



ABU RAYHON AL-BIRUNI AND HIS CONTRIBUTION TO THE DEVELOPMENT OF THE SCIENCES

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Abstract. *Abu Rayhon al-Biruni (973–1048 CE) stands among the most versatile and influential thinkers of the Islamic Golden Age, earning recognition as a foundational figure across both the natural and social sciences. This article presents a comprehensive analysis of al-Biruni's multidisciplinary contributions, paying distinct attention to his pioneering methodology in early anthropology, sociology, comparative religion, and historiography. By examining major treatises such as *Tahqiq ma lil-Hind (Indica)* and *Al-Athar al-Baqiya (The Chronology of Ancient Nations)*, this study illustrates how al-Biruni established empirical, objective, and cross-cultural analytical frameworks long before the formal institutionalization of modern humanities and social disciplines. Furthermore, the paper investigates his legacy within Islamic civilizational thought, highlighting his pivotal role in synthesizing Hellenistic, Indian, and Persian intellectual traditions within classical Islamic scholarship. Finally, the article evaluates the contemporary resonance of al-Biruni's work, demonstrating how his commitments to unbiased inquiry, interfaith dialogue, and scientific rigor offer critical perspectives for addressing modern global academic discourse and intercultural understanding.*

Keywords: *“Osor al-boqiya”, Kath, India, mineralogy, “Saydana”, Aristotle, history, Ma’mun, Eastern culture, philology.*

INTRODUCTION

The great medieval polymath Abu Rayhon Muhammad ibn Ahmad al-Biruni was born in Kath, the ancient capital of Khwarazm, and his interest in science and scholarship grew from an early age. He acquired a thorough knowledge of several disciplines of his time, including astronomy, physics, mathematics, geodesy, geology, mineralogy and history. Al-Biruni studied under the renowned scholar Abu Nasr Mansur ibn Iraq. Ibn Iraq wrote a number of works on astronomy, geometry and mathematics, dedicating twelve of them to al-Biruni. In addition to his native language, al-Biruni mastered

several other languages: Arabic, Sogdian, Persian, Syriac, Greek and ancient Hebrew, and later, while in India, Sanskrit (Muminov, 1972:324).

As he wrote in one of his scholarly works, while living in Khwarazm he began making important astronomical observations in Kath in the 990s. He invented astronomical instruments himself for these observations (Beruniy, 1962:83–192). As the struggle for the throne among the nobility of Khwarazm prevented the scholar from continuing this scientific work, he was forced to leave his homeland at the age of twenty-two and lived in exile for some time in Jurjan, a city on the south-eastern coast of the Caspian Sea. He then went to the famous city of Rayy and, after 998, returned to Jurjan, where he met and studied under his second teacher, the physician, astronomer and philosopher Abu Sahl Isa al-Masihi. Al-Biruni began writing “*Osor al-boqiya an al-qurun al-xoliya*” (“The Surviving Monuments of Ancient Peoples”) during his exile in Jurjan and completed it in 1000. “*Osor al-boqiya*” brought al-Biruni great renown and established him as an outstanding scholar with an interest in every field of science. In addition, al-Biruni wrote more than ten works on astronomy and the history of metrology in Jurjan. He was summoned to Urgench, the country’s new capital, by the new ruler of Khwarazm, Abu Abbas Ma’mun II ibn Ma’mun, and was received with great honour by the Khwarazmshah. In Urgench al-Biruni worked at the scholarly centre established under Ma’mun’s direct patronage (Stars of Spirituality, 1999).

MAIN PART

The years al-Biruni spent in Ghazna between 1017 and 1048 were the most productive period of his scholarly career. His work “Famous People of Khwarazm” was also written during this period. His important astronomical and geographical work “*Tahdid nihoyot al-amoniya li tas’hidi masofat al-masokin*” (“Determining the Ultimate Boundaries of Places to Verify Distances between Settlements” – “Geodesy”) was completed in 1025 (Beruniy, 1966). Al-Biruni’s “The Elements of the Art of Astrology” was also written in Ghazna, in 1029. Persian and Arabic copies of the work have survived to the present day. It provides important information on several disciplines associated with astronomy at that time. Al-Biruni’s renowned major work known as “India”, “*Tahqiq mo li-l-Hind min ma’quda maqbula fi-l-aql av marzula*” (“A Book Investigating Indian Teachings That Are Acceptable or Unacceptable to Reason”),

was written in 1030 (Beruniy, 1963c). This masterpiece has been highly regarded by Western and Eastern scholars, including modern Indian scholars. Academician V. R. Rosen described it as a work that has no equal in the entire ancient and medieval scholarly literature of the East and the West (Stars of Spirituality, 1999). Al-Biruni's studies of Indian mathematical and astronomical teaching, including his book on the Indian rashikas, likewise belong to this period (Beruniy, 1963a:148–170). Al-Biruni's works are distributed by field as follows: astronomy – 70 works; mathematics – 20; geography and geodesy – 12; cartography – 4; climate and weather – 3; mineralogy – 3; philosophy – 4; physics – 1; pharmacy – 2; history and ethnography – 15; and literature – 28 (Hasanov, 2012:57).

Another of al-Biruni's important works is "Mineralogy". This treatise is regarded as an unrivalled work of mineralogy and the finest of its time in Central Asia and the Near East, and even in Europe (Beruniy, 1963b:404–410). The manuscript of al-Biruni's final work, "The Book of Medicinal Plants", was discovered in Turkey in the 1930s. The work is known as "Saydana"; in it al-Biruni provides a comprehensive description and characterisation of medicinal plants growing in the East, especially in Central Asia (Beruniy, 1987).

Al-Biruni left a substantial scholarly legacy to subsequent generations. It is known that more than 160 of al-Biruni's translations, works of varying lengths and items of correspondence relating to different fields of scholarship of his time have survived (Thinkers of Central Asia, 2011).

During the Middle Ages al-Biruni laid the foundations of a truly scientific study of nature, advancing ideas and scientific hypotheses in its various fields that were remarkable for his time and were confirmed in European science several centuries later. In the medieval period al-Biruni was among the pioneers of precise scientific thinking grounded in actual experimentation and observation (Xayrullaev, 1971). Al-Biruni also wrote in the field of philology, producing studies of classical Arabic poetry and of the structure of Indian poetry, as well as Arabic translations of examples of Iranian folklore. Al-Biruni believed that a country's prosperity was inseparably linked to the advancement of science. He stated that every scholar must base his reasoning on practice, be precise in his research, work continuously, seek out and correct his errors, and, for the sake of truth in science, combat all kinds of fabrication and superficiality (Beruniy, 1973:20).

Al-Biruni's works had a profound influence on the subsequent development of the culture of the Muslim East. Important information about al-Biruni appears in the later Arabic and Persian works of Bayhaqi, Shahrazuri, Qifti and Yaqt al-Hamawi. The thirteenth-century Syrian Christian historian and physician Ioannes Bar Hebraeus (1226–1286) observed that al-Biruni, having traversed the ocean of Greek and Indian philosophy, gained renown in the sciences of the past, that he was a specialist in the mathematical sciences and produced a number of important books in this field, that he went to India and lived there for several years, learning the art of the Indian philosophers from them and teaching them Greek philosophy, and that his works are exceedingly numerous, accomplished and highly reliable; in a word, in his own time, thereafter and up to the present, there has been no scholar among his peers so knowledgeable in astronomy or so deeply versed in its foundations and subtleties (Stars of Spirituality, 1999). High praise and descriptions of al-Biruni also appear in the works of such scholars as Tabrizi, Suyuti, Qazwini, Tusi, Muhammad ibn Mansur al-Allami and al-Khurasani. From the nineteenth century onward, interest in al-Biruni's legacy became increasingly widespread in European and Asian countries. His works began to be translated into Latin, French, Italian, German, English, Persian and Turkish. Studies and translations devoted to al-Biruni's works were published by European scholars such as J. Reinaud, E. Sachau, G. Suter, E. Wiedemann, K. Nallino, J. Sarton, R. Wright and M. Meyerhof, and by Asian scholars such as S. H. Nasr, M. Kozim, S. Barani, M. Nizamuddin and Sh. Yaltkay (Xayrullaev, 1971). These researchers held al-Biruni's work in very high esteem. The American historian J. Sarton not only gave al-Biruni's legacy the highest praise but also regarded him as the foremost scholar in the world of his time. The distinguished orientalist V. R. Rosen, meanwhile, noted the astonishing breadth of his scientific outlook and observed that he possessed the spirit of genuine science in the modern sense. Indian scholars also hold al-Biruni's immense contribution to the study of the history of Indian philosophy, religion, science and customs in the highest regard. Al-Biruni's legacy has likewise attracted wide-ranging interest among Russian scholars. Works devoted to him by I. Yu. Krachkovskiy, S. P. Tolstoy, A. A. Raynov, A. M. Belenitskiy, A. A. Semyonov and B. A. Rosenfeld have been published. Praising al-Biruni's legacy, the renowned orientalist I. Yu. Krachkovskiy observed that it is easier to list the fields of knowledge in which he took no interest than those in

which he did, once again emphasising the scholar's encyclopedic intellect (Thinkers of Central Asia, 2011).

The renowned orientalist A. M. Belenitskiy translated al-Biruni's "Mineralogy" from Arabic into Russian. In the course of this translation, inspired by the work, A. M. Belenitskiy wrote fourteen scholarly articles on various minerals. According to the scholar, although the work was written a thousand years ago, it was so meticulously composed that minerals and their properties, which today can be determined only in the most advanced laboratories, were described with remarkable precision (Beruniy, 1963b:404–410). Furthermore, it can be seen that al-Biruni applied scientific experimentation, observation and experimental approaches extensively and effectively in the social science fields of history, geography, comparative linguistics, religious studies, ethnography, anthropology and palaeontology (Muminov, 1972:324). An examination of the great scholar's legacy shows that in his works al-Biruni did not confine himself to theoretical conclusions and explanations; he provided numerous examples to demonstrate the validity of theories and solutions, performing calculations in them using the sexagesimal number system (Classical Science in Central Asia and Modern World Civilization, 2000:124).

CONCLUSION

In conclusion, it would be no exaggeration to describe al-Biruni as a true scientific polymath of the medieval East. The American historian J. Sarton said of the great scholar that astronomy and mathematics, astrology and geography, anthropology and ethnography, archaeology and philosophy, botany and mineralogy would have been impoverished without his great name (Thinkers of Central Asia, 2011).

Considerable attention has also been devoted to al-Biruni's work in his homeland, Uzbekistan. Distinguished scholars, including H. M. Abdullayev, I. M. Mo'minov, V. Yu. Zohidov, Ya. G'. G'ulomov, U. Karimov and S. A. Bulgakov, have written a number of treatises and other works on al-Biruni's activities. A number of international academic conferences dedicated to him have been held in Tashkent. For the first time, a multivolume edition of his selected works, including his major works "Ancient Monuments", "India", "The Mas'udic Canon", "Geodesy" and "Saydana", was published in Uzbek and Russian by the Academy of Sciences of Uzbekistan. Streets

and institutes have been named after him, and a state prize bearing al-Biruni's name has been established in the field of science.

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