DEVELOPMENT OF EXACT SCIENCES IN THE MUSLIM EAST IN THE IX-XII CENTURIES

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Abstract. *The article scientifically substantiates the development of the exact sciences in the Muslim East in the 9th-12th centuries. Based on the influence of the discoveries made in the Middle Ages on world science based on the spiritual heritage of the Central Asian encyclopedias.*

Keywords: *mathematics, astronomy, science, culture, science, natural sciences, social views.*

In the context of rapidly developing globalization in the world, one of the most urgent problems is the study of the interaction between the Central Asian and European Renaissance, the development of natural science and philosophical knowledge in the view of thinkers of the 9th-15th centuries, and the historical and philosophical basis for building the foundations of the Third Renaissance. During the Renaissance, the science and culture of India, Khorasan, Movarunnahr, Persia, Babylonia, Egypt, Greece and Rome mixed and integrated into each other, striving for the highest achievements in the field of science. The Swiss historian and orientalist Adam Metz, who lived in the 19th century, comprehensively analyzed the 9th-12th centuries and called them the Muslim Renaissance [1, p.6].

The study of the scientific aspects of the creation of the universe, the creator and the doctrine of man, the universe, nature and social life in the scientific heritage of thinkers who have made a significant contribution to world civilization, revealing the essence of the relationship between man and nature, substantiating the place of natural science views in the development of socio-philosophical thinking, is relevant and Today.

Abu Rayhan Beruni is one of the greatest geniuses of the Middle Ages. He thoroughly mastered all the sciences of his time, especially astronomy, mathematics, theology and mineralogy. His contribution to the development of these sciences made his name one of the great figures of world science [2].

In the 9th century in the Muslim East, three brothers - Muhammad, Ahmed and Hasan - became famous in the field of mathematics and astronomy. According to the work of the historian Ali ibn Yusuf ibn Ibrahim (XIII), known as Al-Kifti, under the title "Tarikh al-Hukamo" ("History of Hukamo"): "The father of Muhammad, Ahmad and Hasan was a very knowledgeable person in geometry and astronomy, and caliph al-On was a comrade and friend of Mamun" [3, p. 20].

With the help of Muhammad, Ahmed and Hasan, Hunayn ibn Ishaq and Thabit ibn Qurra were among the translators and scholars working under the tutelage of the Caliph of Baghdad and made friends with the friends of the Caliph Mamun. Muhammad was considered the most talented among the three brothers. Muhammad worked on Euclid's Fundamentals and Ptolemy's Almagest, as well as on many historical works in mathematics and astronomy. Ahmad paid more attention to the field of mechanics. According to the well-known bibliographic work “Kitab al-Fehrist” by Abul Faraj Muhammad ibn Ishaq al-Nadim, written at the end of the 10th century, Ahmad was the first author of a work on mechanics among scientists of the Muslim East [3]. , p. 21].

Scholars of this period highly appreciate the work of the three brothers. Al-Kifti said on this occasion: “The works written by the sons of Musa ibn Shakir show the achievements of this time in the field of mathematics. Even Heron did not have these achievements” [3, p.

21], he says. His younger brother Hasan was a scientist in the field of geometry. After reading and working on the first six books of Euclid, he said: “Now I can read all the remaining books on my own and prove the problems in them” [3, p. 22].

Abu Rayhan Beruni in his famous work “Osor ul-Bakiya” (“Monuments of past generations”) spoke about the sons of Musa ibn Shakir and some of their works in the field of astronomy: “We checked Ptolemy's comments on the length of the average month and year. But in this matter, the opinions of the sons of Musa ibn Shakir are closer than others to the truth” [3, p. 166]. This indicates that the scientific works of the three brothers were highly appreciated by Abu Rayhan Beruni. The legacy of the sons of Musa ibn Shakir in the field of mathematics and astronomy has attracted the attention of historians of mathematics from the early Middle Ages to the present day [4, pp. 91-97].

The essay “On the Measurement of Figures”, written by the sons of Musa ibn Shakir, consists of 18 sentences (theorems): I-VI sentences about calculating the ratio of the surface of a circle and the length of a circle to the diameter, sentence VII is about proving Heron’s formula, sentences VIII-XV about spheres and round bodies, Proposition IX concerns the calculation of the lateral surface of a cone, Proposition XI concerns the proof that the product of the radius of a sphere and its surface is up to one third, Propositions XVI-XVII deal with proportional quantities, and Proposition XVIII deal with the problem of dividing an arbitrary angle by equal to a third, calculated from the classical problems of antiquity [5, p.420].

Abu Ali al-Hasan ibn al-Haytham (965-1039). Ibn al-Haytham was from Basra, where he received his primary education. He was devoted to science from a young age and traveled to many countries, as a result of which he met several scientists and was able to receive their training. He went to Egypt and remained there until the end of his life. Al-Khaytham studied many of the works of Aristotle, Galen, Plato, Archimedes and wrote commentaries on some of them thanks to his good knowledge of Arabic, Persian, Greek and Latin.

The works of Ibn al-Khaytham in various branches of mathematics, especially in geometry, attract the attention of many historians of mathematics in Western Europe. In particular, M. Schall (1793-1880), H. Zuter (1848-1922), E. Wiedemann (1852-1928), K. Shoi (1877-1925) translated into European languages the geometric works of Ibn al-Khaytham, who wrote comments on them. At the end of the 10th century, Ibn al-Haytham worked at the astronomical observatory at the court of the Egyptian king al-Hakim (996-1020). Sources confirm that Ibn al-Haytham also wrote a commentary on a well-known work in physics called Euclid's Optics. The following works of Ibn al-Khaytham have come down to us: "Comments on the "Fundamentals" of Euclid" is stored in Leiden under the number 966. "The book for determining the height of inclined objects." This work is also kept in Leiden under the number 1008. "Book for determining the height of the pole." This work is kept in Oxford under the number 873 and in Leiden under the number 1063. "The Book of the Light of the Moon." The work is kept in India under the number 734. "Book on the measurement of paraboloids". The work is stored in India under the number 735. Manuscripts of the work "The Book on the Geometric Problem", "The Book on the Definition of the Qibla", "The Book on the Movement of the Moon" are stored in Oxford under the numbers 870, 877. Also, dozens of his works are stored in the libraries of India, Leiden, Paris and Oxford. If we look at the works of the scientist, we will see that he was more active in the fields of astronomy, mathematics and geometry. The scientific heritage of this scientist had a strong influence on the work of not only scientists of the East, but also scientists of the West.

Ibn al-Haytham, relying on the most advanced ideas of his time, enriched the development of science with new thoughts and ideas.

Abu Sahl Tiflisi Abdul Munim ibn Ali, a mathematician who lived and worked in the 11th century, was a close friend of Abu Rayhan Beruni. "Kitab mo lil-Hind" ("India") Beruni is dedicated to Abu Sakhl Tiflisi. The works of Abu Sahl Tiflisi have not yet been discovered [6, p. 71].

Abu Bakr Muhammad ibn Hussein al-Karhi is one of the mathematicians who gained fame as a scientist in Central Asia and the East, a contemporary of Abu Raykhan Beruni. Al-Karhi is referred to in many sources as al-Karaji, and this name is associated with the name of the city of Karadzha, where the scientist was born. Information about the scientific activity and biography of the scientist has not been preserved. Most historical sources indicate that the scientist died in 1016. Although several mathematical works have been written by scholars, only two are known: The Sufficient Book of Arithmetic and The Book Dedicated to al-Fahri.

The first of these Al-Karhi works was found in Bukhara in 1915. The scientist says that he finished writing his work in 1016. Al-Karhi studied the works of his predecessors well when he wrote these works.

The work "Al-Kofi fi-l-hisab" consists of 70 chapters and includes materials related to algebra, arithmetic and geometry. The book's introduction provides information about the number system.

According to the European historian of mathematics Henry Zutter (1848-1922), al-Karhi dedicated his previous and this work to Fakhr ul-Mulk, a minister of the king of Iran. This work of the scientist is devoted to algebra, and when solving some algebraic problems, Diophantus' reasoning is given. According to many Eastern and European scholars, this work of al-Karhi is second only to the algebra of Muhammad al-Khwarizmi. This work consists of two parts, which are devoted to: Theoretical and practical issues and methods for their solution. The first part of the work is devoted to 15 chapters, and the second part is devoted to various examples and problems, there are 254 of them in total. The first work of Al-Karhi was translated from Arabic into German in 1878-1880 by the German historian of mathematics and astronomy and orientalist Adolf Hochheim (1840 1898) and published in Halle. F. Wiopke (1826-1864) translated part of Hochheim's work into French and published it in Paris in 1853.

Abul Hassan Ali ibn Ahman an-Nasawi was born in Nasa. His youth was spent in Tehran, Rai and Isfahan. Sources indicate that he arrived in Azna in 1029, where he wrote Al Mukani Filis al-Hindi (Sufficient Base of Indian Arithmetic).

In his seminal work on Indian arithmetic, he writes: “I began writing this work for the library of Abu Talib Rustam Majid al-Dawla ibn Fakhr al-Din (990-1029), the Buyid sultan. But it was placed in the library of Sultan Mahmud (Sharaf al-Mulk). This work, which I wrote in Persian, did not satisfy them. Because it was difficult for them to understand some phrases in Persian. So they ordered me to rewrite this work in Arabic so that they could understand it. And I agreed to carry out this order. In order to rewrite this work in Arabic, I reviewed the works of several scholars such as Abu Yusuf Yaqub ibn Ishaq al-Kindi, Abul Qasim Ali ibn Ahmad al-Anataqi, who wrote works on this subject before me.

Further, an-Nasawi said the following: “I divided my work into four books:

Book 1. Operations on Integers (Chapter 15).

Book 2. Operations on fractional numbers (Chapter 7).

Book 3. Operations on integers and fractions (Chapter 7).

Book 4. Seconds and minutes (chapter 7).

Sources indicate that in addition to the book on arithmetic, al-Nasawi also wrote comments on the works of Archimedes and Menelaus on geometry. An-Nasavi's commentary to the famous work of Archimedes "Lemma" was translated into Russian by F. Petrushevsky in 1823 and I. Veselovsky in 1963 [7, p.423].

Abul Wafa Muhammad ibn Muhammad al-Bozhani, the full name of the scientist Abul Wafa Muhammad ibn Muhammad ibn Yahya ibn Ismail ibn al-Abbas al-Bozhani. He was born in 328/940 in the city of Bozzhan, between the cities of Herat and Nishapur in Khorasan. According to sources, Abul Wafa received his primary education from his uncle Abu Amr al-Majazili and uncle Abu Abdullah Muhammad ibn Anboza. They were mature scientists of their time in the fields of mathematics, astronomy and natural sciences. Abu Amr studied geometry with the famous geometer Abu Yahya al-Marwazi and was considered one of his best students.

Abul Wafa came to Iraq at the age of 20 and began to deeply study Nicomachean arithmetic and the works of Diophantus. As a result, he became a mature scholar in arithmetic, geometry, and astronomy.

Until the last minutes of his life, he worked as one of the major representatives of the mathematical school in the city of Baghdad.

In his old age, Abul Vafa communicated with Beruni and collaborated in the scientific field. Beruni writes in his Geodesy that he agreed with Abul Wafa and observed a lunar eclipse in 387 AH / 997 AD: “I agreed with Abul Wafa Muhammad ibn Muhammad al-Bozhani to observe a lunar eclipse in the same the time when he was in Baghdad and I were in Khorezm. We both kept it at the same time in the 387th year of the Hijri” [8, p. 846-856].

It should be said that as a result of this observation, Beruni invented the rule for determining the geographical extent of cities by their lunar eclipses.

Abu Mahmud Hamid ibn al-Khizr al-Khojandi was a famous mathematician and astronomer from Khujand, and Abu Rayhan Beruni was a contemporary of al-Bojani and Ibn Iraqi.

One of the famous mathematicians and astronomers of the 10th century is Mahmud Hamid ibn Khidr al-Khojandi. Some information about the activities and scientific activities of Al-Khojandi was recorded only by his contemporaries.

Abu Rayhan Beruni (973-1048) gives information about his acquaintance and meeting with Mahmud al-Khojandi in his work "Geodesy". Beruni left Khorezm for Paradise in 995. There he met scientists in 995-997 and continued his scientific activity. Beruni Rai goes to the observatory where Mahmud al-Khojandi, a scientist of astronomy and mathematics, works, meets and befriends the scientist. As a result, Beruni spends most of his time at the observatory with al-Khojandi. Here he first got acquainted with an astronomical instrument called “Fakhri sextant”, made by Mahmud al-Khojandi by order of the ruler Ray Fakhr ad-Daul [9, p.54].

This device was the main instrument of astronomy and was considered one of the first samples of the device installed in the Ulugbek observatory. When Abu Rayhan Beruni worked with Mahmud al-Khojandi in Rai, he said of Khojandi: "Mahmud al-Khojandi was the most advanced man of his time in making astrolabes and other instruments."

Abu Said ibn Muhammad ibn Abdal-Jalil as-Sijizi (951-1024) was a contemporary and close friend of Abu Raykhan Beruni. The connection between them can be learned from the words of Beruni: “I heard from the geometer al-Sijizi how the names of the months were called in ancient Sijistan” [10, p. 144]. Abu Said was one of the greatest astronomers and geometers of the early Middle Ages.

In conclusion, it should be noted that the important merits of Abu Rayhan Beruni in the field of mathematics, astronomy, cartography, mineralogy, history and all other sciences

are widely studied today by people all over the world. Therefore, this indicates that the merits of the scientist in the field of science are great.

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