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Ottoman Mathematicians and Astronomers

Malahat Abdullayeva
Azerbaijan State Pedagogical University, Baku, Azerbaijan

The article deals with the scientists in the Ottoman Empire. The readers will get interesting information about the life and practices of those who dedicated their whole life to the development of science, such as Ottoman mathematicians and astronomer Rumi Kadizade from Bursa, Ali Kushchu, Mirim Chalabi, Takiyuddin Bin Maruf-i, Gelenbevi Ismail Efendi, Hoca Ishak Efendi, and Huseyin Tevfik Pasha.

Keywords: Ottoman Empire, mathematics, astronomy, observatory

Introduction

The history of science and education goes as far as the history of humanity. As in all historical periods, the fields of science and education rapidly developed during the Ottoman Empire. The reason for this development was thinkers and intelligent people of that time, the scientists who spent their lives to thinking, and intelligent people who spent their lives on scientific researches, studies, and innovations. At a time when missionaries who opened a school in the Ottoman lands tried to realize their mission, especially spread Christianity around the world, broad-minded and patriotic people of the time developed natural sciences, including mathematics, physics, chemistry, astronomy, and technical fields, but at the same time, they have achieved a high level of education by using new techniques. Just in this sense, it would be expedient to study the life and activity of the connoisseurs of science who lived and created works in the Ottoman Empire and whose scientific researches are used by use today. Our research focuses on the life and creativity of seven mathematician scientists who have great contributions to the development of education and science in the country during the Ottoman Empire.

Rumi Kadizade From Bursa (1364-1436)

Famous Turkish mathematician and astronomer of the Middle Ages, Kadizade Rumi (original name Salahaddin Musa) was born in an educated family in Bursa. The scientist of that era is the son of Bursa's ghazi Mehmet Chelebi who had great influence. He received his first education in the madrasah (Moslem religious school), where Molla Fenari is a valuable scientist in Bursa. Then he went to Khorasan and Maveraunnehir regions to increase his knowledge of mathematics and astronomy. Here, he got religious lessons from the famous scientist of the time and the region, Seyyid Sharif Cucani for a few years. In the meantime, he began to study his teacher's work called "Mevakif". The relationship between him and Seyyid Sharif Cucani was damaged for some shortcomings and mistakes he found in his work. It was necessary to leave him because of the dissatisfaction between them. He came to Samargand from Maveraunnehir, which the fame was heard from

Malahat Abdullayeva, Ph.D. in Pedagogy, Faculty of Mathematics and Informatics, Azerbaijan State Pedagogical University, Baku, Azerbaijan.

Molla Fenari, his teacher in Bursa during those years and began to work at an observation house known as the Samarkand Observatory.

In this city, he was married and had a son named Shamsaddin Mehmet. Salahaddin Musa had come to contact with the famous mathematics and astronomers of his time in Samargand and devoted himself entirely to scientific research and studies. He was soon recognized as one of the most loved and respected intellectual around (Fazlioglu, 2003, pp. 1-66).

In his name, the word "Rumi" (related to Anatolia, living in Anatolia) was added meaning "Anatolia". He became even more famous with the name of Kadizade Rumi from Bursa.

At that time, he also attracted the attention of those around him by making the necessary adjustments to the astronomical book, "Ziji Ilhani" written by Ulugh Bey. At the invitation of Ulugh Bey, Kadizade Rumi was brought to the administration of Ulugh Bey Observatory and the Ulugh Bey Madrasa (today's university) in Samargand and continued his duties until the end of his life (O'Connor & Robertson, 2017).

He was seriously engaged in redesigning of astronomical tables. Therefore, he was referred to as the most serious and responsible astronomer of his time by Kadizade.

"Muhtasar-i Fi'l-Hisab" (A Summary of Calculation) and "Risale Fi-Istihraci'l-Jeyb Derece-i Vahide" (One Risale for Obtaining a sinus of one Degree) refer to Mathematics, "Eshkal-i Te'sis Sherhi" refers to Geometry, and "Sher-ul-Mulahhas Fi'l-Hey" is about astronomy.

Ali Kushchu (1403-1474)

As an astronomer, mathematician, and linguist in Timur State and the Ottoman Empire, Ali Kushchu was born in 1403 in Samarkand. From his early ages, Ali showed interest in mathematics and astronomy. His father, Mahammad Kushchu, saw Ali's interest in science and created condition for his son to study. With his father's help, Ali began to get mathematics and astronomy lessons from Rumi, Giyasaddin Jamshid, and Muinuddin Kashi from Bursa. He then went to Kirman to increase his knowledge. He wrote here the work "Sherh-i-Tajrid" by the letter "Hall-u Eshkal-i Kamer" (Disclosure of Moon Phases). After completing his education in Samargand and Kirman, Ali Kushchu was the assistant to the fourth sultan of the Timur Empire, mathematician and astronomer Ulugh Bey (1394-1449).

Ulugh Bey is the eldest son of Shahruh, the son of Timur's sultan. Ulugh Bey then had great services in the development of science and the growth of scientists in the field of mathematics and astronomy. He built a madrasa and observatory in Samargand. He invited all the engineers, academics, and craftsmen in the region to Samargand for the Observatory and provided them with a comfortable environment to carry out their work with ease. The management of the Observatory was given to Kadizade Rumi from Bursa and Giyasaddin Jamshid. When observations began at Observatory, Jamshid died, and without completing observation, Rumi died, Ulugh Bey assigned all the work of the observatory to Ali Kushchu, who was then young.

In those years, Ulugh Bey wrote his famous work "Zeych Kurkani" or "Zeych Cedit Sultani" based on observations. This work was a work which East and West have benefited from the work for a few centuries. The work has been translated into many European languages. One of the manuscripts of "Zeych Kurkani" was brought to Turkey after the Iraqi and Iranian battles and was kept in the Saint Sophia Library.

Ali Kushchu, after perfecting the observatory's work, wanted to go on a pilgrimage in 1449 and realized his dream. During his visit to Tabriz, Aghkoyunlu ruler Uzun Hasan greatly respected him and asked for help for peace talks with the Ottoman Empire. Ali Kushchu, after representing Uzun Hasan, came to Istanbul at the

invitation of Mehmed II. Ali Kushchu, who was met with a great ceremony by Fatih Sultan Mehmed's order on the Ottoman-Aghkoyunlu border, was appointed as "Mudarris" to the Saint Sophia Madrasah (scholars who taught at madrasahs in the Ottoman Empire and Seljuks, *Mudarris* means "lesson" in Arabic). He died on December 16, 1474 in Istanbul. His tomb belonging to the 15th century was buried around the mausoleum of Eyup Sultan (Fazlioglu & Kushchu, 1999, pp. 216-219).

Shortly after Yavuz Sultan Selim conquered Kahramanmarash, some of the grandchildren of Ali Kushchu were sent to Kahramanmarash for re-expansion of the Shia Sect in that region. Other grandchildren then moved to Duzja at their own requests. After the proclamation of the Republic, some of the family members in Kahramanmarash moved to Bursa. Today, the name of Fuat Kushchuoghlu street in Bursa was taken from the name of Fuat Bey, one of the grandchildren of Ali Kushchu. His generation continues with his family names in Kahramanmarash, Duzja, and Bursa (Ayduz, 1999).

Mirim Chalabi (1450-1525)

Mirim Chalabi is one of the most outstanding mathematicians and astronomers who grew up in the Ottoman period after Kadizade Rumi and Ali Kushchu. Mirim Chalabi, whose real name is Mahmud bin Mahammad, is from the generation of Qushchus who taught several astronomers and mathematicians. Ali Kushchu is the father of his mother, that is, his grandfather. Mirim Chalabi started teaching at madrasahs in Gelibolu, Edirne, Bursa, and Istanbul. In a short time, he was known for his powerful mathematical abilities, and at that time, Mirim Chalabi was invited to the palace as the most influential mathematician and astronomer by Bayazid II.

Mirim Chalabi, who followed the rules of Samarqand Mathematics and Astronomy School, also had a say in history and literature. The works of Mirim Chalabi that survived to the present day belong to mathematics, astronomy, astrology, and optical fields (Haskan, 2014, pp. 40-41).

His researches conducted in the field of mathematics have also been successfully used to solve many problematic issues. He solved the problem of finding the ratio of the highest mountain in the world to the diameter of the Earth mentioned in his work which is kept at the Suleymaniyya Library of Kadizadeh (Baysal, 2010).

Referring to the work titled "Zic'i ilhani" by Tusi, he wrote a Persian commentary to the "Zic'e Formu ulet-amel ve Tasih ul-Rulet" by Ulugh Bey. Mirim Chalabi also commented on the book entitled "Fethiye" on the celestial sciences by Ali Kushchu, his grandfather as a result of the insistence of Yavuz Sultan Selim who loved him very much. He also has a work called "El-Makasit" on astronomy. He died in 1925 in Istanbul (Unat, 2000, p. 154).

Takiyuddin Bin Maruf-i (1521-1585)

Ottoman Turkish Takiyuddin Bin Maruf-i was born in 1521 in Sham. He was a famous mathematician, engineer, and astronomer of his time. After getting education, he was assigned to Tennis district. He was assigned to the administration of palace astrology by Salim II after the death of Mustafa Chalabi in 1571. In 1574, he started observation works at the Tower of Galata. Under the direction of Hoca Saadattin and Sokullu Mehmet Pasha and under the guidance of Takiyuddin based on the order of padishah III Murad, the first Observatory of the Ottoman Empire—Takiyuddin Observatory was established in 1577 at the territory of Tophane (where the building of today's French embassy is located). This observatory was demolished by the

order of III Murad on January 22, 1580, with balls rained down from the ships of Captain Darya Kilish Ali Pasha.

Takiyuddin is particularly famous for his work in the field of trigonometry. He gave the definitions of sinus, cosine, tangents, and cotangents, explained their proofs, and prepared their tables. For the first time in history, he calculated the closest and rightest degree to the truth finding the angle of 23°27' between ecliptic (The huge sky circle during the annual external movement of the Sun is called ecliptic. Ecliptic means eclipses-retention in Greek) and equator by one minute 40 seconds difference in the form of 23°28'40". One of his manuscripts is kept in the Topkapi palace and some others at Bogazici University's Kandilli Observatory and Earthquake Research Institute. He is the true owner of Dolmabahche Palace in Beshiktash. After his death, the palace remained in the state, as he had no children.

Gelenbevi Ismail Efendi (1730-1790)

Famous Turkish mathematician Gelenbevi Ismail Efendi was born in the Gelenbe settlement of the present Manisa city. His second name was Gelenbevi related to the name of the settlement where he was born.

Mostly, his second name brought him a reputation. Gelenbevi Ismail Efendi is one of the most famous mathematicians of the Ottoman Empire. Ismail received his first education from the teachers around him. He then went to Istanbul to perfect his education. Here, he enriched his knowledge of mathematics, benefiting from his valuable and influential teachers, successfully passed the examination "teaching" (teaching at religious schools), and became a "Mudarris" (teacher at higher religious schools) at his 33. After that, Gelenbevi Ismail Efendi continued his works devoted himself entirely to science.

Gelenbevi is an Ottoman mathematician who was able to solve problematic issues by the old method. Regarding the wishes of Khalil Hamid Pasha and Captain Darya Cezayirli Hasan Pasha, his assignment as a math teacher with 60 pennies at Muhendishaneyi Bahriyi Humayun opened in Kasimpasha was an important financial support for him (Unat, 2002, pp. 277-288).

There is such a story about him which survived until our period: "The fact that some guns did not hit the target made III Salim angry and he called and warned Gelenbevi about this. Gelenbevi thought a little how to calm the padishah and found the solution to this problem. To do this, he made necessary changes in weapons predicting the distances from the arms to the target and provided the balls hit the target. This success of Gelenbevi attracted the padishah's attention and he was rewarded" (Demir, 2000).

Gelenbevi has written more than 30 works on mathematics and astronomy in Turkish and Arabic languages. Gelenbevi Ismail Efendi was the first to use logarithmic concept in Turkey. Gelenbevi Ismail Efendi died in 1792 in Yenishehir. Today, Fatih Gelenbevi Anatolian High School operates in Istanbul in his name (Tekeli, 1958, pp. 301-353).

Hoca Ishak Efendi (1774-1834)

It is noted in some sources that the famous scholar of the Ottoman era, Hoca Ishak Efendi whose date of birth is not known exactly was born in 1774 in Narta. Although his father is said to be a Jew, he was found to be the son of a Karlovian Muslim as a result of the study of Ismat Efendi who was the secretary of the padishah writing biographies. It is noted in other sources that he was born in a Jewish family and was educated in madrasah by adopting Islam in his younger age. Hoca Ishak Efendi, who possessed strong intelligence and memory, knew Turkish, Arabic, Persian, Greek, French, Latin, and Indonesian languages fluently. At the same

time, he had strong mathematical talent. Hoca Ishak Efendi came to Istanbul to continue his education after his father's death and soon became a well-known scientist in mathematics, astronomy, metallurgy, and geology.

In 1815, he was appointed as a mathematics teacher to the Imperial School of Military Engineering—Muhendishane-i Berri-i Humayun. He made many improvements while working at Muhendishane. Here, he raised the teaching activities to a higher level, using a similar method of European education. At the same time, along with the works of Eastern scientists, using the books of Western scholars, he created interest in students for the science (Sayli, 1960, pp. 289-305).

His four-volume work, "Mecmuei Ulumi Riyaziye" (the Compilation of Mathematical Sciences), which he prepared with a great deal of effort, became very popular. The book describes Turkish equivalents of many terms used in the Western languages. According to Adnan Adevar's definition, one of the scientific historian of that time, the work in which algebra, geometry, trigonometry, integral, and differential calculation, physics, chemistry, and mechanics were developed, was considered to be "the compilation of new model sciences" for that time and scientific works which were written in subsequent periods were based on them. His books have been used as a textbook for many years in engineering schools. Hoca Ishak Efendi first used many chemistry and physics terms in his scientific works.

Hoca Ishak had great services in his country, inspecting weapons and bullets prepared in Engineering School and Armory, buildings and fortifications built in different places and giving them new directions. He was a man who loved his job very much and worked for his country to come up with new information and ideas. Hoca Ishak Efendi has a very important place in the history of the country's technical progress (Yavuz & Ismail, 1975).

Hoca Ishak Efendi was appointed to the Translation Council of Divani Humayin in 1824. Up until 1828, Ishak Efendi, who was at this position, also executed the duty of inspection of the castles built in the Balkans during that time. When he returned from the Balkans, he continued his career in Barrhu Humayun at Engineering School. In 1831, he was appointed as the principal of that school. While in this position, he renewed the curriculum and reinforced the pedagogical staff. He dismissed teachers who have failed to do their job.

Hoca Ishak Efendi was sent to Medina in 1834 to repair the holy places. Two years later, after finishing his job in 1836, he returned to Istanbul and died in Egypt, Alexandria being ill. His grave was in Alexandria and a stone with his name and death date was put by the school in order to be remembered and for blessing in Istanbul Haskoy Cemetery (at the tope of Engineering School).

Huseyin Tevfik Pasha (1832-1901)

Huseyin Tevfik Pasha was born in 1832 in the city of Vidin, which then was referred to the Ottoman Empire, but now within the borders of Bulgaria.

His father is Hasan Tahsin Efendi. His family was known as Imamzadehs. After completing his first education in Vidin, he went to Istanbul at the age of 14-15 and studied Idadi Askeriya in Machka. Later, he graduated from the Military School and was admitted to Erkani-Herbiya (Avci, 1963).

Huseyin Tevfik was distinguished by his ability and skills from others when he was studying at a military school. He particularly drew the attention of the math teacher Tahir Pasha, who graduated from Cambridge University. Tahir Pasha took into account his talent and taught additional lessons to Huseyin Tevfik Pasha. After graduating from the military school, he began teaching algebra lessons there. When Tahir Pasha died,

they instructed Huseyin Tevfik Pasha to teach his math lessons. While continuing to be a teacher at the military school, he was brought to the Tophane Experiment and Inspection Commission. He was sent as a deputy director of the Osmaniye School in Paris in 1868, at the same time, he was assigned to conduct a research on ballistic and rifle manufacturing. He was admitted to the university in Paris to improve his mathematical knowledge during this period and published articles for two years during his stay there and participated in scientific meetings (Konyalioglu, Isik, Kaplan, Hizarci, & Durkaya, 2017).

Huseyin Tevfik Pasha was known as a public figure among the people. He was sent to the United States in 1872 to check whether the Ottoman Empire donated rifles to American weapons factories and complied with the terms of the contract. Until 1878, he stayed in the Rhode Island, the United States and during that time, he was engaged in mathematics and wrote his English book entitled "Linear Algebra" at that time. He turned "Islamic Educational Society" established in 1865 to the Lyceum of Darushshafaka together with Gazi Ahmad Mukhtar Pasha and Yusuf Ziya Pasha (Chechen, 1988).

In 1878, he was appointed as an engineer minister to the administration of Muhendishaneyi Berri Humayun by II Abdulhamid as the Engineer in the management of Berri Humay. Shortly before this position, he was appointed as an ambassador to the Ottoman Empire between 1883 and 1886, and in 1889 to the position of the Minister of Commerce and Public Works. Until his death, he worked as a aide of Padishah II Albudulhamid. He died on June 16, 1901. His grave is located at Eyup Sultan's Cemetry in Beybaba Street, Istanbul (Akdeniz, 2017).

Conclusion

Science and education, which began to develop before our era, were always in the focus of attention throughout the social periods after our era. In particular, scholars who are engaged in the development of mathematics and its application in the study of other sciences, who spend their entire lives on scientific research and their scientific discoveries, are the most valuable wealth that has come to our time from the Ottoman Empire. This wealth must be protected by every man of science and transmitted to future generations.

References

Akdeniz, F. (2017). *Osmanlı dönemi bilim tarihinden bir kesit* (An excerpt from the history of the Ottoman period). Retrieved from http://turkoloji.cu.edu.tr/GENEL/akdeniz_tevfik_pasa.pdf

Avci, A. (1963). *Türkiyede askeri okullar tarihçesi* (History of military schools in Turkey). Ankara: Gnkur Basımevi.

Ayduz, S. (1999). *Üç sultan bir bilim adamı: Uluğ Bey, Uzun Hasan, Fatih Sultan Mehmed, Ali Kuşçu* (Three sultans, one scientist: Ulugh Bey, Uzun Hasan, Fatih Sultan Mehmed, Ali Kushchu). Istanbul: Sanat Dünyamız.

Baysal, J. (2010). *Osmanlı türklerinin bastiklari kitaplar 1729-1875* (Books published by Ottoman Turks) (2nd ed.). Istanbul: Ada Ofset Matbaacılık.

Chechen, K. (1988). *Hüseyin Tevfik Paşa ve* "*Linear Algebra*". Istanbul: Istanbul Technical University.

Demir, R. (2000). *Takiyüddin'de matematik ve astronomi* (Mathematics and astronomy of Takiyuddin). Ankara: Atatürk Kültür Merkezi Yayınları.

Fazlioglu, I. (2003). *Osmanlı felsefe¯biliminin arkaplanı: Semerkand matematik-astronomi* (The background of Ottoman philosophy: Samarkand mathematics and astronomy). Ankara: Divan İlimi Araşdırmaları.

Fazlioglu, I., & Kushchu, A. (1999). *Yaşamları ve yapıtlarıyla Osmanlılar ansiklopedisi* (Lives and works, encyclopedia of Ottomans) (Vol. 1). Istanbul.

Haskan, M. N. (2014). *Eyüplü Meşhurlar* (The famous from Eyuplu). Istanbul: Eyüp Belediyesi Yayınları.

Konyalioglu, C. A., Isik, A., Kaplan, A., Hizarci, S., & Durkaya, M. (2017). Vidinli Huseyin Tevfik Pasha's triplets in history of mathematics. *Procedia Social and Behavioral Sciences, 15*(2011), 4045-4047.

O'Connor, J. J., & Robertson, E. F. (2017). *Qadi Zada al-Rumi*. Retrieved from http://www-history.mcs.st-andrews.ac.uk/Biographies/Qadi_Zada.html

Sayli, A. (1960). *The observatory in Islam and its place in the general history of the observatory.* Ankara: Türk Tarix Kurumu.

Tekeli, S. (1958). Nasiruddin Takiyuddin ve Tycho Brahe'nin rasat aletlerinin mukayesesi (Comparison of observation instruments of Nasiruddin Takiyuddin ve Tycho Brahe). *Journal of Department of Language, History and Geography of Ankara University, 3*(4), 301-353.

Unat, Y. (2000). *Ali Kuşçu Çağını Aşan Bilim İnsanı* (Ali Kushchu: Scientist who transcended his time). Istanbul: Kaynak Yayınları.

Unat, Y. (2002). *Tâkiyyüddîn ve İstanbul gözlemevi (rasathanesi)* (Takiyyuddin and Istanbul Observatory). Ankara: Yeni Türkiye Yayınları.

Yavuz, F., & Ismail, O. (1975). *Osmanlı Müellifleri: Bursalı Mehmed Tahir Efendi* (Ottoman authors: Bursalı Mehmed Tahir Efendi) (Vol. 1). Istanbul: Meral Yayınevi.