Biographical Encyclopedia of Astronomers

Bīrūnī: Abū al-Rayhan Muhammad ibn Ahmad al-Bīrūnī

Born 4 September 973

Died possibly Ghazna (Afghanistan), circa 1050

Bīrüni was one of the most accomplished scientists of the entire Middle Ages, and his interests extended to almost all branches of science. The total number of his works, mostly in Arabic, is 146, of which only 22 are extant. Approximately half of these writings are in the exact sciences. In addition to mathematics, astronomy, and astrology, he was accomplished in the fields of chronology, geography, pharmacology, and meteorology

Bīrūnī was born in the outskirts (*birün*) of Käth, a city in the district of ancient Khwarizm, located south of the Aral Sea. At the beginning of his career, he worked for the Sämänid ruler Manşür II, but due to political turmoil, he had to change his patrons frequently. Eventually, he was captured as a political prisoner by the Ghaznawid Sultan Mahmud and taken to Ghazna, where he remained until his death.

In his youth, Bīrūnī studied Greek science, especially astronomy

He was convinced of the importance of observation, and he recorded many of his own observations in his books. One of these works is his Tahdid al-amäkin (Determination of Coordinates of Cities), which he wrote as a prisoner on his journey in 1018 from Khwarizm to Ghazna. In this book, Birūnī mentions a lunar eclipse of 997 that he observed in Khwarizm, having arranged a simultaneous observation with Abü al-Wafa al-Büzjānī, who was residing in Baghdad. Birūnī's aim was to find the difference in longitude between the two cities

Birüni's *The Chronology of the Ancient Nations*, written around 1000, is a mine of information on calendars used by the Persians, Sogdians, Kwarizmians, Jews, Syrians, Harranians, Arabs, and Greeks. This is still one of the most reliable sources on ancient and medieval chronology. Birūni does not mention much about India because at this time he was not yet well informed about the Indian calendar

In the second half of his life, Birüni became increasingly interested in Indian culture. This change may have been the result of his accompanying Sultan Mahmud on several expeditions to India. By virtue of Birüni's service as an interrogator of Indian prisoners, among whom were learned scholars, he was able to accumulate much knowledge of Indian culture, especially that of the exact sciences written in Sanskrit. His studies on India resulted in his masterpiece called India, completed in 1030. With this book, Birüni well deserves to be called "the first Indologist" in the modern sense of the word

One may characterize Biruni's attitude toward Indian culture as a mixture of sympathy and criticism; on the whole, he was fair and without prejudice. Because he was well acquainted with Greek science, Biruni was able to compare Greek and Indian astronomy and make evaluative comments. The Indian astronomer to whom he referred most frequently was Brahmagupta. He even stated that he intended to translate Brahmagupta's *Brahmasphutasiddhanta* into Arabic; however, since he was unable to complete it, he instead provided a table of contents.

Biruni was most productive in the years around 1030, after Mahmud died and the throne passed on to his elder son Mas'üd, to whom Biruni dedicated his *magnum opus* on astronomy, *al-Qānün al-Mas'üdi*. The book consists of 11 treatises (*maqalas*), each containing several chapters (*bābs*); Some chapters are further subdivided into sections (*fasls*). Treatise I is an introduction, dealing with the principles and basic concepts of astronomy as well as cosmology, time, and space. Treatise II deals with calendars, the three best known being the Hijra, Greek (i.e., Seleucid), and Persian. Treatise III is on trigonometry. Treatise IV takes up spherical astronomy. Treatise V discusses geodesy and mathematical geography. Treatise VI is on time differences, solar motion, and the equation of time. Treatise VII deals with lunar motion. Treatise VIII is on eclipses and crescent visibility. Treatise IX is on the fixed stars. Treatise X is on the planets. Treatise XI describes astrological operations.

Al-Qānün al-Mas'üdi is primarily based on Ptolemy's *Almagest*, but many new elements of Indian, Iranian, and Arabic origin are added. Bīrūnī also tried to improve Ptolemy's astronomical parameters using observations made by his predecessors and himself. He refers to the elements of the Indian calendar and chronology in Treatises I and II. In Treatise III, after explaining the chords according to Ptolemy, he offers a table of sines as well as a table of tangents (gnomon shadows). The 1,029 fixed stars are tabulated in Table IX.5.2 following the model of those in the Almagest (where the number is 1,022). To the longitude of the stars in the Almagest, Bīrūnī added 13° according to the increase from Ptolemy's time due to the precession of the equinoxes. The magnitudes of the stars are given in two columns, one based on the Almagest and the other from Şüfi's book on 48 constellations. Bīrūnī's planetary theory, which is found in Treatise X, is essentially the same as Ptolemy's, with some modifications in the parameters. The last treatise is on the topic of astrology, which requires highly advanced knowledge of mathematics; this includes the equalization of the houses and the determination of one's lifespan by means of the computation of an arc called tasyir.

Although al-Qanün al-Mas'üdi did not have much influence in medieval Europe, the book was well read in the eastern half of the Muslim world and indeed further east. One example of this is that a very peculiar irregularity in Mercury's first equation table in al-Qanün can be attested to in the Chinese text Huihui li (composed in 1384).

Another major work of Birūnī is on astrology: *Kitab al-tafhim li-awa'ilşină at al-tanjim*. The Arabic manuscript in the British Museum was published with an English translation by R. R. Wright. The translation, however, was made from a Persian version. This book is divided into three parts with the subject areas being mathematics, astronomy, and astrology. Birūnī's aim is very clearly stated by himself: "I have begun with geometry and proceeded to arithmetic and the science of numbers, then to the structure of the Universe, and finally to judicial astrology, for no one is worthy of the style and title of astrologer who is not thoroughly conversant with these four sciences."

It is undoubtedly because Bīrüni and his work were not well known to medieval Europeans that his Latinized name survives in a modern French dictionary as "aliboron," which means "stupid person"—clearly an inept description for this Islamic medieval polymath whose passion for knowledge was reflected in the scope and areas of interest he pursued.

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