ABU RAYHAN BERUNI – AN ENCYCLOPEDIA SCIENTIST WHO WROTE WORKS IN VARIOUS FIELDS OF SCIENCE

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Annotation

The article analyzes information about the life, scientific activities and famous works of the encyclopedist Abu Rayhan Beruni. It also presents the research of modern researchers on the scientific heritage of Beruni and the activities carried out in New Uzbekistan related to the name of Beruni.

Keywords: Beruni, science, Samani, Ghaznavi, natural and social sciences.

Abu Rayhan Muhammad ibn Ahmad Beruni was born on September 4, 973, in the ancient city of Kot. In his genealogy, the word "berun" means "outside city", and "Beruni" means "a person living in an outside city". He mastered all the sciences of his time, primarily astronomy, physics, mathematics, theology, and mineralogy. With his contribution to the development of these sciences, his name has become one of the great figures of world science.

Beruni's interest in science was strong from an early age. He studied under the famous scientist Abu Nasr ibn Iraq Mansur. Ibn Iraq wrote several works on astronomy and mathematics, 12 of which he dedicated to Beruni. Beruni also always mentioned the name of his teacher with great respect. Beruni was engaged in almost all fields of science. He thoroughly studied the rich science and culture of the East, became deeply acquainted with Greek science, and became a great scholar. Beruni was also a poet and literary critic. In addition to his native language, he mastered Arabic, Sogdian, Persian, Syriac, Greek, and ancient Jewish languages. Later, he studied Sanskrit in India. As he wrote in one of his scientific works, Beruni, during his stay in Khorezm - from 990, he conducted important astronomical observations in the city of Kot. He himself invented astronomical instruments for these observations.

The struggle for the throne that began in the country did not allow the scientist to continue these scientific works. The Karakhanids launched an attack on the Samanids. As a result, a coup d'état also took place in Khorezm, and Kot Urgench was conquered by the emir Mamun I. Feeling that his life was in danger, Biruni was forced to leave his homeland at the age of 22. He went to the ancient city of Rai (near present-day Tehran). In Rai, he lived a rather difficult life and encountered financial difficulties. The scholar came to Jurjat after 998, where he met and studied with his second teacher, the physician, astronomer, and philosopher Ali Sahl Isa Masihi.

Beruni began writing the work "al-Osar al-baqiyya an al-qurun al-haliya" ("Monuments of the Ancient Peoples") during his emigration to Jurjan and completed it in 1000. Beruni prepared very well for writing it. He diligently and persistently studied the history, culture, and languages of various peoples. The fact that a young scholar mastered various fields of science so much at a time when scientific works were preserved in very few copies and in manuscript form in the hands of a few individuals shows that he was extremely talented. Beruni returned to Khorezm in 1005 and was later brought closer to the court of the new ruler Ali Abbas Mamun II. At that time, many famous scholars gathered in the palace of the Khorezmshah in Urgench and conducted scientific work in various fields of science. Beruni played an important role in the activities of this conference, which was called the "Academy of Mamun". At the same time, he actively participated in the political affairs of the country as the closest advisor to Shah Mamun II. Beruni's correspondence with Ibn Sina also took place during his stay in Khorezm. Only 18 of their questions and answers and Beruni's objections to Ibn Sina have survived to us. These correspondences show that he was also interested in natural philosophy and physics. In these questions and answers, the two famous scientists conducted scientific discussions on such issues as space, the distribution of heat, the expansion of bodies due to heat, and the reflection and refraction of light. When Khorezm was conquered by Mahmud Ghaznavi (1017), Beruni was taken to the city of Ghazna along with several other scholars from the court of the Khorezmshah. Beruni's time in Ghazna was the most productive period for his scientific activity. Beruni's work "Famous People of Khorezm" was also created during this period. His important work on geodesy, "Tahdid nihayot ilamokin li tassih masafot ilmasokin" ("Determining the boundaries of places to determine distances (between) dwellings"), was completed on November 18, 1025. The only manuscript of this work was found in Istanbul, and it was first translated into Russian from this manuscript under the title "Geodesy" (Tashkent, 1966). "Geodesy" is one of the richest sources for determining Beruni's worldview. The work "Elementary Concepts from the Art of Astronomy" was also written in Ghazni in 1029. Persian and Arabic copies of the work have survived to our time. It provides important information on a number of sciences related to astronomy of that time. Beruni's famous work "India" - "Tahqiq mo lil-Hind min maqula maqula fil-aql av marzula" ("The Book of Determining the Reasonable and Unreasonable Doctrines of the Indians") was written in 1030. This work has been highly appreciated by Western and Eastern scholars.

Biruni accompanied the Shah on his campaigns against India. His thorough study of Sanskrit in India allowed him to become closely acquainted with Indian culture, literature, and the scholars of India of that time, and to create an immortal work about this country. "Hindustan" is a very large work in terms of volume. This masterpiece was highly appreciated by Western and Eastern scholars, including modern Indian scholars. Academician W. R. Rosen assessed it as "there is no work equal to it in the entire ancient and medieval scientific literature of the

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East and the West." Biruni dedicated his astronomical work "al-Qanun al-Masudi" ("The Law of Masud") to Sultan Masud. It is not known when the book was completed. This work is Biruni's most important work on astronomy. Medieval scholars highly appreciated this work. After that, he wrote two more important books. One of these is "Mineralogy", that is, "Kitab al-jamahir fi ma'rifat al-jawahir" ("Collection of information on the knowledge of precious stones"). This treatise was considered the best work in the field of mineralogy for its time in Central Asia and the Middle East, as well as in Europe. The manuscript of his last work, "The Book on Medicinal Plants", was found in Turkey in the 30s of the 20th century. The work is known as "Saidana", and it describes medicinal plants growing in the East, including Turkestan.

Biruni was productive in all fields of science. His scientific heritage is very wide and diverse. Biruni's great ability in the field of scientific work was recognized by many of his contemporaries and later scientists. In 1035-36, Biruni compiled a list of his scientific works. It indicates that the books and treatises he had written by that time amounted to 113. If we include his later works, the scientific legacy he left behind consists of 152 books and pamphlets. Many of his works were considered encyclopedias in their own time. 70 of his works are on catastrophes, 20 on mathematics, 12 on geography and geodesy, 3 on mineralogy, 4 on cartography, 3 on climate science, one on physics, one on medicine, 15 on history and philology, 4 on philosophy, 18 on literature and other sciences.

Beruni also translated a number of scientific and literary works from different languages. Unfortunately, only 28 of the scientist's works are known to date. The rest have not reached us or have not yet been found. The study of Beruni's work, the publication of his works, and the translation into other languages began at the end of the last century. The texts of his works "Monuments of Ancient Peoples", "India", "Geodesy", "Mineralogy", "Masud's Law", "Elementary Concepts from the Art of Astronomy" and others have been published: translated into various languages. Selected works have been published in Russian and Uzbek. Beruni's contribution to astronomy is especially great. In his work "Geodesy" he openly expresses his doubts about the correctness of some theories related to geocentrism. Beruni also wrote about some phenomena in his works. For example, he was the first to come to interesting conclusions in explaining the solar corona. He was also very interested in practical astronomy. Based on his accurate and thorough astronomical observations, Beruni determined the magnitude of the inclination of the Sun's ecliptic to the celestial equator (23°34') and the secular changes in the length of the inclination of the ecliptic, the apogee of the Sun In determining the distance (of the apogee) of the sun, he achieved more accurate results than the ancient and contemporary astronomers. Beruni compiled a table of stars, in which the coordinates and "magnitudes" of 1029 stars were recorded.

Beruni was one of the great mathematicians of his time. His contribution to the science of mathematics is of great importance. In Beruni's works, the concepts of geometry, arithmetic, algebra, number theory, and trigonometry were described in a certain order. The great achievement of the scientist in arithmetic and algebra is that in him irrational numbers became an equal subject of arithmetic and algebra. In the field of arithmetic, he considers the famous third rule, and states the rules generalizing the third rule for the cases of five, seven, and more quantities.

Beruni also achieved great achievements in the field of trigonometry. Some modern researchers consider Beruni to be the first to consider trigonometry as an independent science. scientist. In his work "Al-Qanun al-Mas'udi" he described plane and spherical trigonometry. He developed the linear and quadratic interpolation rule of trigonometric functions, proposed a method of average accurate calculations, presented the corresponding tables, and accurately calculated the value of P for a number of decimal numbers.

Biruni's contribution to the sciences of geography, geodesy and geology is also immeasurable. In the field of descriptive geography, Biruni summarized the information available in geographical literature and enriched it with information collected by travelers and merchants who were his contemporaries. Most of the geographical information left by the scientist is considered the first source in Eastern literature in covering one or another geographical issue. Biruni's information about the northern countries, the Baltic and White Seas, which were little known at that time, and about the places in Siberia where "when it is summer with us, it is winter there" are interesting.

Beruni also described the lands adjacent to China and Tibet more fully and accurately than any of his predecessors. Contrary to Ptolemy, he proved that the southern part of the Atlantic and Indian Oceans was connected to each other. He assumed that there was once a strait between the continents of Asia and Africa, and that the southern part of the Earth was land. The unique information he left behind played an important role in Eastern geographical literature. History records that the American continent was discovered by the sea traveler Christopher Columbus in October 1492. However, it is also known that Beruni had a scientific hypothesis on this matter. In his work "India", the scientist, speaking about the structure of the earth's surface, seas and land, wrote: "... A quarter of the Earth is the continent. The continent is surrounded by the Ocean (Atlantic and Pacific Oceans) from the west and east. This Ocean separates the fertile part of the earth from the land or inhabited islands that may be on the other side of the seas on both sides (west and east)...". He also expresses this idea in his work "Al-Qanun al-Mas'udi". Thus, the existence of a single landmass in the Western Hemisphere, later called America, was assumed by Biruni about 450 years before European scientists and written about several times in his works. Biruni's idea of the existence of a large landmass in the Western Hemisphere was confirmed in the 15th-16th centuries. Biruni also made a great contribution

to the development of mathematical geography. He made innovations in the development of methods for determining the geographical distance and latitude of places: by widely using trigonometry and geometry, he achieved more accurate results than his predecessors. For example, he used a method for determining geographical latitude that is believed to have been discovered by Tycho de Brahe in the 16th century. The new method developed by Beruni for determining distances was also the most perfect compared to the methods used before. The results he achieved in determining the geographical distance and latitude of various geographical places amaze even modern scientists. Beruni's information about the dimensions of the Earth's sphere is much more accurate than the conclusions of Greek, Indian scientists, and scientists of the Near and Middle East who were his contemporaries. He developed a new method for measuring the length of the Earth's circumference. Beruni's method was based on mathematical calculations, without the need for difficult and complex measurements for large distances. He found that one degree of the Earth's meridian arc is equal to 110,275 meters. This is very close to modern data. In the field of geology, Beruni also made remarkable discoveries. He took a scientific approach to the study of the Earth. He writes that each part of the Earth's surface has its own long historical development. It was Beruni who first seriously attempted to study the geological development of some parts of Turkestan, including the Amu Darya valley. His conclusions about the geological past of the Amu Darya valley and the formation of the Aral Sea are among the most successful geological analyses of that time. The scientist relies on the theory that "Seas turn into land, and land into seas." Beruni's conclusions about the formation of mineral deposits, the erosion of rocks, etc. are of great importance. His assumptions about the location of subsurface bodies in order to maintain a balance of gravity in the Earth's crust are also very important.

Biruni created one of the first scientific globes in Central Asia and the Middle East in general. This globe clearly indicated the places where people lived, and with its help it was possible to determine their geographical coordinates. He criticized the unscientific and unfounded methods used in alchemy. He denied the "miraculous properties" of precious stones and some minerals, considering this to be "an excuse for those who do not know the true cause of events." Biruni concluded that the production of gold and silver by alchemy was a futile attempt that science could not solve. Biruni dedicated his work "Kitab fi informatsyon ilmu bayyizat wal-qaramita" ("Book on the White-clothed and the Qarmatians' News") to the Qarmatians, who were one of the most progressive social movements in Central Asia at that time. Later he wrote the books "Monuments" and "India". His works such as "Kitab ul maqalot wal arz waddiyenat" ("Book of Articles, Beliefs and Religions"), "Kitab fi akhbari Khorezm" ("Book of News of Khorezm"), "Kitab tarikhi ayyom as-Sultan Mahmud wa akhbari abihi" ("Book of History of the Period of Sultan Mahmud and News of His Father") have not reached us. "Monuments" ("al-Osar al-Baqiyya") is a historical ethnographic work that covers the history of kings and

famous people and reflects the culture of that era. Biruni was one of the first to highly evaluate Aristotle's contribution to science, but also to express critical opinions. Biruni criticizes Aristotle's concepts such as "natural place", "unity of the world", "heaviness and lightness". In contrast to Aristotle's concept of "heavy" and "light", Beruni in his "Objections" to Ibn Sina put forward the idea that all things are attracted to the center of the earth.

According to Beruni's student Abul Fazl al-Sarakhsi, he died on December 11, 1048 in the city of Ghazni.

Starting from the 19th century, interest in Beruni's legacy became even wider in European and Asian countries. His works began to be translated into Latin, French, Italian, German, English, Persian, and Turkish. Books and translations dedicated to Beruni's works by European scholars J. Reno, E. Zachau, G. Suter, E. Wiedemann, K. Nallino, J. Sarton, R. Wright, M. Meyerhof, and Asian scholars S. Kh. Nasr, M. Kazim, S. Barani, M. Nizamuddin, Sh. Yaltkai were published. These researchers highly appreciated Beruni's work. American historian J. Sarton, while giving the highest assessment to Beruni's legacy, considers him the first world scholar of his time. The famous orientalist V.R. Rosen notes that his scientific views are surprisingly broad, and he is characterized by the spirit of true science in the modern sense.

Indian scholars also highly appreciate Beruni's great contribution to the study of Indian philosophy, religion, science, and the history of customs. Beruni's legacy has also interested Russian scholars in many ways. Works dedicated to him by I.Yu. Krachkovsky, S.P. Tolstoy, A.A. Raynov, A.M. Belenitsky, A.A. Semyonov, and B.A. Rosenfeld have been published. The famous orientalist I.Yu. Krachkovsky highly appreciated Beruni's legacy, saying, "It is easier to list the areas of science he was not interested in than the areas he was interested in," once again emphasizing the scholar's encyclopedic mind.

Beruni's work is also being paid great attention in his homeland, Uzbekistan. Our famous scientists such as H.M.Abdullaev, I.M.Muminov, V.Yu.Zohidov, Y.G.Gulomov, U.Karimov, S.A.Bulgakov have created a number of treatises and works about Beruni's activities. A number of international scientific conferences dedicated to him have been held in Tashkent. For the first time, a multi-volume collection of Beruni's major works, including "Ancient Monuments", "India", "Masud's Law", "Geodesy", and "Saidona", was published in Uzbek and Russian by the Academy of Sciences of Uzbekistan. Streets and institutes are named after him. A state award in the field of science has been established in the name of Beruni.

About Beruni, the creators of the "Uzbekfilm" studio created a 2-part film "Abu Rayhon Beruni" (1974). Uygun wrote the play "Abu Rayhon Beruni" (1973).

The mineral discovered in Uzbekistan for the first time in the world was named after Beruni.

Also, in June 2009, the Iranian government donated the Pavilion of Persian Scientists to the United Nations Office in Vienna, which is currently located on the Memorial Square of the

Vienna International Center. The Pavilion of Persian Scientists includes four famous scientists: Avicenna, Beruni, Zakiri Razi (Reiz and Omar Khayyam).

Beruni's hometown was named after Beruni in 1957 in his honor.

In 1973, academician I.M. Muminov held events in Uzbekistan dedicated to the 1000th anniversary of the birth of Abu Rayhan Beruni.

The Research Institute of Oriental Studies in Tashkent was named after Abu Rayhan Beruni. The Beruni metro station in Tashkent, statues of Beruni in Tashkent and Khorezm, and Tashkent Technical University are also named after Beruni. The lunar volcano Beruni and the asteroid 9936 Beruni are also named in honor of the scientist.

The famous scientist S.P. Tolstov dedicated his monograph "In the footsteps of the ancient Khorezm civilization" to the Khorezmian Abu Rayhan al Beruni.

In 2023, the 1050th anniversary of the birth of the great scientist was widely celebrated on an international scale in Uzbekistan.

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