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Islamic Mathematical Astronomy



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A Handlist of the Arabic and Persian
Astronomical Manuscripts in the Maharaja
Mansingh II Library in Jaipur

THE MAHARAJA JAI SINGH (d. 1743) is well known to the history of science as the founder of the stone observatories of northern India, of which the most spectacular is in the "pink city" of Jaipur.¹ Having convinced his patron, the Emperor Muḥammad Shāh, of the inaccuracy of the current ephemerides, computed with the *zījes* of Ulugh Beg and al-Kāshī (ca. 1425) of Samarqand and with the Indian recensions of the *zīj* of Ulugh Beg made by Mullā Chānd (ca. 1600) in the reign of Akbar, and by Mullā Farīd al-Dīn (ca. 1630) in the reign of Shāhjahān, Jai Singh was ordered to undertake new observations with the help of Muslim, Brahman, and European astronomers. Besides constructing the observatories, Jai Singh collected manuscripts of Sanskrit, Persian, and Arabic astronomical works, as well as printed books from Europe. Some of these, surely only a fraction of his original collection, are still preserved in the library adjacent to the observatory in Jaipur, although not all of them date from the time of Jai Singh, notably the two manuscripts of his own *zīj*.

The purpose of this note is simply to identify the Arabic and Persian astronomical manuscripts preserved in the Library.² The manuscripts mentioned below add little to the corpus of material available for the further study of the history of Islamic astronomy in general, but are of interest in that they illustrate the kind of works that were being studied in Turkey, Iran, and India in the seventeenth, eighteenth, and nineteenth centuries. For each

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1. On Jai Singh's astronomical activities see in the appended bibliography, for example, *Kaye*; *Sayili*, pp. 359-361; *Blanpied*; and *Price*. For an overview of Mogul astronomy see *Ansari*. On the translation of Islamic works into Sanskrit see *Pingree*.

2. A list of the holdings of the Maharaja's Museum and Library, including most but not all of various Sanskrit, Islamic, and European astronomical works, is contained in *Das*. I have not been able to consult *Bahura*, which apparently lists only Sanskrit manuscripts.

work represented I give only the most basic information, such as title and author, together with the accession number, number of folios, and date of copying (Hijra/Christian calendar), as well as the date of acquisition where this is available.³ All of the authors and their works are well known to the history of Islamic science. The references given below, particularly those to the surveys of Arabic literature by C. Brockelmann and F. Sezgin and the survey of Persian literature by C. A. Storey, will guide the reader to other manuscripts of the same works preserved in other libraries.⁴

3. Since these are given in Sanskrit, I have relied on *Das* for this information.

4. The standard reference works on the sources for Islamic science are *Sezgin* (covering the period up till the mid-eleventh century); and *Suter* and *Brockelmann* (still the main sources for the later period); and *Storey* (for Persian works). Additional information on scientific manuscripts in Istanbul and Cairo is given in *Krause* and *King*, respectively. A survey of the Islamic astronomical handbooks known as *zijes* is in *Kennedy*.

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List of manuscripts

1. The Arabic version by Thābit ibn Qurra of Ptolemy's *Almagest*: 20 (ca. 150 fols., copied ca. 1600, breaks off after the beginning of the sixth *maqāla*), and the Arabic recension of Ptolemy's *Almagest* by Naṣīr al-Dīn al-Ṭūsī: 19 (97 pp., copied ca. 1500, acquired 1725).

References: *Sezgin*, VI, pp. 89 and 93.

2. An anonymous Arabic commentary on the *Kitāb al-Manāẓir* (*Optics*) of Ibn al-Haytham, actually the *Tanqīh al-manāẓir* by Kamāl al-Dīn al-Fārisī: 17,1 (ca. 150 fols., copied 1070H = 1659-60, checked 1079H = 1668-69, acquired 1725, clear *naskhī* script with carefully-drawn diagrams). The manuscript appears to have been copied by Abū Muḥammad Samānī (?) for al-Shāh Qiyād ibn ʿAbd al-Jalīl al-Ḥārithī al-Badakhshī known as Diyān-thihān (?).

References: On Ibn al-Haytham and his *Optics* see the article by A. I. Sabra in *DSB* and the references there cited. Prof. Sabra is currently completing an edition of this work. On Kamāl al-Dīn al-Fārisī see the article by R. Rashed in *DSB*, and on the available manuscripts of the *Tanqīh* see *Brockelmann*, I, p. 619 and *SI*, p. 853, and *Krause*, no. 389.

3. The Arabic treatise on the rainbow and lunar halo by Ibn al-Haytham: 17,2 (8 fols. in the same hand as 17,1 – see no. 2 above).

References: On Ibn al-Haytham see 2 above. On this treatise see *Krause*, no. 204(19) and *Brockelmann*, *SI*, p. 853. The only other known copy of this work appears to be the Istanbul copy listed by *Krause*.

4. The Persian version of *al-Tafhīm li-awā'il ṣinā'at al-tanjīm* by Abu'l-Rayḥān al-Bīrūnī: 7 (ca. 150 fols., copied ca. 1300, acquired 1725, fine copy).

References: *Storey*, no. 80; *Boilot*, no. 73. On Bīrūnī see also the article by E. S. Kennedy in *DSB*.

5. The Arabic commentary by Qāḍizāda al-Rūmī on the treatise on theoretical astronomy entitled *al-Mulakḥḥaṣ fi'l-hay'a* by Maḥmūd ibn ʿUmar al-Jaghminī: 18 (106 fols., copied ca. 1600, acquired 1725).

References: On al-Jaghminī see *Suter*, no. 403; *Krause*, no. 403; *Brockelmann*, I, pp. 624-625, and *SI*, p. 865, and *Storey*, no. 88. The *Mulakḥḥas* was compiled in 618H = 1221 (*contra Sezgin*, V, p. 115). On Qāḍizāda see *Suter*, no. 430; *Brockelmann*, II, p. 275. *etc.*

6. The Arabic commentary by al-Nisāpūrī on the treatise on theoretical astronomy entitled *al-Tadhkira* by Naṣīr al-Dīn al-Ṭūsī: 21 (250 fols., copied ca. 1600), and 22 (ca. 120 fols., copied ca. 1600, acquired 1725).

References: On al-Ṭūsī see *Suter*, no. 368; *Krause*, no. 368; *Brockelmann*, I, pp. 670-676 and *SI*, pp. 924-933; *Storey*, nos. 10 and 91; and the article in *DSB* by S.H. Nasr. The *Tadhkira* is currently being investigated in detail by J. Rajeb of Harvard University. On al-Nisāpūrī see *Suter*, no. 395, *Brockelmann*, II, p. 256 and *SII*, p. 273.

7. The Arabic commentary by ʿAlī al-Birjandī on the treatise on arithmetic called *al-Shamsīya* by al-Nisāpūrī: 10 (197 fols., copied 924H = 1518, acquired in 1725).

References: On al-Nisāpūrī see 6 above. On ʿAlī Birjandī see *Suter*, no. 456; and *Storey*, no. 121. Other copies of this commentary are listed in *Brockelmann*, *SII*, p. 273 (to which add MS Princeton Mach 4800).

8. The Persian astrological treatise *Lawā'ih al-qamar* by Ḥusayn ibn ʿAlī al-Bayhaqī al-Kāshifī: 91 (ca. 100 fols., copied ca. 1600, acquired 1725).

References: *Storey*, no. 116.

9. An unidentified anonymous Persian work on astrology: 2 (ca. 150 fols., copied ca. 1700). The author quotes Dorotheos frequently. Incipit: ...

دليلها هفت ستاره بر مولودها

References: This manuscript is not listed in *Das*. No Persian astrological works based on Dorotheos are listed in *Storey*.

10. The Persian *Zij-i Khāqāni* of Ghiyāth al-Dīn al-Kāshī: 9 (184 pp., copied ca. 1600, acquired 1728, fair copy, diagrams unlabelled).

References: *Storey*, nos. 104 and 105; *Kennedy*, no. 20. On al-Kāshī see also the article in *DSB* by A. P. Youschkevitch and B. A. Rosenfeld. An edition and translation of the *Khāqāni Zij* is currently being prepared by E. S. Kennedy.

11. The Persian *Zij-i Sultāni* of Ulugh Beg: 11 (ca. 195 fols., copied ca. 1500, fair copy), plus Persian commentaries by ʿAlī Birjandī: 5 (ca. 200 fols., 1015H), and Mollā Chānd: 6 (ca. 250 fols., copied ca. 1600, acquired 1725).

References: Storey, no. 104; Kennedy, no. 12. On the Arabic versions of this *zij* see also Brockelmann, II, pp. 275-276 and SII, p. 298. Only the Persian introduction of the *Zij* of Ulugh Beg and the star catalogue have been published; for a brief survey of the remaining tables, which merit detailed study, see Kennedy, pp. 166-167.

12. The Persian *Zij-i Shāhjahāni* compiled in Delhi by Farīd al-Dīn Mas'ūd ibn Ibrāhīm al-Dihlawī: 12 (438 fols., copied ca. 1800), and 14 (328 fols., copied ca. 1700, acquired 1725). In the second copy, the *zīj* is followed by an incomplete sexagesimal multiplication table (on which see *Historia Mathematica*, 1 (1974), 317-323, and 6 (1979), 405-417), and an incomplete table for computing the *mizāj* of the moon.

References: Storey, no. 133; and Kennedy, no. X204. The *Shāhjahāni Zij* has, as far as I know, never been studied, and merits investigation.

13. The Persian *Zij-i Muḥammad Shāhi* of Jai Singh: 4 (ca. 150 fols., copied ca. 1800??), and 8 (222 fols., copied ca. 1800).

References: Storey, no. 144; Kennedy, no. X203. Another copy which I have come across that is not listed in Storey is MS Aligarh University Library 30. Kaye, writing in 1918, implies that he was unable to locate a Persian copy of this *zij* in Jaipur (Kaye, p. 7). The *zij* of Jai Singh is unpublished, although much has been written on Jai Singh's astronomical activity (see Storey for references).

Sanskrit Translations of Islamic Works

For the sake of completeness I list the following manuscripts of Sanskrit versions of Islamic astronomical works, for which I have relied mainly on the handlist of the collection prepared by Dr. Asok Das and on Dr. David Pingree's survey of Islamic astronomical works in Sanskrit translation (see Das and Pingree in the bibliography). Other Sanskrit astronomical manuscripts are preserved in the Library, and also some European books on astronomy: see further Das. The Sanskrit manuscripts are listed in Bahura and are classified in D. Pingree's *Census of the Exact Sciences in Sanskrit* (see CESS for a full reference). Dr. Pingree kindly provided me with the information on the works numbered 18, 19, and 20 below.

14. *Zij* of Nityānanda: 23 (443 pp.).

References: Das, p. 7, no. 127; Pingree, pp. 323-326.

15. *Hayatagrantha*: 24 (ca. 50 fols.).

References: Das, p. 6, no. 112; Pingree, pp. 326-328.

16. An extract from the tables in what is apparently a Sanskrit version of the *Zij-i Ulugh Beg*: 45 (ca. 100 fols.).

References: Das, p. 7, no. 115; Pingree, p. 326.

17. Nayanasukhopādhyāya's translation of what purports to be Naṣīr al-Dīn al-Ṭūsī's *Tadhkira* in the commentary of al-Birjandī: 46 (ca. 60 fols.) (unique?).

References: Das, p. 6, no. 114; Pingree, p. 328. This work remains to be studied. For al-Birjandī on the *Tadhkira* see Brockelmann, SI, p. 931. This Sanskrit work is more probably a translation of al-

Birjandī's Persian *Risāla-i hay'a* (see Storey, no. 121), the relation of which to al-Ṭūsī's *Tadhkira* remains to be established.

18. Nayanasukhopādhyāya's translation of Naṣīr al-Dīn al-Ṭūsī's recension of the *Sphaerica* of Theodosius: 44.

References: CESS, A3, 132a, and A4.

19. *Yantrarājarisala bisa bāba*, a translation of Naṣīr al-Dīn al-Ṭūsī's treatise on the use of the astrolabe: 42.

References: CESS, A3, 145a, and A4.

20. *Virodhamardanagrantha*, a work in Marāṭhī composed by Yajnesvara Punakara Jyotirvit in 1837 and based on the *Zij-i-Khāqāni* (see no. 10 above): 205 (16 fols.), unique?

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Das: A. K. Das, "Maharaja Sawai Jai Singh and His City", lithographed on the occasion of the 250th anniversary of the city of Jaipur.

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