

# THE ENCYCLOPAEDIA OF ISLAM

## THREE

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on the Qur'ānic story. Exegeses and traditions, in particular, elaborate on a peculiar connection between Joseph and Benjamin, stating that Benjamin is referred to as “his brother,” as he is his only full brother (by both father and mother) and emphasising Benjamin’s love for and devotion to Joseph (cf. al-Kisāʾī, 170–2). The main episode in which Benjamin appears in Muslim traditions is when he first goes to Egypt with his brothers and it is told how and where Joseph confessed to Benjamin that he was his brother. Reports include various details of the meeting between Joseph and a sorrowful Benjamin (e.g., al-Rabghūzī, 2:242–3). When he first entered Joseph’s presence, Benjamin noted the similarity between the man in front of him and Joseph, but his brothers silenced him (al-Khūshābī, 485–6). When Joseph was alone with him, he questioned him, and Benjamin confirmed his devotion to his “perished” brother, explaining that he gave his ten (or three) sons names that referred to Joseph (al-Thaʿlabī, *Qisās*, 131; al-Kisāʾī, 171). Benjamin even had the name of Joseph written on his garment (al-Khūshābī, 486), and they sat together at a table during a feast at which Benjamin wept thinking about his brother (al-Rāzī, 18:141–2). During the night, Joseph recognised his smell and embraced him until morning (al-Ṭabarī, *Jāmiʿ*, 13:15), or, according to other reports, Joseph made Benjamin sleep with him so that he could confess his identity and tell him not to reveal it to the others (cf. al-Ṭabarī, 397–8). In the rest of the story, Muslim traditions add nothing further to the Qur'ānic version.

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## al-Bīrūnī

Abū Rayḥān (or al-Rayḥān) Muḥammad b. Aḥmad **al-Bīrūnī** (also spelt al-Bērūnī; b. 362/973, d. c. 440/1048) was one of the most accomplished scientists of the Middle Ages, active in nearly all branches of science. His name was derived from Persian *bīrūn* (or *bērūn*, lit., outskirts). We do not know to what the name refers, although some connect it with a place near the southern end of the Aral Sea (now part of Uzbekistan). Although his mother tongue was a Khwārazmian dialect of Persian, all his books were written in Arabic, the language of science in his time. He was born on 3 Dhū l-Ḥijja 362/4 September 973 (Sachau, *Chronology*, xvi). There have been two suggestions for the year of his death, either 440/1048 or a few years later. Hermelink seems to settle the debate in favour of 440/1048, which was also Sachau’s view (*Chronology*, viii).

When al-Bīrūnī was sixty-five years old by the lunar calendar (sixty-three by solar

count), he wrote a bibliography of the works of Abū Bakr al-Rāzī (d. 313/925 or 323/935), the best known physician and polymath of his time, to which he added a list of his own writings. The Arabic text of the bibliography was edited by Kraus and translated into French by Boilot. Ahmad Saeed Khan provided further information on al-Bīrūnī's writings in a bibliography that listed 138 items, including twenty-five that were dedicated to him by other scholars. Because al-Bīrūnī continued writing until his death, there is an unknown number of additional works. Boilot lists 180 and Ahmad Saeed 183, while Kennedy says that the number is "no less than 146" (*al-Bīrūnī*). Approximately half of these writings are in the exact sciences. In addition to mathematics, astronomy, and astrology, al-Bīrūnī was well versed in chronology, geography, pharmacology, and meteorology. He was also a humanist and, in the latter half of his life, devoted himself to the study of Indian culture. Ansari (*Survey*), based on information from Rozenfeld and Ihsanoğlu (2003), counted thirty-nine of al-Bīrūnī's works extant today.

Al-Bīrūnī's teacher was Abū Naṣr Maṣṣūr b. 'Alī b. 'Irāq (d. c. 408/1018), who wrote several works on mathematics and astronomy, in the form of letters to al-Bīrūnī. The collected letters were published as *Rasā'il Abī Naṣr ilā l-Bīrūnī*. Early in his career, al-Bīrūnī worked for the Sāmānid ruler Maṣṣūr II (r. 387–9/997–9), but, on account of political turmoil, he had to change his patrons frequently. Eventually he was made a political prisoner by the Ghaznavid sultan Maḥmūd (r. 388–421/998–1030) and taken to Ghazna (in present-day Afghanistan), where he remained until his death, serving three generations of sultans,

Maḥmūd, Mas'ūd (r. 421–32/1031–40), and Mawdūd (r. 432–40?/1041–8).

One of al-Bīrūnī's earliest works is *al-Āthār al-bāqīya 'an al-qurūn al-khāliya* (usually referred to as the *Chronology of the ancient nations* or, simply, the *Chronology*), written in about 390/1000 and dedicated to the Ziyārid ruler Qābūs b. Washmgīr, who ruled Ṭabaristān and Jurjān (r. 367–71/978–81, 387–402/997–1012). The *Chronology* is a mine of information on calendars used by the Persians, Sogdians, Khwārazmians, Jews, Syrians, Ḥarrānians, Arabs, and Greeks, and it is still one of the most reliable sources on ancient and mediæval chronology. The festivals of various religions—Jewish, Christian, Zoroastrian, Ṣābian, and Islamic—are described in detail. There is little mention of India, because, at the time he wrote the book, he was not well informed on Indian culture in general or Indian calendars in particular. He admitted freely his lack of knowledge of the Indian method of intercalation: "I have not met with anybody who had an accurate knowledge of this subject; therefore I turn away from what I cannot know for certain" (Sachau, *Chronology*, 15).

In his youth, al-Bīrūnī studied Greek science, especially astronomy. He was convinced of the importance of astronomical observation and wrote several books on astronomical instruments, of which five are mentioned in his own bibliography, one of them a lengthy book on the construction of the astrolabe. He recorded many of his own observations in his books, as, for instance, the *Kitāb taḥdūd nihāyāt al-amākin li-taṣṣiḥ masāfāt al-masākin* ("Book of the determination of coordinates of positions for the correction of distances between cities"), which he began in 409/1018—on his journey from Khwārazm to Ghazna as a prisoner—and completed in 416/1025.

In this book, al-Bīrūnī reports on the lunar eclipse of 13 Jumādā I 387/24 May 997, which he observed in Khwārazm, having arranged a simultaneous observation with Abū l-Wafā' al-Būzjānī (d. 388/998), who observed it in Baghdad (Kennedy, *Commentary*, 164). Al-Bīrūnī's intention was to determine the latitude and longitude of important cities from the Mediterranean to Central Asia. His particular purpose, as he says in the introduction, was to determine the geographical coordinates of the city of Ghazna and fix the *qibla*, the true direction of Mecca, the most important subject discussed at the end of the book.

A few years before he wrote the *Chronology*, al-Bīrūnī sent several letters to his younger contemporary, Ibn Sīnā (Avicenna, d. 428/1037). The correspondence, which is mentioned briefly in his *Chronology* (Sachau, Ar. 257, Eng., 247), is not included in his own bibliography but is listed by Boilot and Khan. The text was published as *al-As'ila wa-l-ajwiba* ("Questions and answers") by Seyyed Hossein Nasr and Mehdi Mohaghegh. It consists of al-Bīrūnī's eighteen questions, which are divided into ten concerning Aristotle's cosmology and eight on Aristotelian natural philosophy. All the questions were answered by Ibn Sīnā, but al-Bīrūnī was unsatisfied and sent back additional questions, eight about the first series of questions and seven about the second series. These questions were answered by al-Ma'sūmī, one of Ibn Sīnā's distinguished students.

Al-Bīrūnī was most productive in the years around 421/1030, after Maḥmūd died and the throne passed to his elder son Ma'sūd, to whom al-Bīrūnī dedicated his magnum opus on astronomy, *al-Qānūn al-Ma'sūdī* ("The Ma'sūdī canon"). This consists of eleven books (*maqālas*). This

work has been translated into no modern language but Russian. According to Kennedy (Al-Bīrūnī's Masudic canon), Book 1 is an introduction, dealing with the principles and basic concepts of astronomy, as well as cosmology, time, and space. Book 2 deals with calendars, the three best known being the *hijrī*, Greek (i.e., Seleucid), and Persian. Book 3 is on trigonometry and Book 4 on spherical astronomy. Book 5 discusses geodesy and mathematical geography. Book 6 is on time differences, solar motion, and the equation of time. Book 7 deals with lunar motion, and Book 8 is on eclipses and crescent visibility. Book 9 is on fixed stars and Book 10 on planets. Book 11 describes astrological operations.

Although the *Qānūn* is based primarily on Ptolemy's *Almagest*, al-Bīrūnī introduced many new elements of Indian, Iranian, and Arabic origin and tried to improve Ptolemy's astronomical parameters, using observations made by himself and his predecessors. He referred to the elements of Indian calendars and chronology in Books 1 and 2. In Book 3, after explaining the chords according to Ptolemy, he offered a table of sines and one of tangents (gnomon shadows). 1029 fixed stars are tabulated in *Qānūn* 9.5.2, following the model of the *Almagest* (which lists 1022 fixed stars). To the longitudes of the stars in the *Almagest*, al-Bīrūnī added thirteen degrees to account for the change from Ptolemy's time caused by the precession of the equinoxes. The magnitudes of the stars are given in two columns, one based on the *Almagest* and the other taken from the book on forty-eight constellations written by 'Abd al-Raḥmān al-Šūfī (c. 376/986). Al-Bīrūnī's planetary theory, which is found in Book 10, is essentially that of Ptolemy, with some modification in the parameters. The last book is

on those topics of astrology that require an advanced knowledge of mathematics; these include the equalisation of the astrological houses and the determination of the length of one's life by calculating an arc called *taṣyīr*. Although the *Qānūn* was unknown in mediaeval Europe, the book was well read in the eastern half of the Muslim world and further east. An example of its influence is the fact that a peculiar irregularity in Mercury's first equation table in the *Qānūn* is attested also in the Chinese text entitled *Huihui li* ("Islamic calendar"), composed in 785/1383.

Al-Bīrūnī's four minor works on specialized topics of exact sciences, (1) Chords (*Istikhrāj al-awṭār*), (2) Shadows (*Ifrād al-maqāl*), (3) Transits (*Tamhūd al-mustaqarr*), and (4) Indian rule of three etc. (*Rāshikāt al-Hind*), were bound together and published as *Rasā'il al-Bīrūnī* (1367/1948), out of which (2) and (3) were translated and studied by E. S. Kennedy and his students. Another small work entitled *Maqāṭid 'ilm al-hay'a* ("Keys of astronomy") is devoted to spherical trigonometry.

Another of al-Bīrūnī's major works is on astrology, the *Kitāb al-tafhīm li-awā'il ṣinā'at al-tanjīm* ("The book of instruction in the elements of the art of astrology"), written in 420/1029, in both Arabic and Persian. The copy of the Arabic manuscript held by the British Museum was published, with English translation, by R. Ramsey Wright. This widely used translation was, however, made from the Persian version; a critical edition of the Arabic text is still needed. This book can be divided into five subject areas: (1) geometry; (2) arithmetic; (3) astronomy, including geography, cosmology, and chronology; (4) the astrolabe; and (5) astrology proper (only a quarter of the book). Al-Bīrūnī states his aim clearly: "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" (Wright, 1). Although the geometry in this book is based essentially on Euclid's *Elements*, the order of definitions at the beginning of this book is opposite to that of the *Elements*: he first defines the solid body and then proceeds to the definitions of surface, line, and point. This is an example of the heuristic method of his teaching, which he employs because the book was written at the special request of a lady named Rayḥāna bt. al-Ḥasan. In this book al-Bīrūnī introduced many topics of Iranian and Indian origin; he was already well informed on Indian calendrics and cosmology.

In the second half of his life al-Bīrūnī became increasingly interested in Indian culture. This change might have been a result of his accompanying Sulṭān Maḥmūd on several expeditions to the northwestern regions of India. Al-Bīrūnī's service as an interrogator of Indian prisoners, among whom were learned scholars, enabled him to collect much information on Indian culture, especially from Sanskrit works on the exact sciences. His studies on India resulted in his masterpiece, the *Kitāb fī taḥqīq mā lil-Hind min maqūla* ("Book of the verification of what is said about India," commonly referred to as the *India*), completed in about 420/1030. This book entitles al-Bīrūnī to be considered the first Indologist, in the modern sense of the word. He clearly states his aim in writing the book:

This book is not a polemical one. I shall not produce the arguments of our antagonists in order to refute such of them as I believe to be in the wrong. My book is nothing but a simple historic record of facts. I shall place before the reader the theories of the Hindus exactly as they are, and

I shall mention in connection with them similar theories of the Greeks in order to show the relationship existing between them (Sachau, *Alberuni's India*, 1:7).

Al-Bīrūnī is thus not only the first Indologist but also the first scholar to conduct a comparative study of the history of science. His interest was not limited to this comparative study, and he had a strong “desire of spreading science”; he was thus “occupied in composing for the Hindus a translation of the books of Euclid and of the *Almagest*, and dictating to them a treatise on the construction of the astrolabe” (Sachau, *Alberuni's India*, 1:137). He was learning how to compose Sanskrit verses, because he knew that prose compositions might not attract the attention of Indian scholars.

He begins this book with a general introduction to Indian religion, culture, and literature. In chapters 1–13 he discusses Hindu beliefs, the transmigration of souls, civil law, castes, idol worship, and literatures sacred and profane. Chapters 14–17 are on Indian science in general. Chapters 18–31 deal with geography and cosmology. Chapters 32–50 are devoted to units of time, including those of calendars and cosmic cycles, such as the *kalpa* and the *yuga*. In chapters 51–80 he describes further details of calendars and calendar-related customs and festivals, including astrological elements. The Sanskrit texts on astrology to which al-Bīrūnī most frequently refers in *India* are the *Bṛhatsamhitā* and the *Laghujātaka* of Varāhamihira (mid-sixth century CE). He sometimes refers to Utpala (fl. 966 CE), a Kashmiri commentator almost contemporary with him. The Indian astronomer-mathematicians he names most frequently are Āryabhaṭa (d. 550 CE) and Brahmagupta (d. 668 CE). Al-Bīrūnī confesses that he

was unable to find Āryabhaṭa's original books and that everything he knew was through quotations from the works of Brahmagupta (Sachau, *Alberuni's India*, 1:370). On the other hand, he was able to use Brahmagupta's *Brāhmasphuṭasiddhānta*; he states that he began to translate it into Arabic, although, because he had not yet finished his work, he gives only a table of contents. According to this table, the first chapter is entitled “On the nature of the globe and the figure of heaven and earth,” but this is, in fact, the title of Chapter 21 of the modern editions of the same text. Pingree (Brahmagupta) has shown that al-Bīrūnī actually used a now lost eighth-century CE commentary on the *Brāhmasphuṭasiddhānta* by Balabhadra. Pingree doubts the reliability of al-Bīrūnī's informants and even his ability to understand the sophisticated Sanskrit texts on astronomy (Pingree, *Scholar*). Relevant to this question is Baloch's introduction to his edition of al-Bīrūnī's Arabic translation of the now lost Sanskrit text *Karaṇatilaka*: al-Bīrūnī was “concerned more with idea than with words, with substance than details...he did not concern himself with mere verbal translation” (Baloch, Ghurraṭ, 12).

Al-Bīrūnī's interest in India was not limited to the field of natural science; he was also fascinated by the Indian systems of philosophy. According to his own statement in the *India*, he translated two philosophical books into Arabic, one on *Sāṃkhya* philosophy, the other Patañjali's *Yogasūtra*. Although the Arabic text of the former is lost, the manuscript of the latter was published by Hellmut Ritter and translated into English by Pines and Gelblum. When al-Bīrūnī's Arabic translation is compared with the original Sanskrit text, which is now available, the difference is remark-

able. He changed the aphoristic style of the *sūtra* into a question-and-answer style in which the questions are actually introductory remarks by the commentators. One wonders what kind of text he had before him and what was his attitude towards “translation.” One can imagine that the “Sanskrit text” he used included not only the written text that we are familiar with but also information conveyed to him orally by Indian pundits. Although he referred to the commentator Vyāsa by name, he sometimes failed to distinguish the original words of Patañjali’s *sūtra* from those of Vyāsa’s commentary. One passage is interesting for his translation of *Yogasūtra* 3.26: as he was interested in the cosmological idea that was discussed in the commentaries on this *sūtra*, he made an extensive digression, quoting one of the commentaries which differs from Vyāsa’s.

One may characterise al-Bīrūnī’s attitude toward Indian culture as a mixture of sympathy and criticism. He went so far as to say,

I can only compare their mathematical and astronomical literature, as far as I know it, to a mixture of pearl shells and sour dates, or of pearls and dung, or of costly crystals and common pebbles. Both kinds of things are equal in their eyes, since they cannot raise themselves to the methods of a strictly scientific deduction (Sachau, *Alberuni’s India*, 1:25).

He was, on the whole, fair and unprejudiced. In chapter 26 of *India*, for instance, after mentioning Brahmagupta’s and Varāhamihira’s criticism of Āryabhaṭa’s theory of the rotation of the earth, he says “the rotation of the earth does in no way impair the value of astronomy, as all appearances of an astronomic character can quite as well be explained according to this theory as to the other” (Sachau, *Alberuni’s India*, 1:277) and he refers to his own book entitled *Miftāḥ ʿilm al-hayʿa*

(“Key to astronomy”), in which he claims that he surpassed his predecessors on this topic. This book has, unfortunately, not survived.

Towards the end of his life al-Bīrūnī devoted himself to the study of pharmacology. In his book on this subject, *Kitāb al-ṣaydana* (or *al-ṣaydala*) *fī l-tibb* (“The book on medicinal drugs”), 1095 drugs, including inorganic substances, are listed in alphabetical order, but the section beginning with the letter *r* is missing, and the section beginning with the letter *sh* is found at the end of the work, suggesting that al-Bīrūnī died before completing it. Referring to authorities such as Dioscorides, Galen, and Paul of Aegina, he provided Greek and Latin equivalents, in addition to Persian, Khwārazmian, and Indian names and their dialect variants. His digressions on historical background and anecdotes concerning drugs manifest his abilities as an encyclopaedist. His book on mineralogy, *Kitāb al-jamāhir fī maʿrifat al-jawāhir*, also encyclopaedic, consists of two parts: (1) precious stones and (2) metals. In the long introduction preceding the main parts, he expresses a deep insight into what is truly valuable, materially as well as spiritually, quoting many passages from the Qurʾān.

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## Biṣṭāmī, Shihāb al-Dīn

Shaykh **Shihāb al-Dīn Biṣṭāmī**, known as Kīyābanī (d. 807/1405), was a noble and saint of the Tīmūrid era in Herat. He was a companion of Shaykh Quṭb al-Dīn Yaḥyā al-Jāmī (d. 807/1405), a renowned theologian mystic, and he studied *ḥadīth* with him. While he was Qavām al-Dīn Biṣṭāmī's (d. 743/1342) disciple, he studied *fiqh* (jurisprudence) with Amīr Jalāl