The copy date of the Diyarbakır edition is given as Dhu'l-Hijja 8, 1292/January 8, 1876. In this case, the work had to have been written between 1857 and 1875. The lithographic copies of the work contain eight illustrations. The illustration are noted but not sketched in the Diyarbakır edition.

Tanqīḥ al-ashkāl has for a long time been accepted as the first treatise to provide information about modern astronomy in madrasa circles. However, the presence of Ḳuyucaḳlızāde's and Ḥayātīzāde's works cause this argument to lose its validity. Still, this situation doesn't result in a decrease in the value of Ḳonevī's work. The work's complete presentation of the sources on modern astronomy positions it in an exceptional place for its assistance in understanding the method of the transfer of knowledge.

The longest passage from Ḳonevī, in which he acquiesces to modern astronomy and mentions planets' orbital periods is as follows:

According to the Pythagorean view, the order of the universe has the Sun motionless at the center. This is followed by the orbit of *al-ʿUṭārid* [Mercury] being closest to the Sun. *al-ʿUṭārid* completes its orbit around the Sun in three months. The orbit of *al-Zuhra [Venus]* follows the orbit *al-ʿUṭārid*. *al-Zuhra* completes one orbit

79 İhsanoğlu vd., *Osmanlı Astronomi Literatürü Tarihi*, II, 599.

in eight months. *al-Zuhra*'s orbital plane is surrounded by the spheres of soil, water, air, and fire. *Qamar*'s [Moon] orbit places *al-Arḍ* [Earth] at the center; its cycle takes approximately 28 days. The orbit of *al-Mirrīkh* [Mars] places the Sun at its center and surrounds *al-Arḍ*. The orbital period of *al-Mirrīkh* is approximately two years. The Sun is located at the center of *al-Vestā*'s orbit and surrounds *al-Mirrīkh*'s. *al-Vestā* completes its orbit around the Sun in approximately three years and 240 days. The Sun is at the center of *al-Yūnūnā*'s orbit, which surrounds *al-Vestā*'s. One rotation of el-Yūnūnā around the Sun takes four years and 121 days [four years 11 days in the lithographic copy]. *al-Ṣarara*'s orbital center is the center of the universe [the Sun], and its orbit surrounds *al-Yūnūnā*'s. *al-Ṣarara* completes one orbit in four years and 221 days. The center of *al-Falada*'s orbit is also the center of the universe. This orbit surrounds the orbit of *al-Ṣarara*. *al-Falada* completes one orbital cycle in four years and 222 days. Afterward this comes the orbit of *al-Mushtarī* [Jupiter]. The orbital period of *al-Mushtarī* is approximately 30 years. Four stars take *al-Mushtarī* as the center of their obits. After this come the orbit of *al-Zuḥal* [Saturn], which finishes its orbit in 29 years and 174 days. Seven stars take *al-Zuḥal* as the center of their orbits. These celestial bodies were observed by Kūpernīkūs [Copernicus], Kapnāryūs [Johannes Kepler] and others. These have been named as *Ḳumayrāt*. Meanwhile, some astronomers call these stars little moons. After this comes the orbit of al-Hershel, also presently known as *al-Ūrānūs*. Al-Hershel completes a cycle in 84 years and 28 days. Six satellite place al-Hershel at the center of their orbits; these satellites were observed by William Hershel. Finally, the orbit of *al-Luveriye* [Le Verrier, Neptune] is present. This planet, completes its rotation in 217 years. After this are fixed stars that are far too numerous to count; these surround the orbits of the planets.[80]

Explanations in the square brackets have been appended by the author in translating. The following table provides Ḳuyucaḳlızāde's, Ḥayātīzāde's, and Ḳonevī's designations of the celestial bodies and their orbital periods to facilitate which sources Ḳonevī used.

80 Abdullah Şükrī b. Abdulkerim al-Ḳonevī, *Tanqīh al-ashkāl ʿalā Tawḍīḥ al-idrāk*, Süleymaniye Library, Tahir Ağa Tekke, 592/2, 42–44; Ziya Gökalp Manuscript Library, 1715/2, 25b–26b.

Table 13. The Names and Orbital Periods of Celestial Bodies as Given by Ḳuyucaḳlızāde, Ḥayātīzāde and Ḳonevī

Celestial Body Name			Orbital Period		
Ḳuyucaḳlızāde	**Ḥayātīzāde**	**Ḳonevī**	**Ḳuyucaḳlızāde**	**Ḥayātīzāde**	**Ḳonevī**
al-ʿUṭārid	al-ʿUṭārid	al-ʿUṭārid	Approximately 3 months	88 days	3 months
al-Zuhra	al-Zuhra	al-Zuhra	Approximately 8 months	225 days	8 months
al-Qamar	al-ʿArḍ	al-Qamar	28 (27) days	1 year	Approximately 28 days
al-Mirrīkh	al-Mirrīkh	al-Mirrīkh	Approximately 2 years	1 year 322 days	Approximately 2 years
-	al-Vestā	al-Vestā	-	3 years 240 days	3 years 240 days
-	al-Yūnūnā	al-Yūnūnā	-	4 years 11 days	4 years 121 (11) days
-	al-Ṣarara	al-Ṣarara	-	4 years 221 days	4 years 221 days
-	al-Falada	al-Falada	-	4 years 222 days	4 years 222 days
al-Mushtarī	al-Mushtarī	al-Mushtarī	Approximately 12 years	11 years 327 days	Approximately 30 years
al-Zuḥal	al-Zuḥal	al-Zuḥal	Approximately 30 years	29 years 174 days	29 year 174 days
al-Hershel	al-Hershel	al-Hershel	-	84 years 28 days	84 years 28 days
-	al-Luveriye	al-Luveriye	-	217 years	217 years

As stated before, Ḳuyucaḳlızāde didn't provide the names of asteroids nor their orbital periods. In addition, Neptune is not mentioned in the treatise because it had not yet been discovered. In addition to Ḥayātīzāde's usage of other names for asteroids in his treatise, he followed closely the denomination ʿAbbāsḳulu Ağa had given, as shown in the table. Ḳonevī seems to have followed Ḥayātīzāde in designating names. At this point, one may consider the likelihood that Ḳonevī had a copy of ʿAbbāsḳulu Ağa's treatise and had based his designations on it. However, ʿAbbāsḳulu Ağa's work makes no mention of *Luveriye* [Neptune]. The complete version of the table exists Ḥayātīzāde's treatise. Because Ḳonevī mentioned *Luveriye* and provided its orbital parameters, the probability of him having used ʿAbbāsḳulu Ağa's treatise is out of question. As can be seen from Table 13, Ḳuyucaḳlızāde and Ḳonevī gave the orbital period of the Moon whereas Ḥayātīzāde gave that of *Arḍ* [Earth].

Ḥayātīzāde didn't use approximations when providing orbital period values. However, Ḳuyucaḳlızāde and Ḳonevī adopted different methods. Both gave similar approximate values for *ʿUṭārid*, *Zuhra* and *Mirrīkh*. Ḳuyucaḳlızāde's first edition gives 28 days for the orbital period of the Moon and the second edition has it as 27 days. Because the value of 28 days is scientifically erroneous, coming across sources with this value is nearly impossible. Ḳonevī, who also used the value of 28 days, must have taken this value from a source that had been presented erroneously. Based on these similarities, Ḳonevī can be suggested to have followed the first version of Ḳuyucaḳlızāde's treatise for these celestial bodies.

When dealing with asteroids, Ḳonevī (at least in the lithographic edition) followed Ḥayātīzāde as his single source of knowledge. Ḳonevī appears to have given "approximately 30 years" for *Mushtarī* [Jupiter] while giving "approximately 12 years" for *Zuḥal* [Saturn]. A planet whose orbit is more distant from the Sun cannot be shorter than a planet that is closer to the Sun. As a result, Ḳonevī made a mistake when transferring data from its source. The figure Ḳuyucaḳlızāde provides for *Zuḥal*'s orbit is "approximately 30 years." Perhaps Ḳonevī had mis-scribed *Zuḥal*'s orbital value onto *Mushtarī*'s. With respect to *Zuḥal*, *Hershel*, and *Luveriye*, Ḳonevī apparently followed Ḥayātīzāde's treatise.

Another point well worth noting in Table 13 is *Yūnūnā*'s orbital period. Ḳonevī's lithographic copy provides a value of 4 years 11 days (1,472 days); this is the same as the value Ḥayātīzāde provided, despite being erroneous. Meanwhile, this period is shown as 4 years 121 days (1,582 days) in Ḳonevī's Diyarbakır edition. When considering that the actual value of *Yūnūnā*'s orbital period is 1,592 days, if a mistake didn't occur while copying (i.e., if H أربع سنين وإحدى وعشرين ومأة أياما was written instead of أربع سنين وإحدى عشر أياما by accident), one may conclude that the erroneous data had been corrected while copying the Diyarbakır edition. If this is the case, this correction is vital in showing that one could access current sources of information to correct a scientific mistake in Mardin, that Mardin as a geography can be regarded as a county in terms of the opportunities of transportation and communication of the era, and that these sources had been monitored by *mudarris*es.

XI. Conclusion

Turning the telescope to the sky as an instrument of observation changed humanity's view of the universe completely. Countless celestial bodies that had remained unobservable due to the limits of sight now became a part of the visible universe through telescopes. This alteration in cosmological awareness occurred first in the closest systematical component of the universe: the Solar System. This process started with the discovery of Jupiter's satellites, and with the telescopic developments that occurred as a result of increased technological possibilities, investigations of the known limits of the Solar System had expanded approximately three-fold. Hence, by the end of the 18^{th} century, two new planets beyond Saturn and a series of asteroids between Mars and Jupiter with magnitudes much smaller than satellites had been discovered.

Recently discovered celestial bodies were of interest to Ottoman scientific circles, especially after the first quarter of the 19th century. This interest is considered to have been instigated mostly by modern educational institutions like the *Mühendishāne* (Engineering School). In reality, however, the ulama had been the first to show interest. The first authors to refer to the two newly discovered planets of Uranus and Neptune were Ḳuyucaḳlızāde and Ḥayātīzāde, both of whom had received their educations at madrasas. Ḳonevī, who came after these two scholars and was their intellectual successor, created a composition of their two treatises.

All three authors were from madrasa circles, and Ḳuyucaḳlızāde and Ḥayātīzāde in particular seem to have used foreign sources as well. The facts that Ḳuyucaḳlızāde and Ḥayātīzāde suggested *Sātellītā* and *Saṭāllīd* as equivalents to the term of satellite, being derived from French and English, as well as Ḥayātīzāde's statements regarding the names of asteroids qualify as supporting this view.

Two versions of Ḳuyucaḳlızāde's work can be said to exist in terms of content. The data from the second version is more accurate and its content is more comprehensive.

Ḥayātīzāde supplemented his work with the scientific developments that occurred while he was undertaking the translation and dated these supplements. Hence, one can say based on the dates about the planets and asteroids that the writing of his treatise had begun on June 15, 1847 and continued at least until August 20, 1847.

Newspapers of the era conveyed scientific developments to their readers quickly. For example, the Ottoman newspaper *Taḳvīm-i Veḳāyi'* announced the discovery of Neptune and Hebe approximately 1.5 months after they had been found. Considering the irregular publishing schedule of newspapers, this period may actually have been shorter. The importation of scientific knowledge is commonly thought to have occurred through foreign books. Nevertheless, local newspapers and journals were also accepted as sources, as in the case of Ḥayātīzāde. Periodical studies investigating this type of work will be useful in determining which references were used.

The sources of information from newspapers appear to have generally been French newspapers. The reason for this was that the *lingua franca*s of the era had been French. *Taḳvīm-i Veḳāyi'* had been published thanks to the translations to various languages that had occurred by the mid-1830s, and the first language it had been translated to was French. News about external scientific developments of the era were mainly transmitted to the reader by the translations made from French newspapers. While the discoveries from Continental Europe made news in a short span of time, discoveries originating from Britain or the United States of America found little place in newspapers, if any at all. For instance, while the asteroid Hebe German astronomer Karl Ludwig Hencke (d. 1866) discovered on July 1, 1847 was published, the asteroid Iris English astronomer Hind discovered about a month later on August 13, 1847 didn't get published in the newspapers. This might have been a decision to use French newspapers as a source rather than the policy of the newspaper. Meanwhile, no information is found about the asteroid Astraea that had been discovered before Hebe, not in Ḥayātīzāde's treatise nor in *Taḳvīm-i Veḳāyi'*. The reason for this asteroid not being included in the news might have been a change in the newspaper's publishing policies; in fact, newspaper may have later on increased the space they gave to science.

Ḳonevī's up-to-date knowledge of astronomy originated substantially from Ḳuyucaḳlızāde's and Ḥayātīzāde's works. As evidence of this, the designations Ḳonevī used and the corresponding quantitative data on celestial bodies can be given as evidence of this through their treatises.

If the orbital period of *Yūnūnā* [Juno] had not been incorrectly written, the data regarding its orbital period (4 years 121 days instead of 4 years 11 days) in the Diyarbakır edition of Ḳonevī's work shows that current scientific developments were followed closely in rural madrasas and incorrect information appears to have been corrected.

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