BĪRŪNĪ, ABŪ RAYḤĀN

BĪRŪNĪ, ABŪ RAYḤĀN MOḤAMMAD b. Aḥmad (362/973- after 442/1050), scholar and polymath of the period of the late Samanids and early Ghaznavids and one of the two greatest intellectual figures of his time in the eastern lands of the Muslim world, the other being Ebn Sīnā (Avicenna).

(Multiple Authors)

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BĪRŪNĪ, ABŪ RAYḤĀN i. Life

BĪRŪNĪ, ABŪ RAYḤĀN

i. Life

Bīrūnī was born in the outer suburb (*bīrūn*, hence his *nesba*) of Kāṯ, the capital of the Afrighid Ḵᵛārazmšāhs (see āl-e afrīḡ), and spent the first twenty-five years of his life in Ḵᵛārazm studying both the *al-ʿolūm al-ʿarabīya* "Arab sciences" (*feqh*, theology, grammar, etc.) and the *al-ʿolūm al-ʿajamīya* "non-Arab sciences" (essentially Greek: mathematics, astronomy, medicine, etc.); in the later part of his life, much of his contemporary reputation was to be as a *monajjem* or astrologer at the Ghaznavid court. It is likely that his own sympathies, and perhaps also his family connections, were with the Afrighids, who in 385/995 were overthrown by the rival dynasty in Gorgānj of the Maʾmunids (see āl-e maʾmūn). At all events, he left his homeland for the Samanid capital of Bukhara and secured the patronage of the ante-penultimate Samanid amir, Manṣūr II b. Nūḥ II (387-89/997-99). He had previously been in correspondence with Ebn Sīnā there, and there is extant an important exchange of views between the two scholars (ed. S. Ḥ. Naṣr and M. Moḥaqqeq, *Abū Rayḥān Bīrūnī wa Ebn Sīnā, al-asʾela waʾl-ajweba*, Tehran, 1352 Š./1973). He then went, apparently in 388/998, to the court of the Ziyarid amir of Ṭabarestān and Gorgān, Šams-al-Maʿālī Qābūs b. Vošmgīr (q.v.), and it was there that he wrote his first major work, *al-Āṯār al-bāqīa ʿan al-qorūn al-ḵālīa* on historical and scientific chronology (see vi, below), probably in about 390/1000, though he made later emendations to it. He clearly came to accept the accomplished fact of the definitive passing of the Afrighids and made his peace with the Maʾmunids, whose court in Gorgānj was becoming famed for its brilliance. He served the Ḵᵛārazmšāh Abuʾl-ʿAbbās Maʾmūn b. Maʾmūn (399-407/1009-17) for seven years, according to the historian Abuʾl-Faẓl Bayhaqī (who utilized Bīrūnī's history of his homeland, the *Ketāb al-mosāmara fī aḵbār Ḵᵛārazm*, see below, for his own *Tārīḵ-e āl-e Saboktegīn*), he acted as a *nadīm* or boon-companion and adviser to the Ḵᵛārazmšāh, being also used by the latter for delicate diplomatic missions.

A well-known anecdote of Neẓāmī ʿArūżī Samarqandī (*Čahār maqāla*, ed. Qazvīnī, pp. 118-19, rev. tr. E. G. Browne, London, 1921, pp. 86-97, cf. idem, *Lit. Hist. Persia*II, pp. 96-97) describes how Sultan Maḥmūd of Ghazna, jealous of the splendor of Maʾmūn b. Maʾmūn's court circle, sent him an ultimatum demanding that all the leading scholars there be sent forthwith to Ghazna in order to adorn his own court. The story goes on to tell how the philosophers Ebn Sīnā and Abū Sahl ʿĪsā Masīḥī escaped to the west, the former eventually serving the Kakuyid ʿAlāʾ-al-Dawla Moḥammad in Isfahan till his death there, but Bīrūnī, the mathematician Abū Naṣr Jīlānī, and the physician Abuʾl-Ḵayr Ḵammār went to Ghazna and entered Maḥmūd's service. Bīrūnī then spent the remainder of his life, what must have been well over three decades, with the

Ghaznavids Maḥmūd, Masʿūd, Mawdūd, and their successors, dying at some unknown date after 442/1050, perhaps during the sultanate of ʿAbd-al-Rašīd.

According to recent works by scholars in Tashkent, Bīrūnī died on 2 Rajab 440/11 December 1048 (Karimov, pp. 150-51; cf. Bulgakov); unfortunately, the details and the chronology of Bīrūnī's life under the Ghaznavids are most obscure. He seems to have been generally famed as court astrologer there, and another anecdote of the *Čahār maqāla* (pp. 91-93, rev. tr. 65-67; cf. Browne, *Lit. Hist. Persia* II, pp. 97-98, which does not, however, seem credible) describes how his accurate astrological prognostications nevertheless led him into difficulties with the irascible sultan. It seems probable that Bīrūnī spent part at least of his twelve years or so under Maḥmūd in imbibing information about India, acquiring a knowledge of Sanskrit and contemporary Indian languages and of Hindu philosophy and science in those northwestern parts of India under Ghaznavid control and possibly accompanying Ghaznavid plunder raids into the northern Indian heartlands, although as Sachau pointed out (*Alberuni's India*, London, 1888, repr. Delhi, 1964, preface, pp. ix, xi ff.), there is nothing to show that Bīrūnī enjoyed any sort of official patronage or favor under Maḥmūd. He did however utilize the information

gathered over these years for his major work on India, the *Taḥqīq mā le'l-Hend*, conventionally known in Western scholarship as his *India*, completed in 421/1030 just after Maḥmūd's death (see viii, below). Shortly before this he had completed a concise work on mathematics and astronomy, the *Ketāb al-tafhīm le-awāʾel ṣenāʿat al-tanjīm* (see iii, below). At the opening of Sultan Masʿūd's reign, Bīrūnī finished his *al-Qānūn al-masʿūdī fi'l-hayʾa wa'l-nojum´* on astronomy and science (421/1030). He must have been encouraged to carry on his scientific work and provided with the necessary facilities, for we have from the reign of Mawdūd b. Masʿūd (432-40/1041-1048 or 1049) his treatise on mineralogy, the *Ketāb al-jamāher fī maʿrefat al-jawāher*, and at the end of his life, when he states that he was over 80 (hence after 442/1050), he wrote his book on pharmacology and materia medica, the *Ketāb al-ṣaydala fi'l-ṭebb* (see v, below).

Bīrūnī was obviously a prolific author, who preferred to use Arabic, the scientific language of the Muslim world, for most of his works, rather than Persian, in which the creation of a technical and scientific vocabulary was only just taking rough shape during his time. In the introduction to his *Ṣaydala*, Bīrūnī inveighs against the use of Persian for scientific works, implying that such a usage was in fact taking place in his lifetime. One of his major works, the *Tafhīm*, exists in both Arabic and Persian versions, and it is unclear which came first. However, it was more common at this period to translate from Arabic into Persian than vice-versa, and G. Lazard is inclined to treat the Persian version as a very early translation of an Arabic original, whether made by Bīrūnī himself or not being unclear (*La langue des plus anciens monuments de la prose persane*, Paris, 1963, pp. 58-62).

In the bibliography of Rāzī's works, *Resāla fī fehrest Moḥammad ebn Zakarīyāʾ al-Rāzī*, which Bīrūnī composed in 427/1036, Bīrūnī also inserted a *fehrest* of his own works to that date,

computing them at 103 completed and 10 unfinished ones (in which last group were placed the *al-Āṯār al-bāqīa* and *al-Qānūn al-masʿūdī*). His total works amount, according to Boilot, to 180, ranging from large-scale treatises covering great expanses of knowledge to brief epistles on specific topics. Boilot has listed these in his "L'œuvre d'al-Bērūnī. Essai bibliographique," in *Mélanges de l'Institut dominicain d'études orientales du Caire* 2, 1955, pp. 161-256, 3, 1956, pp. 391-96, following the earlier attempt of H. Suter, E. Wiedemann, and O. Rescher in "Beiträge zur Geschichte der Naturwissenschaften. LX. Ueber al Bîrûnî and seine Schriften," *Sb. der Physikalisch-Medizinischen Sozietät zu Erlangen* 52-53, 1920-21, pp. 55-96.

Bibliography:

For the early stages of Bīrūnī's life and career see C. E. Bosworth, "The Khwārazmian Historical Background to Bīrūnī's Life," *The Commemoration Volume of Biruni International Congress Tehran* B: *English and French Papers*, Tehran, 1356 Š./1976, pp. 11-27.

The main primary sources are the biographies of Bīrūnī in ʿAlī b. Zayd Bayhaqī's *Tatemmat ṣewān al-ḥekma*, ed. M. Šafīʿ, Lahore, 1935, pp. 62-64; Yāqūt, *Eršād al-arīb* VI, pp. 308-14; and Ebn Abī Oṣaybeʿa, *ʿOyūn al-anbāʾ*, ed. A. Müller, Königsberg, 1884, II, pp. 20-21.

The secondary literature on Bīrūnī is extensive. Standard works include Suter, *Mathematiker*, pp. 98-100; G. Sarton, *Introduction to the History of Science*, Baltimore, 1927, I, pp. 707-09; Brockelmann, *GAL* I², pp. 626-27, Suppl. I, pp. 870-75; Sezgin, *GAS* III, index, V, pp. 375-83; E. S. Kennedy, "Al-Bīrūnī . . . , Abū Rayḥāṇ . . . Muḥammad b. Aḥmad," in *Dictionary of Scientific Biography*, New York, 1970, II, pp. 148-58; *İA* II, pp. 635-47.

D. J. Boilot, "al-Bīrūnī," in *EI*², contains a detailed bibliography of secondary works. It is supplemented by the special sections on Bīrūnī in Pearson, *Index Islamicus* and its quinquennial supplements under philosophy and science: individual scientists and philosophers. Recent works of bibliographical interest include Ṣalāḥ-al-Dīn Monajjed, "Molāḥaẓāt ʿalā ṭabaʿāt moʾallafāt al-Bīrūnī," in *The Commemorative Volume of Biruni International Congress . . .* A: *Persian and Arabic Papers*; A. S. Khan, *A Bibliography of the Works of Abu'l-Rayḥān Bīrūnī* (in Urdu), New Delhi, 1982 (Pers. tr. ʿA. Ḥabībī, *Ketāb-šenāsī-e Abū Rayḥān Bīrūnī*, Tehran, 1352 Š./1973); M. Mīnovī, "Abū Rayḥān Bīrūnī," in *Barrasīhā-ī dar bāra-ye Abū Rayḥān Bīrūnī be monāsabat-e hazāra-ye welādat-e ū*, Tehran, 1352 Š./1973; S. Ḥ. Naṣr, *Ketāb-šenāsī-e tawṣīfī-e Abū Rayḥān Bīrūnī*, Eng. title, *Al-Bīrūnī. An Annotated Bibliography*, Tehran, 1352 Š./1973.

For question of dating, see P. Bulgakov, *Life and Works of Bīrūnī*, Tashkent, 1972; U. Karimov, tr., *Ṣaydana*, Tashkent, 1973.

(C. Edmund Bosworth)

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BĪRŪNĪ, ABŪ RAYḤĀN ii. Bibliography

BĪRŪNĪ, ABŪ RAYḤĀN

ii. Bibliography

Bīrūnī catalogued both his own works and those of Rāzī. In 427/1035-36 or a little thereafter Bīrūnī wrote, at the urging of a friend, a *Resāla fī fehrest kotob Moḥammad b. Zakarīyāʾ al-Rāzī* (Epistle concerning a list of the books of Moḥammad b. Zakarīyāʾ al-Rāzī). This consists of two parts, the first devoted to Rāzī and his works, the second to Bīrūnī himself with an inventory of the books that he had authored up to that time. This sort of bibliographical treatment of an individual is modeled on those produced by Galen in antiquity and by Ḥonayn b. Esḥāq in the 3rd/9th century.

The catalogue of Rāzī's works contains 184 titles divided into 11 categories: medicine; natural science; logic; mathematics and astronomy; commentaries, synopses, and extracts; philosophy and assessment; metaphysics; theology; alchemy; heretical; and miscellaneous. After it Bīrūnī presents a chronological table of Greek physicians from Asclepius to Galen followed by brief notes on the history of medicine. This part of the *Resāla* has been studied by Ruska.

Bīrūnī's catalogue of his own literary production up to his 65th lunar/63rd solar year (the end of 427/1036) lists 103 titles divided into 12 categories: astronomy, mathematical geography, mathematics, astrological aspects and transits, astronomical instruments, chronology, comets, an untitled category, astrology, anecdotes, religion, and books of which he no longer possesses copies. Except for the books in the last category he usually mentions the number of folios occupied by each work in the copy available to him. After an account of the astrologers' predictions of the length of his life and of a dream he had in his sixty-first (lunar ?) year, he adds ten more titles of his own works followed by twenty-five of those written in his name by Abū Naṣr Manṣūr b. ʿAlī b. ʿErāq, Abū Sahl ʿĪsā b. Yaḥyā the Christian, and Abū ʿAlī Ḥasan b. ʿAlī Jīlī. His own works, he says, he regards as his sons, and so also does he those that were written in his name.

A *Mošāṭa*, or appendix to the *Resāla*, in which Bīrūnī's horoscope is thoroughly analyzed, was written by Abū Esḥāq Ebrāhīm b. Moḥammad Tabrīzī, called Ḡażanfar (see Bīrūnī, *al-Āṯār al-bāqīa*, pp. XIV-XV). Ḡażanfar states that he was born 184 Persian years after Bīrūnī's death. Since he gives the latter date as 440/1048-49, Ḡażanfar must have been born in 630/1232-33.

The titles of some 155 works composed by Bīrūnī are known (see Boilot). Some he wrote after he had finished his bibliography, others he simply forgot to include in it. Perhaps five-sixths of the total number of 155 treatises are now irretrievably lost.

Bīrūnī's extant works. The list given here follows the order of Boilot, whose RG numbers are prefaced to the appropriate items:

RG 7: *Ketāb maqālīd ʿelm al-hayʿa*, preserved on fols. 163-84 of ms. 597 in the Sepahsālār Mosque, Tehran (Kennedy).

RG 11: *Maqāla fi'l-taḥlīl wa'l-taqṭīʿ le'l-taʿdīl*, publ. by mistake as part of work no. 1 (*Esteḵrāj al-awtār*) in *Rasāʾel al-Bīrūnī*, Hyderabad, 1948, and by A. S. Demerdāš, Cairo [1965] (Hogendijk, pp. 148, 150-52).

RG 15: *Ketāb fī efrād al-maqāl fī amr al-aẓlāl*, publ. as work no. 2 in *Rasāʾel al-Bīrūnī*, but with some omissions and confusions (Hogendijk, p. 145).

RG 19: *Ketāb taḥdīd nehāyat al-amāken le-taṣḥīḥ masāfāt al-masāken*, ed. P. G. Bulgakov, in *Maʿāḵeḏ al-maḵṭūṭāt al-ʿarabīya*, Cairo, 1962; Russ. tr. P. G. Bulgakov, in Bīrūnī's selected works (*Izbrannye proizvedeniya*) III, Tashkent, 1966; tr. J. Ali, *The Determination of the Coordinates of Cities*, Beirut, 1967; comm. by E. S. Kennedy, *A Commentary upon Bīrūnī's Kitāb taḥdīd al-amākin*, Beirut, 1973.

RG 24: *Maqāla fī esteḵrāj qadr al-arż be-raṣd enḥeṭāṭ al-ofoq ʿan qolal al-jebāl*; a brief extract survives on fols. 43-43v of Berlin 5794 (see Wiedemann).

RG 38: *Fī rāšīkāt al-Hend*, publ. as work no. 4 in *Rasāʾel al-Bīrūnī* (Hogendijk, pp. 145-46).

RG 45: *Tamhīd al-mostaqarr le-taḥqīq maʿna'l-mamarr*, publ. as work no. 3 in *Rasāʾel al-Bīrūnī*, tr. M. Saffouri and A. Ifram, *On Transits*, Beirut, 1959, with a comm. by E. S. Kennedy (Hogendijk, p. 146).

RG 46: *Ketāb fī estīʿāb al-wojūh al-momkena fī ṣanʿat al-aṣṭorlāb*, preserved in many mss. RG 47: *Fī tashīl al-taṣḥīḥ al-aṣṭorlābī wa'l-ʿamal be-morakkabāteh men al-šamālī wa'l-janūbī*, preserved on fols. 1-43 of Berlin 5794 (Bīrūnī, *al-Āṯār al-bāqīa*, p. L).

RG 48: *Maqāla fī tasṭīḥ al-ṣowar wa tabṭīḥ al-kowar*, ed. A. S. Saʿīdān, *Derāsāt* 4, 1977, pp. 7-22; a facsimile of the ms. is given in Berggren, pp. 81-95.

RG 63: *Maqāla fi'l-nesab allatī bayn al-felezzāt wa'l-jawāher fi'l-ḥajm*, preserved in ms. 223 of the Université de St. Joseph in Beirut.

RG 64: *Maqāla fī esteḵrāj al-awtār fi'l-dāʾera be-ḵawāṣṣ al-ḵaṭṭ al-monḥanī fīhā*, publ. as work no. 1 in *Rasāʾel al-Bīrūnī*; ed. A. S. Demerdāš, Cairo, [1965]; both editions are defective (Hogendijk, p. 147).

RG 67: *Maqāla fī anna lawāzem tajazzoʾ al-maqādīr elā lā nehāya qarība men amr al-ḵaṭṭayn allaḏayn yaqrabān wa lā yaltaqīān fi'l-estebʿād*; a fragment preserved on 1 fol. was published as part of work no. 1 of *Rasāʾel al-Bīrūnī* (see Hogendijk, pp. 149, 158-59).

RG 73: *Ketāb al-tafhīm le-awāʾel ṣenāʿat al-tanjīm*, in both Arabic (ed. R. R. Wright, London, 1934) and Persian (ed. J. Homāʾī, Tehran, 1318 Š./1939, rev. 1353 Š./1975).

RG 76: *Maqāla fī sayr sahmai'l-saʿāda wa'l-ḡayb*, ed. F. I. Haddad, D. Pingree, and E. S. Kennedy, "Al-Bīrūnī's Treatise on Astrological Lots," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 1, 1984, pp. 9-54.

RG 93: *Ketāb taḥqīq mā le'l-Hend men maqūla maqbūla fi'l-ʿaql aw marḏūla*, ed. C. E. Sachau, London, 1887; rev. ed., Hyderabad, 1958; tr. C. E. Sachau, *Alberuni's India*, 2 vols., London, 1888, 1910.

RG 98: *Tarjamat ketāb Bātanjalī fi'l-ḵalāṣ men al-ertebāk*, ed. H. Ritter, "Al-Bīrūnī's Übersetzung des *Yoga-sūtra* des Patañjali," *Oriens* 9, 1956, pp. 165-200.

RG 104: *al-Qānūn al-masʿūdī fi'l-hayʿa wa'l-nojūm*, ed. S. H. Baranī, 3 vols., Hyderabad, 1954-56; *maqāla* 3 ed. E. E. Aḥmad, Cairo, 1970.

RG 105: *al-Āṯār al-bāqīa ʿan al-qorūn al-ḵālīa*, ed. C. E. Sachau, Leipzig, 1879, repr. Leipzig, 1923; tr.

C. E. Sachau, *Chronology of Ancient Nations*, London, 1887, repr. Frankfurt, 1969; lacunae in Sachau's text have been filled by J. Fück, "Sechs Ergänzungen zu Sachaus Ausgabe von al-Bīrūnīs "Chronologie orientalischer Völker"," in *Documenta Islamica Inedita*, Berlin, 1952, pp. 69-98, and by K. Garbers, "Eine Ergänzung zu Sachaus Ausgabe von al-Bīrūnī' s "Chronologie orientalischer Völker", ibid., Berlin, 1952, pp. 45-69.

RG 143: *Ketāb al-dorar fī saṭḥ al-okar*, preserved in a Bodleian ms. (Bīrūnī, *al-Āṯār al-bāqīa*, p. XXXXIX).

RG 156: *Ketāb al-jamāher fī maʿrefat al-jawāher*, ed. F. Krenkow, Hyderabad, 1936.

RG 157: *Ketāb nozhat al-nofūs wa'l-afkār fī ḵawāṣṣ al-mawālīd al-ṭalāṭa al-maʿāden wa'l-nabāt wa'l-aḥjār*, extant in a Bodleian Ins. (Bīrūnī, *al-Āṯār al-bāqīa*, p. XXXXIX).

RG 158: *Ketāb al-ṣaydana fi'l-ṭebb*, ed. Hakim Muhammad Said, Karachi, 1973.

RG 168: *Resāla fī-fehrest kotob Moḥammad b. Zakarīyāʾ al-Rāzī*, ed. P. Kraus, Paris, 1936; tr. J. Ruska, "Al-Bīrūnī als Quelle für das Leben und die Schriften al-Rāzī's," *Isis* 5, 1922, pp. 26-50; ed. with Pers. tr. M. Moḥaqqeq, Tehran, 1352 Š./1973.

RG 169: *Ḥekāyat al-āla al-mosammā al-sods al-faḵrī*, ed. L. Cheikho, *al-Mašreq* 11, 1908, pp. 68-69; tr.

L. A. Sédillot, "Les instruments astronomiques des arabes," *Mémoires de l'Académie royale des inscriptions*, 1st Ser., 1, 1844, pp. 202-06.

RG 170: *Rīāżat al-fekr wa'l-ʿaql*, preserved in a ms. in Hyderabad.

RG 171: *Ajwebat al-masāʾel al-ḵʷārazmīya*, extant in a ms. in Tehran. RG 180:*Ketāb Abī Rayḥān elā Abī Saʿīd*, ed. Kennedy, "A Letter of al-Bīrūnī. Ḥabash al-Ḥāsib's Analemma for

the Qibla," *Historica Mathematica* 1, 1974, pp. 3-11; not in Boilot. *Ḡorrat al-zījāt*, ed. S. S. H. Rizvi, "A Unique and Unknown Book of al-Bīrūnī: Ghurrat-uz-zījāt or Karaṇa Tilaka," *Islamic Culture* 37, 1963, pp. 112-30, 167-86, 223-45; 38, 1964, pp. 47-74, 195-212; 39, 1965, pp. 1-26, 137-80.

Studies. J. L. Berggren, "Al-Bīrūnī On Plane Maps of the Sphere," *JHAS* 6, 1982, pp. 47-95.

D. J. Boilot, "L'œuvre d'al-Beruni. Essai bibliographique," *Mélanges de l'Institut dominicain d'études orientales du Caire* 2, 1955, pp. 161-256; 3, 1956, pp. 391-96.

M. I. Čagātāʾī, *Āṯāral-Bīrūnī*, Lahore, 1978.

J. P. Hogendijk, "Rearranging the Arabic Mathematical and Astronomical Manuscript Bankipore 2468," *JHAS* 6, 1982, pp. 133-59.

E. S. Kennedy, "Al-Bīrūnī's Maqālīd ʿilm al-hayʿa," *JNES* 30, 1971, pp. 308-14.

A. S. Khan, *A Bibliography of the Works of Abu'l-Rayḥān Bīrūnī* (in Urdu), New Delhi, 1982 (Pers. tr. ʿA. Ḥabībī, *Ketāb-šenāsī-e Abū Rayḥān Bīrūnī*, Tehran, 1352 Š./1973).

M. S. Khan, "A Bibliography of Soviet Publications on al-Bīrūnī," *Arabica* 23, 1976, pp. 77-83.

G. P. Matvievskaya and B. A. Rozenfel'd, *Matematiki i astronomy musul'manskogo srednevekov'ya i ikh trudy (VIII-XVII vv.)* 3 vols., Moscow, 1983, II, pp. 264-95.

M. Mohaghegh, “Notes on Bīrūnī’s Fihrist,” in *Al-Bīrūnī Commemorative Volume*, Karachi, 1979, pp. 228-31.

S. Ḥ. Naṣr, *Ketāb-šenāsī-e tawṣīfī-e Abū Rayḥān Bīrūnī*, Eng. title, *Al-Bīrūnī. An Annotated Bibliography*, Tehran, 1352 Š./1973.

H. Suter and E. Wiedemann, “Über *al-Bîrûnî* und seine Schriften. Beiträge zur Geschichte der Naturwissenschaften LX,” *Sb. der Physikalisch-Medizinischen Sozietät zu Erlangen* 52-53, 1920-21, pp. 55-96; repr. in E. Wiedemann, *Aufsätze zur arabischen Wissenschaftsgeschichte*, 2 vols., Hildesheim and New York, 1970, II, pp. 474-515.

E. Wiedemann, “Bestimmungen des Erdumfanges von al-Bêrûnî,” *Archiv für die Geschichte der Naturwissenschaften und der Technik* 1, 1909, pp. 66-69; repr. in E. Wiedemann, *Gesammelte Schriften zur arabisch-islamischen Wissenschaftsgeschichte*, 3 vols., Frankfurt am Main, 1984, I, pp. 310-13.

(David Pingree)

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BĪRŪNĪ, ABŪ RAYḤĀN iii. Mathematics and Astronomy

BĪRŪNĪ, ABŪ RAYḤĀN

iii. Mathematics and Astronomy

Ninety-five of 146 books known to have been written by Bīrūnī, about 65 percent, were devoted to astronomy, mathematics, and related subjects like mathematical geography (Kennedy, p. 152). The mathematical portions of his works were invariably devoted to applied, rather than theoretical, mathematics; nevertheless, in the process of solving problems, Bīrūnī did sometimes indulge in theoretical discussions. Similarly, although his main concern in astronomy was for computations, he also devoted attention to theoretical problems. The following assessment of Bīrūnī's contributions is based on his work in applied mathematics and on the theoretical portions of his astronomical works.

Theoretical concepts. Bīrūnī's major contribution to astronomy is *al-Qānūn al-masʿūdī fi'l-hayʾa wa'l-nojūm* (Masʿudic canon of astronomy), covering the same ground as Ptolemy's *Almagest* but introducing new material. Most of Bīrūnī's original theoretical concepts are to be found in this work. Like the *Almagest*, the *Qānūn* contains theoretical derivations of astronomical parameters, as well as tabular functions to facilitate the computation of planetary positions. It thus differs from the works of most of Bīrūnī's predecessors and contemporaries who were concerned only with constructing astronomical tables (*zīj*) suitable for computation of planetary positions, usually without any discussion of the derivation of the parameters upon which the tables were based.

Although Bīrūnī did not write texts on algebra or geometry and his arithmetical works have not survived, he did introduce new mathematical concepts. For instance, in the *Qānūn* (bk. 3), in the course of a discussion devoted to the trigonometric functions used in astronomy, he defined the irrational number *pi* as the result of division of two other numbers (the circumference of a circle and the diameter), whereas his predecessors, including the Greek authors, had defined it as a geometric ratio. Elsewhere (bk. 6, chap. 8) he described the variation in the motion of the sun with respect to the earthly observer in mathematical language that modern historians of science have construed as among the earliest references to mathematical functional relationships (cf. Hartner and Schramm). In determining the mobility of the solar apogee, Bīrūnī followed his Muslim predecessors in departing from the traditional Greek astronomy of Ptolemy, but by means of more refined observational techniques he was able to go farther and to discover that the apogee has a motion of its own, distinct from the motion of precession.

In trigonometry his major contributions are to be found in *Ketāb maqālīd ʿelm al-hayʿa* (compendium on astronomy), in which he concentrated mainly on the applications of spherical trigonometry in astronomy and provided a detailed classification of spherical triangles and their solutions; in *Ketāb fī efrād al-maqāl fī amr al-ẓelāl* (exhaustive treatise on shadows), in which he developed the familiar trigonometric definitions further and applied them to such religious practices as determining times of prayer and finding the direction of Mecca; and in the third book of the *Qānūn*, in which he propounded trigonometric theorems equivalent to those related to the sums and differences of angles. It was in this last context that he developed his solution to the algebraic equation of the third degree (see below) as part of an attempt to compute the sine of 1°; the iteration method used in this calculation is no less sophisticated than methods developed by theoretical mathematicians. Furthermore, in these works, Bīrūnī not only defined all the trigonometric functions used today but also discussed methods of computing them from a circle with radius R = 1 (still used for this purpose); he also applied fully developed methods of second-order interpolation to computation of the intermediary values of these functions, thus demonstrating a clear understanding of functional relationships.

Elsewhere in the *Qānūn* (bk. 6, chap. 10; bk. 7, chap. 8) Bīrūnī showed similar sophistication in handling functional relationships by manipulating the equations of the sun and the moon so that the functions would always be positive; in contrast these relations varied between positive and negative in Ptolemy's (fl. 150) *Almagest* and *Handy Tables*. Bīrūnī also calculated the side of a nonagon, a problem resulting from his attempt to trisect an angle in order to compute the value of the sine of 1° (*Qānūn*, bk. 3, chap. 3); his calculations yielded the third-degree equation $1 + 3x = x^3$. He then solved the equation by inspection: root x = 1;50,45,47,13 (i.e. 1.846051929), which is correct to the third sexagesimal fraction (i.e. 1.84605). Theoretical considerations of this kind apparently stirred Bīrūnī's imagination, for he composed a book on the extraction of roots, unfortunately not extant. The most important aspect of this work, however, lay in Bīrūnī's ability to go beyond the strictly geometric approach of the Greeks to tackle the problem of trisecting an angle and in his recognition that algebraic solutions have the desired precision.

Applied mathematics. In mathematical geography Bīrūnī developed a new technique for measuring the difference in longitude between two given cities: He computed the longitudinal difference between Baghdad and Ḡazna at 24;20°, differing from the modern value by only eighteen minutes. In the same vein he described a method for calculating the circumference of the earth different from those preserved in Greek sources, though it may have been invented during the caliphate of al-Maʾmūn (198-201/813-17).

In the domain of numerical analysis and approximative techniques, Bīrūnī's ability to conceptualize in functional terms is equally clear. His calculation of the sine and tangent functions and their tabulation in the *Qānūn* (bk. 3, chap. 7-8) required him to develop an interpolation scheme involving second-order differences, for he was aware of the failure of a simple linear interpolation to account for extreme variation in functional values. It is curious that Bīrūnī did not adopt the similar, though not identical, method developed by Brahmagupta (b. ca.

598) in the *Khaṇḍakhādyaka*; he must have been aware of it, for he quoted from Brahmagupta's book in his own works several times (see *Qānūn*, ed. Hyderabad, p. 175 and passim). That he understood the power of his own second-order method of interpolation is apparent from his comment that it could be applied to all other tables.

Bīrūnī's attempts to record and classify all previously known methods for astrolabe projections, as well as methods that he himself proposed, in his comprehensive book on the astrolabe (*Ketāb fī estīāb al-wojūh al-momkena fī ṣaṇʿat al-aṣṭorlāb*) can perhaps also be included in the domain of applied mathematics. The problem of projections as such must have engaged his imagination, for he included some geographical map projections in another of his works *Maqāla fī-tasṭīḥ al-ṣowar wa tabṭīḥ al-kowar*, ed. A. S. Saʿīdān, *Derāsāt* 4, 1977, pp. 7-22). In all his writings Bīrūnī called attention to original concepts, though usually only in passing. In *Ketāb fī estīāb*, for instance, in discussing an astrolabe invented by his contemporary Abū Saʿīd Aḥmad Sejzī (ca. 339-415/951-1024), who had assumed for the purpose that the apparent daily rotation of the celestial spheres resulted from the motion of the earth, rather than of the celestial spheres themselves, he commented briefly that, though the motion of the earth is quite possible, the problem was one for natural philosophers, rather than for mathematicians, among whom he counted himself.

Bīrūnī does not appear to have been interested in the genre of astronomical writing in which Ptolemaic planetary models were considered as describing both the apparent motion of the planets and the physical spheres responsible for the kinematic forces acting upon them; this genre included Ptolemy's own *Planetary Hypotheses* and a number of later works usually containing the word *hayʿa* in their titles. The main concern of the authors was either to explain the Ptolemaic models, and thus to explain planetary motion as resulting from the motion of physical spheres, or to suggest new models for resolving the apparent contradiction between the physical and mathematical assumptions underlying the Ptolemaic models. Recent studies of these works are revolutionizing modern understanding of the role of Islamic astronomy in what later came to be known as Copernican astronomy, for the development of non-Ptolemaic models can be viewed as forerunners to Copernicus' own work. (E. S. Kennedy and I. Ghanem, eds., *The Life and Work of Ibn al-Shatir*, Aleppo, 1976, contains a collection of recent, pre-1976, studies dealing with planetary theories; D. King and G. Saliba, eds., *From Deferent to Equant*, Annals of The New York Academy of Sciences 500, 1987, p. xxvi, lists six recent works by G. Saliba.)

Bīrūnī's lack of concern with philosophical matters is apparent in his treatment of Sejzī's assumption about the earth's motion. In addition, he seems to have been content to apply himself to solution of the mathematical and astronomical problems that presented themselves to him, seeking only to achieve greater precision in the derivation of parameters and thus to obtain a better understanding of the relevant phenomena. His main contribution must thus be seen in the comprehensiveness of his work, as in his book on astrolabe construction, and in his continual attempts to formulate concepts like prayer times in mathematical terms. His attraction to

sophisticated computational problems thus led him to consideration of more general theoretical questions.

Bibliography:

The most recent survey of Bīrūnī's works and biographical sources is that of E. S. Kennedy, "Al-Bīrūnī (or Berūnī), Abū Rayḥān (or Abūʾl Rayḥān) Muḥammad ibn Aḥmad," in *Dictionary of Scientific Biography* II, New York, 1970, pp. 148-58, and should be consulted by any serious reader. A considerably shorter essay by G. Saliba in *Dictionary of the Middle Ages* II, New York, 1983, pp. 248-51, covers some issues not treated by Kennedy and should also be consulted. The main bibliographical essay is still that of D. J. Boilot, "L'œuvre d'al-Beruni. Essai bibliographique," *Mélanges de l'Institut dominicain d'études orientales* 2, 1955, pp. 161-256; 3, 1956, pp. 391-96.

See also S. Ḥ. Naṣr, *Ketāb-šenāsī-e tawṣīfī-e Abū Rayḥān Bīrūnī*, Tehran, 1352 Š./1973; A. Saʿīd Khan, *Ketāb-šenāsī-e Abū Rayḥān Bīrūnī*, Pers. tr. ʿA. Ḥabībī, Tehran, 1352 Š./1973.

On the theoretical issues raised in this article see W. Harmer and M. Schramm, "Al-Bīrūnī and the Theory of the Solar Apogee. An Example of Originality in Arabic Science," in *Scientific Change*, ed. A. C. Crombie, London, 1963, pp. 206-18. A. Jouschkevitch, *Les mathématiques arabes (VIII^{e}-XV^{e} siècle)*, Paris, 1976. E. S. Kennedy et al., *Studies in the Islamic Exact Sciences*, Beirut, 1983. R. Rashed, *Entre arithmétique et algèbre*, Paris, 1984.

(George Saliba)

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BĪRŪNĪ, ABŪ RAYḤĀN iv. Geography

BĪRŪNĪ, ABŪ RAYḤĀN

iv. Geography

Bīrūnī's conceptions of the spherical shape of the earth and of the distribution of geographical features on its surface are those of Greek scientists, and especially of Ptolemy, as modified by earlier Muslim geographers. Thus he explains the Greek astronomers' theory of the earth in his *al-Qānūn al-masʿūdī* (1/2, pp. 24-54), but adds to his discussion of the distribution of land and sea over its surface much new information and some arguments of his own devising (*Tafhīm*, secs. 210-12, pp. 120-25; *Taḥdīd*, pp. 41-64, tr. pp. 15-32; *India*, chap. 18, pp. 155-57, tr. vol. 1, pp. 196-98). In the course of these discussions especially in that in the *Taḥdīd* he has much to say about changes in climate and of terrain that is based on a close examination of fossils, seashells, and stratigraphy. In India he describes the theories of the earth both of the *Purāṇa*s (chap. 221, pp. 185-91, tr. vol. 1, pp. 228-33) and of the Indian astronomers (chap. 26, pp. 219-32, tr. vol. 1, pp. 263-77).

Moreover, he accepts the need to determine anew the dimensions of the earth. In this connection he records the story of the ascertainment by the astronomers of al-Maʾmūn of the length of a degree as 56 2/3 miles in three works: the *Taḥdīd* (pp. 213-14, tr. pp. 178-79), the *Tafhīm* (sec. 208, pp. 118-19), and the *Qānūn* (bk. 5, chap. 7, pp. 529-30; see Barani, pp. 11-22). Bīrūnī also devised his own method of determining the radius of the earth by means of the observation of the height of a mountain and carried it out at Nandana in India (*Taḥdīd*, pp. 221-26, tr. pp. 187-89;*Qānūn*, bk. 5, chap. 7, pp. 530-31); he determined that the length of a degree is 55;53,15 miles in the *Taḥdīd*, 56;5,50 miles in the *Qānūn* (see Barani, pp. 35-44, and *Taḥdīd* comm. p. 143).

In speaking of the inhabited part of the world Bīrūnī follows the Greek tradition of the seven climes, whose limits are determined by increments of half an hour in the lengths of longest daylight (*Taḥdīd*, pp. 138-41, tr. pp. 103-06; comm. pp. 77-78;*Tafhīm*, secs. 236-38, pp. 138-40; *Qānūn*, bk. 5, chap. 9, pp. 536-45). But he also describes in considerable detail the seven *kešvar*s (climes) of traditional Persian geography (*Taḥdīd*, pp. 134-36, tr. pp. 101-02; and *Tafhīm*, sec. 240, pp. 141-142) and the seven *dvīpa*s of the Indian *Purāṇa*s (*India*, chaps. 21 and 24, pp. 191-96, 207-12, tr., vol. 1, pp. 233-38, 251-56), as well as the Indian traditions concerning the geography of Bharatavarṣa (*India*, chaps. 25 and 29, pp. 212-19, 246-50, tr., vol. 1, 257-62, 294-305). He adds as well an account of the Hindu *tīrtha*s (places of pilgrimage) based on the *Purāṇa*s (*India*, chap. 66; pp. 461-66, tr., vol. 2, pp. 142-48).

But Bīrūnī's main concern in the domain of geography lay in the location of places relative to each other, the determination of their latitudes and longitudes, and the computation of their azimuths of the *qebla* (direction of Mecca). For the first purpose he records a number of routes in India, emanating primarily from Kanawj (Kānyakubja), the then capital of the Pratīhāras, and branching out from nodes along the direct routes from that city; to this system he appends descriptions of Kashmir and the source of the Indus, of the east and west coasts of the peninsula, and of Ceylon and other islands in the Bay of Bengal (*India*, chap. 18, pp. 157-70, tr., vol. 1, pp. 198-211). In most cases Bīrūnī gives the distance in parasangs between the major towns on these routes.

Bīrūnī does not attempt to construct a map of India on the basis of these itineraries as, for instance, Ptolemy had done with similar material. But he has compiled from various earlier authorities and his own observations and computations a list of the geographical coordinates of about 600 localities, arranged according to the seven climes (*Qānūn*, bk. 5, chap. 10, pp. 546-79; these places are included in Kennedy and Kennedy); some indication of his innovations with respect to localities in the east is given in Haddad and Kennedy (pp. 99-100). He himself had made observations of the latitudes of various places in Ḵᵛārazm, Khorasan, Jorjān, Afghanistan (see Bivar), the Punjab, and northern Sind; many other observations made by his predecessors among Muslim astronomers were known to him from the literature.

The methods of determining local latitude are relatively straightforward (*Taḥdīd*, pp. 63-87, tr. pp. 34-57; *Qānūn*, bk. 4, chaps. 7-9, pp. 402-11). The more difficult problem was to determine the longitudinal difference between two localities. The preferable solution was to compute this from simultaneous observations of a lunar eclipse (*Taḥdīd*, pp. 167-206, tr. pp. 130-72; *Qānūn*, bk. 5, chap. 1, pp. 507-11); but, lacking the possibility of doing that in most cases, Bīrūnī devised a method of approximating the longitudinal difference through a modification of the itinerary distance between two localities, a knowledge of the latitude of each, and a determined value for the circumference of the earth (*Taḥdīd*, pp. 227-72, tr. pp. 192-240, with a number of worked examples; *Qānūn*, bk. 5, chaps. 2-4, pp. 512-22; see Schoy and Kramers); in the course of his discussion of the second method in the *Taḥdīd* he describes and criticizes a related Indian method which he deals with more extensively in India (chap. 31, pp. 265-69, tr. vol. 1, pp. 311-16). Finally, when the longitudinal difference between any locality of known latitude and Mecca has been determined, it is possible to compute accurately the azimuth of the *qebla* (*Taḥdīd*, pp. 272-89, tr. pp. 241-59; *Qānūn*, bk. 5, chaps. 5-6, pp. 522-28).

Bīrūnī composed a number of works on geography besides the *Taḥdīd* before 427/1036; they are listed as nos. 20-33 in his *Fehrest* (Boilot, pp. 183-87). We also know of his *Ketāb taqāsīm al-aqālīm* from the same source (Boilot, pp. 229-30). Still extant are his *Maqāla fī tasṭīḥ al-ṣowar wa tabṭīḥ al-kowar* on projecting the points on the surface of a sphere onto a plane (see Berggren and Richter-Bernburg) and his *Ketāb Abī Rayḥān elā Abī Saʿīd* on Ḥabaš's analemma for finding the azimuth of the *qebla* (see Kennedy).

Bibliography:

S. H. Barani, "Muslim Researches in Geodesy," in *Al-Bīrūnī Commemoration Volume*, Calcutta, 1951, pp. 1-52.

J. L. Berggren, "Al-Bīrūnī on Plane Maps of the Sphere," *JHAS* 6, 1982, pp. 47-95.

Bīrūnī, *Ketāb taḥqīq mā le'l-Hend men maqūla maqbūla fi'l-ʿaql aw marḏūla*, ed. C. E. Sachau, London, 1887, rev. ed., Hyderabad, 1958; tr. C. E. Sachau, *Alberuni's India*, 2 vols., London, 1888, 1910.

Idem, *Ketāb al-tafhīm le-awāʾel ṣenāʿat al-tanjīm*, in both Arabic (ed. R. R. Wright, London, 1934) and Persian (ed. J. Homāʾī, Tehran, 1318 Š./1939, rev. 1353 Š./1975).

Idem, *Ketāb taḥdīd nehāyat al-amāken le-taṣḥīḥ masāfāt al-masāken*, ed. P. G. Bulgakov, in *Maʿāḵeḏ al-maḵṭūṭāt al-ʿarabīya*, Cairo, 1962; Russ. tr. P. G. Bulgakov, in Bīrūnī's selected works (*Izbrannye proizvedeniya*) III, Tashkent, 1966; tr. J. Ali, *The Determination of the Coordinates of Cities*, Beirut, 1967; comm. by E. S. Kennedy, *A Commentary upon Bīrūnī's Kitāb taḥdīd al-amākin*, Beirut, 1973.

Idem, *al-Qānūn al-masʿudī fi'l-hayʿa wa'l-nojūm*, ed. S. H. Baranī, 3 vols., Hyderabad, 1954-56.

A. D. H. Bivar, "The Stations of al-Bīrūnī on the Journey from Ghaznah to Peshawar," in *Al-Bīrūnī Commemorative Volume*, Karachi, 1979, pp. 160-76.

D. J. Boilot, "L'œuvre d'al-Beruni. Essai bibliographique," *Mélanges de l'Institut dominicain d'études orientales du Caire* 2, 1955, pp. 161-256; 3, 1956, pp. 391-96.

F. I. Haddad and E. S. Kennedy, "Geographical Tables of Mediaeval Islam," *Al-Abhath* 24, 1971, pp. 87-102.

E. S. Kennedy, "A Letter of al-Bīrūnī. Ḥabash al-Ḥāsib's Analemma for the Qibla," *Historica Mathematica* 1, 1974, pp. 3-11.

E. S. Kennedy and M. H. Kennedy, *Geographical Coordinates of Localities from Islamic Sources*, Frankfurt, 1987.

J. H. Kramers, "Al-Bīrūnī's Determination of Geographical Longitude by Measuring the Distances," in *Al-Bīrūnī Commemorative Volume*, Calcutta, 1951, pp. 177-83.

L. Richter-Bernburg, “Al-Bīrūnī’s *Maqāla fī tasṭīḥ at-ṣuwar wa tabṭīḥ al-kuwar*. A Translation of the Preface with Notes and Commentary,” *Journal for the History of Astronomy* 6, 1982, pp. 113-22.

C. Schoy, “Aus der astronomischen Geographie der Araber,” *Isis* 5, 1923, pp. 51-74.

(David Pingree)

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ĪRŪNĪ, ABŪ RAYḤĀN v. Pharmacology and Mineralogy

BĪRŪNĪ, ABŪ RAYḤĀN

v. Pharmacology and Mineralogy

Pharmacology. Bīrūnī, a traveler proficient in several Asian languages and an inquisitive and attentive observer, was interested all his life in gathering precise information on plants and their medicinal uses. At the end of his long life, he arranged them alphabetically in a treatise entitled *Ketāb al-ṣaydana*. This book was known to Orientalists only in its Persian translation until Velidi Togan discovered the original Arabic text at Bursa in 1926 (for details on the authenticity of the work and the various manuscripts, cf. Anawati, 1976, pp. 75-97).

The work has been published (in a photographic reproduction of one manuscript) and translated into English by a team of scholars from the Hamdard National Foundation in Karachi under the direction of Hakim Mohammad Said (1973). A second volume, containing a long introduction and commentary, was published by Dr. Sami Hamarneh of The Smithsonian Institution, also in 1973 under the auspices of the Hamdard Foundation.

In a preliminary remark in the introduction, Bīrūnī defines *ṣaydana* (or *ṣaydala*), or rather *ṣaydalānī* as "he who makes a profession of gathering medications in their best forms and of experimentally testing the best types, whether they be simple or compound, according to the best formulas transmitted by the most renowned physicians." He describes the relation of pharmacology to medicine, to which it serves only as an introduction.

The second chapter is devoted to the study of medications as such (*dawāʾ*, plur. *adwīa*, also called *ʿoqqār*, plur. *ʿaqāqīr*), as distinguished from poisons (*somūm*) and foodstuffs (*aḡḏīa*). In the third chapter Bīrūnī speaks of *ṣaydana* itself, which is the knowledge of the virtues and properties of medications through experience and deduction. The pharmacist must be acquainted with two operations: omission (*ḥaḏf*) of one constituent of a compound medication without negation of the primary action of the latter and replacement (*tabdīl*) of one medication by another that is almost equivalent.

In the fourth and fifth chapters there is a now classic panegyric to the Arabic language, which is the language of science but has the defect of not lending itself easily to transcription of foreign words.

This introduction represents only a very small part of Bīrūnī's book (hardly a twentieth of the text pages printed by Meyerhof, more precisely, 22 of 855 pages of the manuscript in the University of Baghdad). Its Birunian character is manifest: spontaneity and elegance of style, philological comments, reminiscences of India, extensive erudition. But the bulk of the book is obviously devoted to the description of medications. Some articles are long, elaborate, and full of lexicographical notes, whereas others are limited to several lines or even to simple mention of terms.

Altogether 1,197 drugs are mentioned, however, some drugs are cited under several synonyms.

Bīrūnī's sources number nearly one hundred: botanists, pharmacologists, physicians, philosophers, grammarians, poets, and so on.

Finally, attention should be called to the many languages and dialects that he mentions for a single drug. Generally, the entry for a single drug will not include more than four or five languages. Overall about twenty languages or dialects can be counted (cf. the list in Anawati, 1976).

Mineralogy. When he was already eighty years old, Bīrūnī devoted a book entitled *Ketāb al-jamāher fī ma refat al-jawāher* (The sum of knowledge about precious stones) to mineralogy. It is the most comprehensive book on this subject in medieval Arabic literature. In it Bīrūnī describes the minerals and metals of Europe, Asia, and Africa, drawing upon earlier sources and his own vast experience. The work was edited by F. Krenkow (Hyderabad, 1355/1936), who relied on three extant manuscripts. M. Y. Haschmi devoted his short doctoral thesis (48 pages) to the analysis of its sources (*Die Quellen des Steinbuches des Bērūnī*, Bonn, 1935). Different parts of the *Ketāb at-jamāher* have been translated by various authors, and the entire book was translated into Russian in 1968 (for details of all these publications, see Anawati, 1979).

The work consists of three parts, beginning with an introduction composed of a *dībāja* (preamble) devoted to praise of the wisdom possessed by created beings and fifteen *tarwīḥa* (sections) describing the situation of man in nature and how he came to use gold and silver and to make use of jewels for his adornment (32 pages of the printed text).

The second part (200 pages) is devoted to precious stones (*al-jawāher*), as well as to other minerals. The principal stones described are the following: *yāqūt* (hyacinth, sapphire), *yāqūt aḥmar* (ruby), *yāqūt aḵżar* (green corundum), *yāqūt jamrī* (carbuncle), *laʿl* (spinel), *bīǰādī* (garnet), *almās* (diamond), *sanbāḏej* (emery), *loʾlo* (pearl), *zomorrod* (emerald), *fayrūzaj* (turquoise), *ʿaqīq* (agate), *jaẓʿ* (onyx), *ballūr* (rock crystal), *jamast* (amethyst), *lazaward* (lapis lazuli), *dahanj* (malachite), *yašm* (jade), *yašb* (jasper), *sabaj* (obsidian), *bādzahr* (bezoar), *kahro bā* (amber), *maḡnaṭīs* (magnetite), *šaḏenj* (hematite), *zojāj* (glass), *mīnā* (enamel), *qīsaʿ*

ṣīnīya(porcelain). Metals (*felezzāt*)
include *zeʾbaq* (mercury), *ḏahab* (gold), *feżża* (silver), *noḥās* (copper), *ḥadīd* (iron), *asrob* (lead), and *ḵār ṣīnī* (Chinese iron, i.e., zinc).

Bīrūnī makes use of numerous ancient Greek and Arab authors and cites many verses from Arab or Persian poets. He carefully analyzes the names of minerals from the philological point of view, citing authors like Ḵalīl b. Aḥmad, Aṣmaʿī, Farrāʾ, Abū Ḥanīfa, and Dīnavarī.

Bīrūnī accepts the vapor theory, more specifically Jāber b. Ḥayyān's sulphur-mercury theory, of the origins of the minerals and metals. He rejects the notion of transmutation, though he admits the growth and gradual transformation of metals into gold in nature.

Finally, thanks to an apparatus he constructed himself, he succeeded in determining the specific gravity of a certain number of metals and minerals with remarkable precision.

Bibliography:

G. C. Anawati, "The Kitāb al-jamāhir fi maʿrifat al-jawāhir of al- Bīrūnī," in *Al-Bīrūnī Commemorative Volume*, ed. H. M. Said, Karachi, 1979, pp. 437-53.

Idem, "Le Kitāb al-Ṣaydana d'al-Bīrūnī," in *The Commemoration Volume of Beruni International Congress in Tehran*, 1355 Š./1976, pp. 75-96.

Ebu Reyhan Biruni, "Kitabussaydelesinde şahsi fikirleri hakkında," *Türk tıp tarihi arkivi* 5/17, 1940.

Max Krause, review of S. Yaltkaya, *Kitabussaydele . . .* , in *Der Islam* 25, 1938, pp. 194-96.

F. Krenkow, "The Drug-Book of Beruni," *Islamic Culture* 20, 1946, p. 109-10.

M. Meyerhof, "The Article on Aconite from al-Beruni's Kitab al-Ṣaydana," ibid., 19, 1945, pp. 323-28.

Idem, "Etudes de pharmacologie arabe tirées de manuscrits inédits. I. Le livre de la droguerie d'Abu'r-Rayhan al Beruni," *Bulletin de l'Institut d'Egypte* 22, 1940, pp. 138-52.

Idem, "Das Vorwort zur Drogenkunde des Beruni," *Quellen und Studien zur Geschichte der Naturwissenschaften* 3, 1932, pp. 157-208.

G. Sarton, review of M. Meyerhof, 1940, in *Isis* 33, 1941, p. 358.

A. Süheyl Ünver, “Ebu Reyhan Biruninin Farmakolojiye ait fikirleri,” *Tıp fakültesi mecmuası* 1, 1938, pp. 233-38 (with French summary).

Sherefeddin Yaltkaya, *Kitabussaydele fittib mukaddimesi*, Istanbul, 1937; cf. *Isis* 38, 1948, pp. 76.

(Georges C. Anawati)

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BĪRŪNĪ, ABŪ RAYḤĀN vi. History and Chronology

BĪRŪNĪ, ABŪ RAYḤĀN

vi. History and Chronology

Bīrūnī's main essay on political history, *Ketāb al-mosāmara fī aḵbār Ḵᵛārazm*(Book of conversation concerning the affairs of Ḵᵛārazm) is now known only from quotations in Bayhaqī's *Tārīḵ-e masʿūdī* (ed. Fayyāż, pp. 906ff.). In addition to this various discussions of historical events and methodology are found in connection with the lists of kings in his *al-Āṯār al-bāqīa* (q.v.; esp. chap. 6, ed. pp. 72-143, tr. pp. 84-140, and the supplementary material provided by Garbers) and in the *Qānūn*(bk. 2, chap. 5; vol. 1, pp. 148-68) as well as elsewhere in the *Āṯār*, in *India* (see Khan, 1976), and scattered throughout his other works.

Though Bīrūnī often quotes the Koran as an irrefutable source of truth, his attitude toward the human sources of historical fact, whether written or oral, is characterized by intelligent skepticism. His method is, briefly, to collect as many traditions as he can concerning a topic, to subject them to impartial assessments of their plausibility, rejecting those that are contrary to reason or to nature, and to compare the remainder in a search for the most believable and consistent solution to any contradictions. He recognizes that this task can never be completely carried out, both because of the limitations of time and resources available to the historian and because of the loss or corruption of much relevant material, but feels it to be his duty to make the attempt for the benefit of future scholars (*Āṯār*, pp. 4-5, tr. Sachau, pp. 3-4).

Examples of this methodology are easily found in the *Āṯār*. He assembles from books and from oral informants seven different versions of the Persian names of the five epagomenal days, but has no means for determining which, if any, is more authoritative than the others (pp. 43-44, tr. pp. 53-54). In chapter six he collects every available king list and records them accurately even when he is aware that they are full of scribal errors (p. 84, tr. p. 98), but is seldom able to resolve their differences (p. 100, tr. pp. 108-09). Only in the case of the Aškānīān, i.e., Parthians, was he able to solve this problem by comparing the lists with the evidence of Mānī's *Šābuhragān* (pp. 112-19, tr. pp. 116-22), which enabled him to condemn the Sasanian king list reconstructed by Kesrawī (pp. 129-31, tr. pp. 127-28).

Bīrūnī's rejection of historical traditions that contain logical incoherencies or inherent implausibilities is best exemplified by his discussion of different stories concerning Ḏu'l-Qarnayn and forged genealogies of famous people in chapter four of the *Āṯār* (pp. 36-42, tr. pp. 43-51). His frequent application of his knowledge of astronomy to the criticism of historical sources is seen,

for instance, in his treatment of the determination of the length of Ramażān (pp. 64-68, tr. pp. 76-81). But those who are subject to his most sarcastic diatribes in the *Āṯār* are the astrologers such as Abū Maʿšar Balḵī (q.v.), who reconstructed history to fit their own theories of astral influences (pp. 25-27, 78-83, tr. pp. 29-31, 90-97). This repugnance, however, does not deter him from expounding, though with apologies, Abū Maʿšar's theory of cycles in the final chapter of the *Qānūn* (bk. 9, chap. 12, vol. 3, pp. 1471-82; see Pingree, 1968, pp. 59-63).

Finally, Bīrūnī's insistence on the historian's maintaining impartiality in confronting two contradictory historical traditions is most evident in his investigations into various Jewish and Christian views of Old Testament chronology (pp. 15-23, 72-78, tr. pp. 18-27, 85-90). Both sides justly receive his criticisms of their historical methodology. Similarly, in his discussion of the religious calendars of the Harranians, Jews, and Christians he carefully describes the computations upon which each is based and points out their numerous scientific errors while appealing to all three groups to accept his complete objectivity (p. 322, tr. p. 319).

Unhappily, Bīrūnī's intelligent criticism at times leads him into the error of distorting intellectual history because of his false assumption that people raised in cultures other than his own must develop philosophy and science from the same foundations that were available to him. Thus he seriously misrepresents Indian astronomy in *India* and the *Qānūn* by attempting to interpret it through Aristotelian physics and Euclidean geometry (see Pingree, 1975). Notwithstanding this failing, Bīrūnī's inquisitiveness, thoroughness, technical ability, and honesty make the corpus of his surviving works a prime source of materials clarifying the history of the ancient and medieval Orient both as it actually was and as it was perceived to be.

Bibliography:

Bīrūnī, *Ketāb taḥqīq mā le'l-Hend men maqūla maqbūla fi'l-ʿaql aw marḏūla*, ed. C. E. Sachau, London, 1887; rev. ed., Hyderabad, 1958; tr. C. E. Sachau, *Alberuni's India*, 2 vols., London, 1888, 1910.

Idem, *al-Qānūn al-masʿūdī fi'l-hayʾa wa'l-nojūm*, ed. S. H. Baranī, 3 vols., Hyderabad, 1954-56.

K. Garbers, "Eine Ergänzung zu Sachaus Ausgabe von al-Bīrūnī's "Chronologie orientalischer Völker"," in *Documenta Islamica Inedita*, Berlin, 1952, pp. 45-68.

M. S. Khan, "Al-Bīrūnī and the Political History of India," *Oriens* 25-26, 1976, pp. 86-115.

D. Pingree, *The Thousands of Abū Maʿshar*, London, 1968.

Idem, “Al-Bīrūnī’s Knowledge of Sanskrit Astronomical Texts,” in *The Scholar and the Saint*, New York, 1975, pp. 67-81.

E. Yarshater, “List of the Achaemenid Kings in Biruni and Bar Hebraeus,” in *Biruni Symposium*, ed. D. Bishop and E. Yarshater, Persian Studies Series 7, New York, 1976, pp. 49-65.

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BĪRŪNĪ, ABŪ RAYḤĀN vii. History of Religions

BĪRŪNĪ, ABŪ RAYḤĀN

viii. History of Religions

Bīrūnī is one of the most important Muslim authorities on the history of religion. In this article some of his remarks on pre-Islamic Iranian religions, on Christianity and Judaism, and on Muslim sects will be discussed (for Indian religions, see viii, below).

There is some uncertainty about Bīrūnī's own religious position within Islam. In *Ketāb al-āṯār al-bāqīa ʿan al-qorūn al-ḵālīa* (Book of vestiges from past centuries), which belongs to the first period of his scholarly career, many passages reveal profound sympathy for Shiʿism. Aside from repeated conventional blessings on ʿAlī and on the family of the Prophet in general, this sympathy is especially apparent in his accounts of the celebrations of *āšūrāʾ* and *ḡadīr ḵomm* (*Āṯār*, pp. 329, 334; the latter section is truncated in the printed edition). In another passage (p. 67) Bīrūnī invokes the protection of God specifically for the Zaydī Shiʿites, though his disparaging remarks about Nāṣer ʿOtrūš (p. 224) show that he did not support this claimant to the Zaydī imamate. In his account of Muslim chronology (Garbers, pp. 59-68), however, Bīrūnī counts as "caliphs" Abū Bakr, ʿOmar, ʿOṯmān, ʿAlī, and Ḥasan; the Omayyads are designated only as "kings," the ʿAbbasids as "imams." These designations are in clear contradiction to the Shiʿite insistence that the caliphate/imamate belonged exclusively to ʿAlī and his descendants. It appears that Bīrūnī, like quite a few other scholars of the 4th/10th century, combined an intense attachment to ʿAlī and the *ahl al-bayt* (members and descendants of Moḥammad's own family) with recognition of the first three caliphs and, in part, of the ʿAbbasids as well, this attitude was particularly clear among some of the Muʿtazilites of the period, for example, Ebn ʿAbbād. In Bīrūnī's later works, written after his forced removal to Ḡazna (408/1017; see i, above), Shiʿite sympathies are less apparent, which is not surprising in view of the strict Sunnism of the Ghaznavid rulers. For example, the full account of Muslim observances given in *Āṯār* (pp. 328-35, supplemented by Fück, text VI) can be compared with the abridged version in al-*Qānūn al-masʿūdī fi'l-hayʿa wa'l-nojūm* (Masʿūdic canon on astronomy; I, pp. 255-57). Nonetheless, Bīrūnī continues to speak of the family of the Prophet with the greatest respect and to present the Shiʿite and Sunnite positions fairly side by side. In a discussion of Muslim prayer times (*Ẓelāl*, p. 162), for example, he quotes in succession the opinions of ʿOmar and of Jaʿfar al-Ṣādeq. He also defends the Muʿtazilites against a slanderous misrepresentation of their doctrines (*Hend*, p. 3). In a curious passage in the *Ketāb al-jamāher fī maʿrefat al-jawāher* (Book of the sum of knowledge about precious stones, p. 215) he mentions that the Shiʿites used white stones in their signet rings, the Sunnites black ones. "For my part," Bīrūnī continues, "I used to combine the two stones in a

double ring as a way of outwitting both factions." This passage certainly reflects the author's distaste for factional squabbling; it is also possible, however, that here Bīrūnī is feigning sectarian indifference in order to disarm criticism of the impassioned pro-Shiʿite writings of his youth.

Bīrūnī's approach to other religions must be viewed against the background of his own Muslim convictions. He displays remarkable fairness and open-mindedness toward other faiths without, however, any trace of syncretism or religious relativism. He is as unequivocal in rejecting beliefs unacceptable to Muslims as he is in condemning unfair criticism of other faiths. A typical example is his assessment of reports by Muslim authors about a celebration during which the Nestorian Christians supposedly engage in promiscuous orgies: He rejects them as "defamations." "May god protect us," he continues, "from slandering anyone, whether friend or foe, and especially the sect of the Christians. For, although their doctrines are bad, their way of life is the highest pinnacle of chastity and integrity and kindliness toward everyone" (*Tafhīm*, p. 179; see also de Blois, 1984, pp. 85-86). (The Persian translator of *Tafhīm*, ed. Homāʾī, p. 251, has misread *tajrīḥāt ʿalayhem*, "defamations of them," as *taḵrīǰāt ʿalayhem* and has translated it as *bar īšān bīrūn āmadand*, which makes no sense in the context; contrary to what has often been claimed, it is thus clear that the Persian version of *Tafhīm* cannot be the work of Bīrūnī himself.)

Bīrūnī's works contain frequent references to Zoroastrianism. Much of his information on this subject, as on Persian secular history and chronology, was derived from the writings of Ḥamza Eṣfahānī, whom Bīrūnī often cites by name; much, however, seems to have come from other sources as well. His account of the life of Zoroaster (Fück, pp. 75-79) is largely devoted to a discussion of the eschatological expectations that Zoroastrian and Muslim sects attached to the 1,500th anniversary of the appearance of the Iranian prophet. Particularly valuable is his detailed description of the Zoroastrian feasts (*Āṯār*, pp. 215-33; Fück, text IV; Khalidov, texts II and III), which contains much information on Zoroastrian beliefs, as well as on popular Persian superstitions of the author's own day. On the other hand, his accounts of the celebrations of the Sogdians (*Āṯār*, pp. 233-35) and of his own compatriots, the Khwarezmians (pp. 235-38), contribute little to our knowledge of their religions. Bīrūnī himself notes (p. 235) that the Khwarezmian Zoroastrians of his day were few in number and largely ignorant of their own religious principles.

Although Bīrūnī has no sympathy for the doctrines of the Manicheans, he displays an astonishing degree of interest in the writings of Mānī. He quotes verbatim an important passage from Mānī's *Šābuhragān* (*Āṯār*, p. 207), which strongly resembles that in Turfan fragment M 5794 (cf. Boyce, p. 29). He uses the same book to correct the chronology of the Arsacid kings (p. 118), going out of his way to emphasize Mānī's reliability: "Mānī is one of those who teach that the telling of lies is forbidden; besides he had no need to falsify history." In another passage (*Fehrest*, pp. 3-4) Bīrūnī reports that he had looked for Mānīs' *Book of Mysteries* for more than forty years before discovering it in Ḵʷārazm.

Bīrūnī is familiar with the names of Bar Dayṣān and Marcion but has little of substance to say about them (*Āṯār*, p. 207). He also gives a brief account of Mazdak (p. 209; Fück, pp. 79-80).

Bīrūnī evidently had Arabic translations of the Old and New Testaments, as well as of other Jewish and Christian writings, at his disposal. He devotes much space in *Āṯār* to a description and critique of the Jewish calendar, concerning which he is apparently the oldest surviving source of any substance. In his description of the celebrations of the Melkite (Greek Orthodox) Christians (pp. 288-302) he gives valuable bits of information about the Christians of eastern Iran, apparently supplied by Christian informants. After a briefer account of the holy days of the Nestorians (pp. 309-15) he apologizes for not also informing his readers about the rites of the Jacobites, which he omits because "we have not succeeded in finding anyone who belonged to their sect or knew their principles" (p. 315). Bīrūnī dismisses unreliable reports on Christian beliefs with the observation that "there is nothing of this in the Gospel" (p. 301), yet in another passage he himself erroneously attributes a curious version of the story of Jacob and Esau to "the Torah" (Khalidov, p. 156). As a Muslim Bīrūnī cannot accept the Christian concept of the Trinity, yet, in a remarkable passage (*Hend*, p. 18), he goes a long way toward exonerating the Christians by showing, through various biblical quotations, that the Jewish and Christian scriptures use the words "father" and "son" in a metaphorical, as well as a literal, sense.

The open-mindedness which the author displays in his treatment of non-Muslim religions is less apparent when he turns to Muslim "heresies." His principal contribution to Muslim heresiography was evidently the lost early work, *Aḵbār al-mobayyeża wa'l-qarāmeṭa* (History of the Mobayyeża and the Qarmatians), to which he refers in *Āṯār*, in his rather lurid accounts of Moqannaʿ (p. 211) and the "Qarmatians" of Bahrain (pp. 213-14). This work, which was clearly of a polemical nature, seems to have been used, or rather plagiarized, by Bağdādī in his book *al-Farq bayn al-feraq* (cf. Madelung, p. 79 n. 2). In *Āṯār* Bīrūnī also gives brief and rather unsubstantial accounts of Mosaylema (pp. 209-10), Beh-Āfarīd (pp. 210-11), Ḥallāj (pp. 211-12), and Moḥammad Šalmağānī (Fück, pp. 80-81).

Whereas in *Āṯār* the author's approach to religious history is essentially descriptive, in his late work, *Ketāb taḥqīq mā le'l-Hend men maqūla maqbūla fi'l-ʿaql aw marḏūla* (Book of detailed description of the doctrines of the Indians, whether rationally acceptable or unacceptable), he makes a number of excursions into the field of comparative religion. In several passages (e.g., pp. 4, 16, 43) the author compares the beliefs of the Hindus with those of the Greek philosophers and the Muslim Sufis. As he does not show any particular sympathy for Sufism, it is likely that these comparisons are intended to cast doubt on its orthodoxy. Elsewhere (pp. 23, 27) he draws attention to parallels between Indian and Manichean teachings and concludes that Mānī borrowed his beliefs—notably the doctrine of metempsychosis—from the Indians. In another passage (p. 82) he compares the Indian holy syllable *ōm* with the Muslim *basmala* and the ineffable name of god in Judaism. Finally, Bīrūnī correctly observes (p. 44) that the word *dēv/dēva* is used by Hindus to designate the "angels" (as a monotheist he is reluctant to speak of "gods") but by the Persians to refer to "demons." Like Masʿūdī and other Muslim authors, Bīrūnī labors under the

illusion that the Iranians, before the time of Zoroaster, had followed the Buddhist religion (*šamanīya*, for Mid. Ind. *ṣamaṇa-*, Skt. *śramaṇa-* "ascetic"; see *Hend*, p. 10; cf. *Āṯār*, p. 204, where the pre-Zoroastrian Persians are said to have been followers of Būḏāsaf/Bodhisattva), and he thus concludes that Zoroaster changed the meaning of the word *dēv* in order to distance himself from the Buddhists. If the term "Buddhists" is replaced by "followers of the old Indo-Iranian religion," however, Bīrūnī's analysis is very close to that of modern students of Zoroastrianism.

Bibliography:

Works by Bīrūnī: *Āṯār*; tr. Sachau. J. Fück, "Sechs Ergänzungen zu Sachaus Ausgabe von al-Bīrūnīs "Chronologie orientalischer Völker"," in *Documenta Islamica Inedita*, Berlin, 1952, pp. 69-98; K. Garbers, "Eine Ergänzung zu Sachaus Ausgabe von al-Bīrūnī's "Chronologie orientalischer Völker"," in *Documenta Islamica Inedita*, Berlin, 1952, pp. 45-68; A. B. Khalidov, "Dopolneniya k tekstu "Khronologii" al-Bīrūnī po Leningradskoĭ i Stambul'skoĭ rukopisyam," *Palestinskiĭ sbornik* 4/67, 1959, pp. 147-71.

Resāla fī fehrest kotob Moḥammad b. Zakarīyāʾ al-Rāzī, ed. P. Kraus, Paris, 1936; tr. J. Ruska, "Al-Bīrūnī als Quelle für das Leben und die Schriften al-Rāzī's," *Isis* 5, 1922, pp. 26-50; ed. with Pers. tr. M. Moḥaqqeq, Tehran, 1352 Š./1973.

E. Sachau, ed. *Ketāb taḥqīq mā le'l-Hend men maqūla maqbūla fi'l-ʿaql aw marḏūla*, London, 1887; rev. ed., Hyderabad, 1958; tr. Sachau, *Alberuni's India*, London, 2 vols., London, 1888-1910.

Ketāb al-jamāher fī maʿrefat at-jawāher, ed. F. Krenkow, Hyderabad, 1936.

Al-qānūn al-masʿūdī fi'l-hayʿa wa'l-nojūm, ed. S. H. Baranī, 3 vols., Hyderabad, 1954-56.

Ketāb al-tafhīm le-awāʾel ṣenāʿat al-tanjīm, ed. R. R. Wright, London, 1934 (Arabic); ed.

J. Homāʾī, Tehran, 1318 Š./1939, rev. ed., Tehran, 1353 Š./1975 (Persian).

Ketāb fī efrād al-maqāl fī amr al-ẓelāl (*Rasāʾel al-Bīrūnī* 2), Hyderabad, 1948.

Other: F. de Blois, "*Laylat al-māšūš*: Marginalia to al-Bayrūnī, Abū Nuwās and Other Authors," *Journal of Semitic Studies* 29, 1984, pp. 81-96.

M. Boyce, *A Reader in Manichaean Middle Persian and Parthian*, Leiden, 1975.

A. Jeffery, “al-Bīrūnī’s Contribution to Comparative Religion,” in *Al-Bīrūnī Commemoration Volume*, Calcutta, n.d., pp. 125-60.

W. Madelung, “Fatimiden und Baḥrainqarmaṭen,” *Der Islam* 34, 1959, pp. 34-88.

G. Messina, “al-Biruni sugli inizi del cristianesimo a Merv,” in *Al-Bīrūnī Commemoration Volume*, Calcutta, n.d., pp. 221-31.

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BĪRŪNĪ, ABŪ RAYḤĀN viii. Indology

BĪRŪNĪ, ABŪ RAYḤĀN

viii. Indology

Bīrūnī's fame as an Indologist rests primarily on two texts. One is a translation from Sanskrit into Arabic of the *yogasūtra*s of Patañjali, entitled *Ketāb Bātanjal* (The book of Patañjali). The other, Bīrūnī's magnum opus, is *Ketāb taḥqīq mā le'l-Hend men maqūla maqbūla fi'l-ʿaql aw marḏūla* (The book confirming what pertains to India, whether rational or despicable). This is a wide-ranging examination of Sanskrit scientific sources, supplemented by conversations with Hindu pandits whom Bīrūnī met while accompanying his patron, Sultan Maḥmūd of Ḡazna, on military campaigns in northern India. In the West it is most often referred to as *India*, after E. C. Sachau's translation (*Alberuni's India*, 2 vols., London, 1888, 1910). There are also some references to Indian data in Bīrūnī's *al-Āṯār al-bāqīa*.

Of the two works, *Ketāb Bātanjal* is the earlier. In the *India*, Bīrūnī alludes to two texts of Hindu scripture which he had translated from Sanskrit into Arabic, "one about the origins and a description of all created beings, called *Sāmkya* [Sāṃkhyal, and another about the emancipation of the soul from the fetters of the body, called Bātanjal [Patañjali]" (*India*, p. 8). Both Sāṃkhya and Yoga, specifically the *Yogasūtra*s of Patañjali, represent the epitome of Hindu metaphysical speculation. The Sāṃkhya text has not survived; the Patañjali has, albeit in a unicum. First discovered by L. Massignon (1922) and later described by J. W. Hauer (1930), it was eventually published by H. Ritter (1956). It is divided into four parts, corresponding to the four divisions of the *yogasūtra*s of Patañjali but also interpolating the views of an anonymous Hindu commentator into the Arabic rendition. A dialogic format, probably inspired by Socratic treatises with which Bīrūnī was well familiar, gives an ease of access to *Ketāb Bātanjal* not found in the Sanskrit original. Each part has a different focus: the questions and answers of part 1 focus on the complex interaction of the soul with the body and its own essence. Three methods of mind-control are described: 1. habituated action (Skt. *abhyāsa*, Ar. *ta wīd*); 2. intellectual ascesis (Skt. *vairāgya*, Ar. *al-zohd al-fekrī*); and 3. devotion (Skt. *bhakti*, Ar. ʿebāda). They correspond to the three stages of yoga elaborated in several Hindu treatises, including the *Bhagavadgītā*: *kriyā* or *karma-yoga*, *jñāna-yoga*, and *bhakti-yoga*. Their common goal is self-realization or liberation (Skt. *mokṣa*, Ar. *etteḥād*). Part 2 draws attention to the discipline required if self-realization is to be achieved. The adept must gradually disentangle himself from sense perceptions, following a seven-stage progression that includes four outer and three inner stages of preparation. Bodily withdrawal is now possible if one pursues the classical yoga system, often referred to as eight-limbed (*aṣṭāṅga*). Exposition of this system constitutes part 3 of *Ketāb*

Bātanjal. In it Bīrūnī demonstrates his genius at lexical innovation. He is perhaps at his best in finding Arabic equivalents for the *prāna*s (breaths, vital forces) and the *siddhi*s (*ʿajāʾeb al-afāl*; extraordinary feats, both physical and mental), which together represent the pinnacle of yogic ascesis. In part 4 Bīrūnī further elaborates the five means by which the *siddhi*s may be obtained, paralleling the Sanskrit original most closely in delineating *jñāna-* and *bhakti-yoga* as the fourth and fifth means respectively. He concludes his unprecedented translation with an addendum summarizing the primary purpose of Patañjali: to affirm the principles of metempsychosis and unicity (Ar. *tanāsoḵ* and *etteḥād*) as well as the benefits of asceticism (Ar. *zohd*).

There are numerous contradictions between the Sanskrit text of Patañjali and the Arabic rendition of Bīrūnī. The five means of exercising mind control and attaining liberation, for instance, are reduced to three: the second means is roughly the equivalent of *jñāna-yoga*, while the method involving spells and cryptic formulae (Skt. *mantra*) is omitted altogether from *Ketāb Bātanjal* just as it is devalued as alchemy (*rasāyana*) in the *India*.

The major issue in *Ketāb Bātanjal* is not textual but theological: what sense does Bīrūnī make of the various paths to liberation that Patañjali proposes? That question can only be answered with reference to the *India*. There is a significant overlap of categories between *Ketāb Bātanjal* and the *India*. Composed around 421/1030, while Bīrūnī was at the height of his analytical powers, the *India* represents both a distillation and an extension of what had been broached in *Ketāb Bātanjal*: to classify and evaluate the major categories of Hindu philosophy and religion. Nearly two-thirds of the *India* (48 of 80 chapters) reviews the achievement of Indian science in several fields. Yet there is not a continuum of methodological perspective between *Ketāb Bātanjal* and the *India*. The former represents a bold effort to communicate the essentials of yogic ascesis to an Arabic readership. The *India* not only communicates but also evaluates the full range of Hindu thought and ritual. The initial twelve chapters provide a magisterial overview of Hindu notions of God, creation, metempsychosis, salvation, and idolatry. The Hindu approach to God, creation, and salvation is generously commended, bearing favorable comparison to reflections that emerged from ancient Greece and classical Islam. The same is not true for metempsychosis. While noting some parallels between it and the teachings of both Greek philosophers and Sufi masters, Bīrūnī stresses the disjuncture between such notions and normative Muslim belief. He himself has memorialized the disjuncture by his oft-quoted remark: *al-tanāsoḵ ʿelm al-neḥla al-hendawīya*("metempsychosis is the password of Hindu belief," tr. I, p. 50). Nor is Bīrūnī sympathetic to idol worship. He portrays it as class-specific, being the indulgence of uneducated, superstitious masses, rather than the preference of those literate Brahmins with whom he himself was in frequent contact.

It is in chapter seven of the *India* that we find Bīrūnī's longest and best documented assessment of Hindu beliefs. He examines in detail the three paths to liberation and in so doing, signals his preference for the teachings of Patañjali over the directives of other Indian scriptures, including the *Bhagavadgītā*. The contest is framed by the discipline of devotion (*bhakti-yoga*) and the pursuit of knowledge (*jñāna-yoga*). On the one hand, Bīrūnī draws extensive attention to *bhakti-*

yoga, especially in depicting ethical norms and drawing on parallel notions from the Sufi tradition. Many of the most extensive quotations illustrating the three-fold path to liberation derive from the *Bhagavadgītā*. On the other hand, however, the schematization of these paths and the topical sentences for each are directly quoted or paraphrased from *Ketāb Bātanjal*. It is to *jñāna-yoga* that Bīrūnī draws attention time and again. Salvation in his view is inseparable from self-cognition; in its most direct form, "it is the return of the soul as a knowing being into its own nature" (*Ketāb Bātanjal*, par. 78), or as he states in the *India*, "the soul distinguishes between things by defining them and so grasps its own essence (*aqalat ḏātahā*)" (tr. I, p. 68 [rev.]).

If Bīrūnī seems to be an inadvertent theologian in the early chapters of the *India*, in the later chapters he assumes the role of a pre-modern anthropologist. Ten of the last seventeen chapters in the *India* address ritual practices, principally initiation and funerary ceremonies but also obligatory sacrifices and dietary rules, together with fasting, pilgrimage, and festival observances. Textual evidence is constantly checked off against the declarations of personal informants, nowhere more tellingly than in chapter seventy-one. Bīrūnī begins by chronicling the mythical separation of scholars and riders. The innate merit of the former failed because most Hindus, like most people elsewhere, were not philosophers, and so philosophers could not rule. Warriors filled the power vacuum. Becoming kings, they proved to be perverse purveyors of power: they exempted Brahmins from the death penalty but exempted themselves from the penalty of being blinded for theft! Hindu prisoners of war suffered the worst fate, however. According to canonical law (the *dharmaśāstra*s), such prisoners could only achieve expiation by an elaborate rite requiring them to ingest *pancagavya*, the five products linked to the cow. While that requirement in itself seems extreme, even it is not adequate according to Bīrūnī's Brahmin informants. In their view, no expiation is possible for Hindu prisoners of war who return to India: they are never allowed to resume their former status (tr., II, p. 163).

Throughout the final chapters of the India, Bīrūnī continues to display his penchant for comparing and evaluating. While he tries to offer his readers a compendium of Hindu religious lore, as he read, heard about, and observed it, he also hopes to appropriate the "higher" truth of Indian philosophy, bracketing it with the Hellenistic corpus and integrating both into the worldview of educated Muslims. He cares little for the uneducated—whether Muslim or Hindu—and so the final chapters of the *India* that are devoted to Hindu rituals, appear as a kind of ethnographic afterthought. They lend an air of completeness to his massive tome without, however, aiding his primary goal: to pursue the Truth. In the final analysis, Bīrūnī is better classified as an anthropological philosopher than a philosophical anthropologist.

One would be justified in criticizing Bīrūnī's presuppositions as elitist and his methodology as overly reliant on literary data, despite his overtures to personal informants. Yet Bīrūnī stands at the apex of Islamic scholarship on non-Muslim religious traditions. After him no one followed his lead as a dispassionate enquirer into the subtleties of Hindu thought until the late medieval-early modern period of Indo-Muslim history. It remained for nineteenth-century European scholars to

spark an interest in further study along the lines he had initiated, among both educated Muslims and also Western scholars of Islam.

Bibliography:

A substantive assessment of Bīrūnī's data on Indian beliefs and customs before the publication of *Ketāb Bātanjal* is provided by A. Jeffery, "Al-Bīrūnī's Contribution to Comparative Religion," in *Al-Bīrūnī Commemoration Volume*, Calcutta, 1951, pp. 125-60.

An attractive abridgment of Sachau's translation of *India* has been done, with introduction and notes, by A. T. T. Embree, *Alberuni's India*, New York, 1971.

See also B. B. Lawrence, "Al-Biruni's Approach to the Comparative Study of Indian Culture," in *Biruni Symposium*, ed. D. Bishop and E. Yarshater, Persian Studies Series 7, New York, 1976, pp. 27-47; F. Mojtabāʾī, "Bīrūnī wa Hend," in *Barrasīhā-ī dar bāra-ye Abū Rayḥān Bīrūnī be monāsabat-e hazāra-ye welādat-e ū*, Tehran, 1352 Š./1973, pp. 242-91, and idem, "Bīrūnī and India. The First Attempt to Understand," in *Aspects of Hindu Muslim Cultural Relations*, New Delhi, 1978, pp. 9-59; F. E. Peters, "Science, History and Religion. Some Reflections on the *India* of Abū Raiḥān Al-Bīrūnī," in H. M. Said, ed., *Al-Bīrūnī Commemorative Volume*, Karachi, 1979, pp. 233-42; B. A. Dar, "Al-Bīrūnī on Hindu Religious Thought," ibid., pp. 336-543.

For the *Ketāb Bātanjal*, see L. Massignon, *Essai sur les origines du lexique technique de la mystique musulmane*, Paris, 1922; J. W. Hauer, "Das neugefundene arabische Manuskript von al-Bîrûnîs Übersetzung des Pâtanjala (Ein vorläufiger Bericht)," *Orientalistische Literaturzeitung*, 1930, no. 33, cols. 273-82; H. Ritter, "Al-Bīrūnī's Übersetzung des *Yoga-sūtra* des Patañjali," *Oriens* 9, 1956, pp. 165-200; partial English rendition: S. Pines and T. Gelblum, "Al-Bīrūnī's Arabic Version of Patañjali's *Yogasūtra*," *BSOAS* 29/2, 1966, pp. 302-25; 40/3, 1977, pp. 522-49; 46/2, 1983, pp. 258-304.

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