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Persian Garlands of Stars: Islamicate and Indic Astral Sciences in Seventeenth-Century North India

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Abstract

This paper offers a study of Mullā Farīd and Mullā Ṭayyib, two astronomers active in several North Indian courts in the first half of the seventeenth century. The lives and works of these two brothers illustrate the central role of mathematical astronomy and astrology in the science of the time and its use by Indian Muslim nobility. They also document the familiarity of Indian Muslim scholars with Indic astrology and its practice in Muslim milieux. Mathematical astronomy was very much alive in seventeenth-century Mughal India, and Persian-writing scholars were commenting and revising the astronomical data and mathematics transmitted from the Maragha and Samarqand schools of astronomy. Their intellectual activities are also better understood in the context of the avid interest in occult sciences cultivated by early modern Persianate societies, and more particularly by the Mughal court. Mathematical astronomy was nurtured for the precise purpose of casting horoscopes and creating astrological almanacs. Astrological practices in North-Indian courts, including Delhi, the Mughal imperial capital, were evidently mixed and flavoured with elements from both Islamicate and Indic traditions. Knowledge was widely shared across languages and scientific interests went well beyond religious denominations. Crucially too, the exchange between the Persian and the Sanskrit scholastic worlds was sponsored by Mughal patrons and resulted in scientific translations from one language to the other.

A closer reading of Mullā Farīd and Mullā Ṭayyib's Persian works allows us to see that besides their more classical astronomical works, the two brothers shared a common interest in Indic methods of prognostication, in particular *muhūrtaśāstra*, the

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science of electing an auspicious moment to perform a certain action. In this paper, we elucidate an intricate dossier on the “*bust* hours,” an ancient prognostication method popular with Islamicate astrologers. Identified by Islamicate scholars as coming ultimately from India, the source of many features of Islamicate astrology, these *bust* hours were reinterpreted on Indian soil by Mullā Farīd and Mullā Ṭayyib in light of their first-hand knowledge of *muhūrtaśāstra*. In this manner, these *bust* hours came back full circle to the original Indian prognostication practices.

Keywords

Mughal India – astronomy – Islamic astrology – jyotisha – translation

Mullā Farīd al-Dīn Mas‘ūd Dihlavī is described in several court chronicles as a prominent astronomer active during the reigns of Jahāngīr and Šāh Jahān. According to the *Ma‘ātir-i Raḥīmī* (1025/1616–7), a chronicle written by ‘Abd al-Bāqī Nahāvandī, Mullā Farīd was versed in various sciences such as lettrism (*jafr*), numerology (*a‘dād*), astrology (*nujūm*), mathematics (*riyāzī*), geometry (*handasa*), charms (*nīranjāt*) and talismans.¹ However, his most notable accomplishment remains the *Zīj-i Šāh Jahānī*, a set of astronomical tables (*zīj*) compiled towards the end of his life. Entitled *Kārnāma-yi šāhib-qirān-i tānī zīj-i Šāh Jahānī* (“The Great Work of the Second Lord of the Conjunction, the Tables of Šāh Jahān”; *Zīj-i Šāh Jahānī* in short). It was modelled on Ulūg Bīg’s famous *Zīj-i jadīd-i Sulṭānī* (also known as *Zīj-i Ulūg Bīg*) but set to an epoch corresponding to the vernal equinox of the regnal year of Emperor Šāh Jahān’s enthronement (i.e., an epoch of 21 March 1628, marking the beginning of the *tārīḥ-i ilāhī-yi Šāh Jahānī* “the Divine Era of Šāh Jahān”).²

1 ‘Abd al-Bāqī Nahāvandī, *Ma‘ātir-i Raḥīmī*, ed. Hidāyat Ḥusayn (Calcutta: Asiatic Society of Bengal, 1910–31), vol. 3, p. 10.

2 The title “Lord of the second conjunction” (*šāhib-qirān-i tānī*) given to Šāh Jahān “refers to the auspicious conjunction (*qirān*) of Jupiter and Venus at the time of his birth on 5 Jan. 1592 in Lahore” (S.M. Razaullah Ansari, “Survey of *Zījes* Written in the Subcontinent,” *Indian Journal of History of Science* 50, no. 4 (2015): 584). This title (*šāhib-qirān*) had first been applied to Timūr, Šāh Jahān’s ancestor, in reference to a conjunction of Mars and Jupiter in the zodiacal sign Taurus in the year of Timūr’s birth (Eva Orthmann, “Circular Motions: Private Pleasures and Public Prognostication in the Nativities of the Mughal Emperor Akbar,” in *Horoscopes and Public Spheres: Essays on the History of Astrology*, ed. Günther Oestmann, H. Darrel Rutkin, and Kocku von Stuckrad (Berlin: Walter de Gruyter, 2005), 111). According to Eva Orthmann, “the date of Timūr’s birth was likely invented to fall on a good configuration.”

Information about his career is otherwise sparse. In the *Ma'ātir-i Raḥīmī*, Mullā Farīd was given pride of place among the scholars active at the court of the powerful Mughal minister and general 'Abd al-Raḥīm Ḥān-i Ḥānān (d. 1627).³ Mullā Farīd was hired in 1006/1597–8 and was evidently still on his payroll in 1616–7. During this time, he seems to have received a position as a high judge or governor (*manṣab-i ṣadārat-i 'ālī*). At a later stage in his career, he attached himself to the service of the Mughal minister Āṣaf Ḥān, who gave him instructions to compose the *Zij-i Šāh Jahānī*. According to the *Ṭabaqāt-i Šāh Jahānī* (also quoted in the *Nuzhat al-ḥawāṭir*), Mullā Farīd died in 1039/1629–30,⁴ but the *Tārīḫ-i Muḥammadī* gives the more precise date of 2 Rabī' al-avval 1039 (October 19, 1629).⁵ However, according to Ghori, this date is incorrect since the positions of the stars in the *Zij-i Šāh Jahānī* are calculated for the year 1041/1631–2.⁶

Born in Delhi in a family of scholars,⁷ Mullā Farīd benefited from a well-rounded education with some of the foremost scholars of his age. First educated by his father Ibrāhīm Ḥāfiẓ, he was later sent to Narnaul to study under the guidance of the famous Čištī sheykh Niẓām al-Dīn "Ilāhdād" Nārnawli (d. 1588–9).⁸ Later on, Mullā Farīd completed his schooling with the Iranian émigré Faṭḥ Allāh Šīrāzī (d. 1589), a famous authority at the Mughal court. Through his connection to these two figures, Mullā Farīd probably found an entry into major religious and scholarly networks, as well as imperial patronage.

Niẓām al-Dīn was a master of the Čištī *ṭarīqa*, a popular Sufi order in North India. Niẓām al-Dīn's credentials were impressive, and at a young age, he had accompanied his father to Gwalior to live in the lodge of the famous Šaṭṭārī sheykh Muḥammad Ġawṭ (d. 1563).⁹ After the passing of his master Šayḥ Ḥānū

3 Nahāvandī, *Ma'ātir-i Raḥīmī*, vol. 3, 14–5.

4 Muḥammad Kašmīrī Hamadānī, *Ṭabaqāt-i Šāh Jahānī: ṭabaqa-yi avval*, ed. Muḥammad Aslam Ḥān (Delhi: Baḥš-i fārsī, dānišgāh-i dihlī, 1990), p. 48; 'Abd al-Ḥayy b. Faḥr al-Dīn al-Ḥasanī, *Al-'lām bi-man fi tāriḫ al-hind min al-'lām al-musammā bi-Nuzhat al-ḥawāṭir wa-bahjat al-masāmi' wa-l-nawāzīr* (Beirut: Dār Ibn Ḥazm, 1999), 440.

5 *Tārīḫ-i Muḥammadī*, MS British Library, London, Or. 1824, fol. 162v; also see Rieu, vol. 3, p. 1088.

6 S.A. Khan Ghori, "Development of Zij Literature in India," *Indian Journal of the History of Science* 20 (1985): 34.

7 See Nahāvandī, *Ma'ātir-i Raḥīmī*, 3, 9–10.

8 Ḥabīb al-Raḥmān Ḥān Mivātī, *Tadkīra-yi šūfiyān-i mivāt* (Mewat: Mewat Academy, 1985), 305–311.

9 Besides his *Jawāhir al-ḥamsa*, an influential Arabic compendium on Sufi meditation practices, Muḥammad Ġawṭ penned the unorthodox *Baḥr al-ḥayāt*, a Sufi adaptation in Persian of an earlier Arabic translation of the yogic treatise *Amṛtakunḍa*. An illustrated copy of this

Gwāliyārī, Nizām al-Dīn remained in Narnaul for 40 years as the head of the *ṭarīqa* before his death in the month of Šafar 997 (1588–9).¹⁰ Narnaul was an important educational centre where Šēr Šāh Sūrī (r. 1537–45), the founder of the Suri empire, had established a madrasa.¹¹ Nizām al-Dīn's reputation earned him a visit from Emperor Akbar, who in his quest for religious enlightenment visited the sheykh in November 1577 but, according to Abū l-Faẓl, was unimpressed.¹² One of Nizām al-Dīn's most brilliant disciples was Šāh A'lā Čištī Pānīpatī, a member of a prominent Čištī family and himself a reputed spiritual master.¹³ Interestingly, Šāh A'lā's father, Nizām al-Dīn Pānīpatī,¹⁴ has often been identified with Nizām Pānīpatī, the author of a well-known Persian translation of the Sanskrit *Laghuyogavāsiṣṭha*.¹⁵

text, now at the Chester Beatty Library in Dublin, was produced for prince Salīm, future emperor Jahāngīr (see Debra Diamond, ed., *Yoga: The Art of Transformation* (Washington, DC: Arthur M. Sackler Gallery, Smithsonian Institution, 2013), 150–9). After putting his mystical exploits at the service of emperors Bābur and Humāyūn, Muḥammad Ġawṭ was far less successful at Akbar's court (see A. Azfar Moin, *The Millennial Sovereign: Sacred Kingship and Sainthood in Islam* (New York: Columbia University Press, 2011), chapter 4; Orthmann, Eva. "The Occult Sciences at the Mughal Court During the Sixteenth Century," in *The Empires of the Near East and India: Source Studies of the Safavid, Ottoman, and Mughal Literate Communities*, ed. Hani Khafipour (New York, Columbia University Press, 2019), 384–400).

- 10 This account is based on two *taḍkiras* (Muḥammad Ġawṭī Šaṭṭārī, *Gulzār-i abrār*, ed. Muḥammad Dakī (Patna: Khuda Bakhsh Oriental Library, 1994), 259; al-Ḥasanī, *Nuzhat al-ḥawāṭir*, 440) and 'Abd al-Qādir Badā'ūnī's chronicle. Notably, Badā'ūnī, who lists Nizām al-Dīn among the prominent Sufi masters of the realm, notes his predilection for psychotropic drugs for obtaining visions of the next world ('Abd al-Qādir Badā'ūnī, *Muntakhabu-ṭ-tawārīkh*, tr. W. Haig (Calcutta: Asiatic Society of Bengal, 1925), 44–5).
- 11 Šēr Šāh Sūrī's grandfather, Ibrāhīm Ḥān had controlled the area around Narnaul. Around 1540–5, Šēr Šāh Sūrī built a magnificent mausoleum in Narnaul for him.
- 12 Abū l-Faẓl, *Akbarnāma*, ed. Mawlavi 'Abd al-Raḥīm (Calcutta: The Urduo guide, 1877–86), vol. 3, p. 227; Abū l-Faẓl, *The Akbarnāma*, vol. 3, tr. H. Beveridge (Calcutta: Asiatic Society of Bengal, 1939), vol. 3, 321. A more favourable picture of this encounter is found in Nizām al-Dīn Aḥmad's *Ṭabaqāt-i Akbarī*: remarkably, during this visit, Nizām al-Dīn and his followers convened for *samā'* and fell into a trance (Nizām al-Dīn Aḥmad, *The Ṭabaqāt-i Akbarī*, trans. B. De (Calcutta: Asiatic Society, 1936), vol. 2, 507).
- 13 Šāh A'lā's colourful account of his encounter with Nizām al-Dīn is reported in the *Siyar al-aqtāb*, a seventeenth-century Čištī hagiography (*taḍkira*) by Ilāhdiya Čištī (Ilāhdiya Čištī, *Siyar al-aqtāb* (Lucknow: Naval Kishore, 1881), 237–42); see also Muḥammad Miyān Šāhib, *Pānīpat ōr buzurgān-i pānīpat* (Lahore: Jam'īya Publishings, 2000), 297–316).
- 14 Only a few sources are available on Nizām al-Dīn Pānīpatī: Ilāhdiya Čištī, *Siyar al-aqtāb*, 231–232; 'Abd al-Ḥamid Lāhōrī, *Bādšāh-nāma*, ed. Kabīr al-Dīn Aḥmad and 'Abd al-Raḥīm (Calcutta: Asiatic Society of Bengal, 1867–8), vol. 1, p. 455; Miyān Šāhib, *Pānīpat ōr buzurgān-i pānīpat*, 297.
- 15 The identity of Nizām Pānīpatī is not settled among scholars: Shankar Nair (*Translating Wisdom: Hindu-Muslim Intellectual Interactions in Early Modern South Asia* (Oakland:

Faḥ Allāh Šīrāzī, Mullā Farīd's other teacher, was the most prominent Iranian scholar at Akbar's court.¹⁶ Attracted by the prospect of better pay, Faḥ Allāh, like his fellow-students who had also been studying in Shiraz under the aegis of the great scholar and theologian Ġiyāṭ al-Dīn Maṣṣūr Daštakī (d. c.1541), chose to emigrate to the Deccan. Indeed, from the 16th century onwards, Indian courts boasted a brilliant artistic and literary culture, both in the Mughal realm in the North and the Deccan sultanates in the South. These Indian courts were reputed to provide newcomers with lucrative and prestigious positions. Faḥ Allāh Šīrāzī started his Indian career in the service of Sultan 'Alī 'Adil Šāh I of Bijapur (d. 1580) before settling in the Mughal capital, Agra.¹⁷ Emperor Akbar appointed him to key positions within the administration and entrusted him with an overhaul of the madrasa curriculum. This reform, inspired by the Šīrāzī intellectual tradition, stressed the importance of the "rational sciences" (*'ulūm-i 'aqlīya*)—comprising mathematical and natural sciences, ethics, poetry, and history—to the detriment of the "traditional [Islamic] sciences" (*'ulūm-i naqlīya*). This reform was also aimed at providing both better staff for the ever growing revenue department as well as incentives for Hindus from scribal and Brahman castes to enrol in madrasas and learn the practical skills needed for the positions offered in the Mughal administrative service.

In Faḥ Allāh, Mullā Farīd found an ideal master in Islamicate astronomy. Šīrāzī scholars were remarkable mathematicians and astronomers: Faḥ Allāh Šīrāzī's own teacher Ġiyāṭ al-Dīn Maṣṣūr Daštakī had written a commentary on the *Zij-i Uluġ Bīg* entitled *Maḥāṭih al-munaġġimīn* as well as a commentary on Ptolemy's *Almagest* entitled *Takmila-yi majīstī*.¹⁸ One of Daštakī's other students, Muḥammad Muṣliḥ al-Dīn Lārī, had dedicated a commentary on

University of California Press, 2020), 47) seems to consider it a solved case but others such as Muzaffar Alam (*The Mughals and the Sufis: Islam and Political Imagination in India, 1500–1750* (Albany: State University of New York Press, 2021), 223, note 17) are less decided. None of the Persian and Urdu sources I have been able to consult mention the *Yogavāsīṣṭha* in relation to Niẓām al-Dīn Pānīpatī.

16 Ali Anooshahr, "Šīrāzī Scholars and the Political Culture of the Sixteenth-Century Indo-Persian World," *The Indian Economic and Social History Review* 51, no. 3 (2009): 331–52.

17 'Alī 'Adil Šāh I was known for his deep interest in Indian occult sciences. It is particularly evident in his *Nujūm al-'ulūm* (1570), a massive Persian treatise describing various Indian occult theories (Emma Flatt, *The Courts of the Deccan Sultanates: Living Well in the Persian Cosmopolis* (Cambridge: Cambridge University Press, 2019), 210–267).

18 Boris Abramovich Rosenfeld and İhsanoġlu Ekmeleddin, *Mathematicians, Astronomers, and Other Scholars of Islamic Civilization and Their Works (7th–19th c.)* (Istanbul: Research Center for Islamic History, Arts and Culture, 2003), 322, no. 963.

‘Alī Qūšjī’s *Risāla fī ‘ilm al-hay’a* to Humāyūn (c.1530) before leaving for the Ottoman court.¹⁹ Continuing the legacy of Šīrāzī astronomers, Faṭḥ Allāh Šīrāzī was responsible for setting up the Ilāhī calendar, celebrating a brand new era starting with Akbar’s reign. This precedent set by his former teacher was probably not lost on Mullā Farīd when the latter was commissioned to design a new calendar for Šāh Jahān, called the “Ilāhī calendar of Šāh Jahān.” Faṭḥ Allāh was particularly renowned at the Mughal court as being well versed in occult sciences. Amongst his duties as court astronomer, Faṭḥ Allāh was casting horoscopes for emperor Akbar²⁰ and was instructed to supervise a partial translation into Sanskrit of the *Zij-i Uluġ Biġ* for the imperial library with the help of Abū l-Faẓl and several Sanskrit scholars, Kišan Jūšī, Gangādhara and Mahīs Mahānand.²¹ This work may have been a model for the later commission to Nityānanda of a Sanskrit translation of Mullā Farīd’s *Zij-i Šāh Jahānī*.²²

19 MS Vienna, Österreichische Nationalbibliothek, MS mixt. 169; Anooshahr, “Šīrāzī Scholars,” 345–6; Ali Anooshahr, “Science at the Court of the Cosmocrat: Mughal India, 1531–56,” *The Indian Economic and Social History Review* 54, no. 3 (2017): 305–9; one manuscript is available at the Khuda Bakhsh Library in Patna (MS 1041); the Vienna manuscript can be viewed online at https://digital.onb.ac.at/RepViewer/viewer.faces?doc=DTL_3326613&order=1&view=SINGLE.

20 Orthmann, “Circular Motions,” 104, 110.

21 “Kišan Jūšī, Gangādhara and Mahīs Mahānand translated a part from the *Zij-i jadīd-i Mūrẓā’ī* from Persian to Hindi with the supervision of Amīr Faṭḥ Allāh Šīrāzī and the interpretation (*tarjumānī*) of the writer of this fortunate work [Abū l-Faẓl]” *laḥṭī-yi zij-i jadīd-i mūrẓā’ī rā ba didavari-yi amīr faṭḥ allāh šīrāzī u tarjumānī-yi rāqīm-i iqbal-nāma kišan jūšī gangādhara mahīs mahānand az hindī ba fārsī* [sic] *āvardand* (Abū l-Faẓl, *Ā’īn-i Akbarī*, ed. Blochmann (Calcutta: Baptist Mission Press, 1872–7), vol. 1, 115). Although the manuscripts and edited text contain the reading “from Hindi to Persian” (*az hindī ba fārsī*), it must probably be replaced with the more plausible “from Persian to Hindi” (*az fārsī ba hindī*) as in the Japanese translation (Ayako Ninomiya, et al., “アブル・ファズル著『アーイーニ・アクバリ』 訳注 (9)” [Translation of Abū l-Faẓl’s *Ā’īn-i akbarī*]. 神戸大学文学部紀要 [Bulletin of the Faculty of Letters, Kobe University] 48 (2021): 113–4. It is not clear how many Sanskrit scholars are here mentioned. One of them is identified by S.R. Sarma (“Jyotiṣarāja at the Mughal court,” in *Studies on Indian Culture, Science, and Literature: Being Prof. K.V. Sarma Felicitation Volume Presented to Him on His 81st Birthday*, ed. Natesa Gangadharan, Krishna V. Sarma, S.A.S. Sarma, and S.S.R. Sarma (Chennai: Sree Sarada Education Society Research Centre, 2000), 367) as a scholar named Kṛṣṇa Daivajña who served Akbar and Jahāngīr and wrote a commentary on Śrīpati’s *Jātakapaddhati*, which included a horoscope of ‘Abd al-Raḥīm Ḥān-i Ḥānān (see below).

22 This translation of the *Zij-i Uluġ Biġ* doesn’t seem to be extant. A Sanskrit translation of the *Zij-i Uluġ Biġ* tables is kept in Jaipur but seems significantly more recent (c. late eighteenth century) (Anuj Misra, personal communication; MS Jaipur, Maharaja Man Singh II Museum, no. Museum 45; David Pingree, *A Descriptive Catalogue of the Sanskrit Astronomical Manuscripts Preserved at the Maharaja Man Singh II Museum in Jaipur, India* (Philadelphia: American Philosophical Society, 2003), 135). Jean Arzoumanov, and Anuj

Mullā Farīd's first known patron was 'Abd al-Raḥīm Ḥān-i Ḥānān, one of the most important statesmen and patrons of his age. A prolific poet in Hindavi himself, 'Abd al-Raḥīm Ḥān-i Ḥānān sponsored many Hindavi and Persian-speaking literati in his multilingual court.²³ He was evidently extremely interested in both Islamicate and Indic astronomy, and his fondness for Mullā Farīd probably reflects the high value he placed in astronomical knowledge and astrological prognostication. He himself is credited with a treatise in Sanskrit on Islamicate astronomy, entitled *Khetakautuka*, which contains numerous Arabic and Persian words transcribed in Sanskrit.²⁴ His Sanskrit horoscope was also reproduced in a contemporary astrological treatise by Kṛṣṇa Daivajāna.²⁵

Mullā Farīd's second patron, Āṣaf Ḥān Abū l-Ḥasan (1569–1641), was, besides being a powerful statesman, a versatile scholar. Coming from an Iranian family, Āṣaf Ḥān was the father in law of Šāh Jahān.²⁶ During the last years of Jahāngīr's reign, he had been named *vakīl* (deputy), the highest ministerial rank available at the Mughal court. Upon Jahāngīr's death, Āṣaf Ḥān played a decisive role

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- Misra, "Calendars, Compliments, and Computations: A Comparative Survey of the Canon in the Persian *Zīj* of Šāh Jahān and in its Sanskrit Translation, the *Siddhāntasindhu*," *History of Science in South Asia* (forthcoming) contains a comparative survey of Mullā Farīd's *Zīj-i Šāh Jahānī* and its translation by Nityānanda, entitled *Siddhāntasindhu*; see also Anuj Misra, "Persian Astronomy in Sanskrit: A Comparative Study of Mullā Farīd's *Zīj-i Šāh Jahānī* and its Sanskrit Translation in Nityānanda's *Siddhāntasindhu*," *History of Science in South Asia* 9 (2021): 30–127.
- 23 Corinne Lefèvre, "The Court of 'Abd-ur-Raḥīm Khān-i Khānān as a Bridge Between Iranian and Indian Cultural Traditions," in *Culture and Circulation: Literature in Motion in Early Modern India*, ed. Thomas de Bruijn and Allison Busch (Leiden: Brill, 2014); 'Abd al-Raḥīm Ḥān-i Ḥānān was also sponsoring Sanskrit scholars such as Rudrakavi, who dedicated to him the *Khānakhānācarita* (1609), a text praising the amīr. On this text, see Audrey Truschke, "Regional Perceptions: Writing to the Mughal Court in Sanskrit," in *Cosmopolitismes en Asie du Sud. Sources, itinéraires, langues (XVI^e-XVIII^e siècle)*, ed. Corinne Lefèvre, Ines Županov, and Jorge Flores, (Paris: Editions de l'ÉHESS, 2015), 259–63; Audrey Truschke also addresses the thorny question of how Sanskrit encomia could have been received by Muslim patrons who had only a very limited knowledge of the language.
- 24 David Pingree, *Census of the Exact Sciences in Sanskrit: Series 1, Volume 2* (Philadelphia: American Philosophical Society, 1971), 79–80; see edition and translation: 'Abd al-Raḥīm Ḥān-i Ḥānān, *Star-lore; Being an Account of the Disposition of the Planets of the 12 Houses of the Horoscopes*, ed. and transl. S.D. Udhrain (Delhi: Sagar Publications, 1973).
- 25 *Jātakapaddhatyudāharaṇa*.
- 26 Corinne Lefèvre, "Āṣaf Khān," in *Encyclopaedia of Islam, THREE*, ed. by Kate Fleet, Gudrun Krämer, Denis Matringe, John Nawas, Everett Rowson (Leiden: Brill, 2008); his biography is given at length in Šāhnavāz Ḥān, *Ma'ātir al-umarā*, transl. H. Beveridge and rev. Bains Prashad (Calcutta: Asiatic Society of Bengal, 1941–52), vol. 1, pp. 387–95.

in facilitating Šāh Jahān's smooth accession to the throne and was generously rewarded by the new emperor. Besides his political clout, Āṣaf Ḥān was also famed for his extensive scholarship and received the sonorous title "Kindler of the flame of the character of the Illuminationists, Learner of the temperament of the Peripatetics."²⁷ To honor Āṣaf Ḥān, the Kashmiri ruler Mukunda Ray commissioned the scholar and court poet Jagannātha Paṇḍitarāja (d. c.1670) to write the Sanskrit *Āsaphavilāsa* (c.1628–41), a text praising Šāh Jahān's visit to Kashmir in the company of Āṣaf Ḥān.²⁸ The famous Iranian philosopher and alchemist Mīr Findiriskī visited India at the invitation of Āṣaf Ḥān and was granted audiences with Šāh Jahān in 1037/1627 and 1046/1636.²⁹ From this voyage, Mīr Findiriskī brought back Niẓām Pānīpatī's translation of the *Laghuyogavāsiṣṭha* on which he wrote a marginal commentary and which became a popular text on Indic philosophy in Iran. It is tempting to imagine an encounter between the famed and aging astronomer and the philosopher.

Despite being less well-known compared to his brother Mullā Farīd, Mullā Ṭayyib was also an esteemed scholar with interests ranging from Islamicate astronomy to Indic prognostication.³⁰ The most detailed account on Mullā Ṭayyib is also found in the *Ma'āṭir-i Raḥīmī*.³¹ It credits "Šayḥ Ṭayyib" with the *Navādir al-iḥṭiyārāt*, a work dedicated to 'Abd al-Raḥīm Ḥān-i Ḥānān. According to the same account, Mullā Ṭayyib also constructed an astrolabe for this same patron, for which he was rewarded with the weight of the instrument in pure gold.

Besides the two *zījes* described below, jointly written with his brother, only two of his works are now extant. The *Risāla dar ḥall-i taqvīm* composed during the reign of Akbar is a short compendium on almanacs and was commissioned

27 *Šu'la-afrūz-i fiṭrat-i iṣrāqīyān dāniš-āmūz-i ṭab'iyat-i maššā'īyān* (Šāhnavāz Ḥān, *Ma'āṭir al-umarā*, ed. 'Abd al-Raḥīm and Mīrzā Ašraf 'Alī (Calcutta: Asiatic Society of Bengal, 1888–91), vol. 1, 158).

28 Jatindrabimal Chauduri, *Muslim Patronage of Sanskrit Learning: Part 1* (Calcutta: Prācyavāṇī, 1954), 46–71; Truschke, "Regional Perceptions," 263–6; for the original text and the translation of the *Āsaphavilāsa*, see pp. 112–5; on Jagannātha Paṇḍitarāja, see also Sheldon Pollock, "Sanskrit Literary Culture from the Inside Out," in *Literary Cultures in History: Reconstructions from South Asia*, ed. Sheldon Pollock (Berkeley: University of California Press, 2003), 96–9. During his long career in the service of Mughal grandees, Jagannātha Paṇḍitarāja also worked with prince Dārā Šikōh.

29 Heike Franke, "Die persischen Übersetzungen des *Laghuyogavāsiṣṭha*," in *The Mokṣopāya, Yogavāsiṣṭha and Related Texts*, ed. Jürgen Hanneder (Aachen: Shaker Verlag, 2005), 121.

30 In his three extant works, he calls himself "Ṭayyib Ibrāhīm Dihlavī".

31 Nahāvandī, *Ma'āṭir-i Raḥīmī*, vol. 3, 62–3; his name is misspelt *ṭabīb*; this account is summarized in the *Nuzhat al-ḥawāṭir* (al-Ḥasanī, *Nuzhat al-ḥawāṭir*, 548).

by ‘Abd al-Raḥīm Ḥān-i Ḥānān.³² Mullā Ṭayyib’s objective in this *risāla* is to update the information on almanacs (*taqvīm*) found in earlier treatises. Without mentioning its source, he largely quotes from Nizām al-Dīn ‘Abd al-‘Alī Birjandī’s (d. 934/1527–8) much longer *Bist bāb dar ma’rifat-i taqvīm*. Among the new materials included, Mullā Ṭayyib describes the Ilāhī calendar, introduced by Akbar. His other work, the *Muntaḥab-i ratan mālā*, is a compendium on Indic catarchic astrology (*muhūrtaśāstra*; see below) also dedicated to ‘Abd al-Raḥīm Ḥān-i Ḥānān. It is described by its author as a “selection” (*intihāb*) of “trusted Indian books” (*kutub-i mu’tabara-yi hind*) such as the “*Ratan mālā*” (from Sanskrit *ratnamālā*, “garland of jewels”) and several unnamed texts.³³ The title refers to the popular Sanskrit astrological text *Jyotiṣaratnamālā* attributed to Śrīpatibhaṭṭa (11th century). The *Muntaḥab-i ratan mālā* is intended as a practical guide to help in electing (*iḥtiyār*) the auspicious times for a wide range of actions. Notably, the third chapter offers a description of the most auspicious hours for accomplishing a number of actions which are listed following the order of the letters contained in ‘Abd al-Raḥīm Ḥān-i Ḥānān’s complete title (*navāb ḥān-i ḥānān mīrzā ḥān bahādur sipah-sālār*).

Scholars have long noted the particular importance of astrology at the Mughal court, where emperors surrounded themselves with astronomer-astrologers.³⁴ Emperors would have horoscopes cast for their sons³⁵ and astrologers were pictured in miniatures standing close to the birth-chamber.³⁶ Astronomers

32 Two manuscripts are kept in Rampur Reza Library: MS 1217 and MS 1221 (Anonymous, *Fihrist-i nuṣṣahā-yi ḥaṭṭi-yi kitābhāna-yi riḏā - rāmpūr. Jild-i avval* (Rampur: Rampur Reza Library, 1996), 339, 344).

33 One complete manuscript is kept at the Rampur Reza Library: MS 1649 (Anonymous, *Fihrist*, 488); an incomplete manuscript is kept in Aligarh: Maulana Azad Library, Aligarh Muslim University, no. Abdus Salam 478/33.

34 Eva Orthmann, “Ideology and State-Building: Humāyūn’s Search for Legitimacy in a Hindu-Muslim Environment,” in *Religious Interactions in Mughal India*, ed. Vasudha Dalmia and Munis D. Faruqui (New Delhi: Oxford University Press, 2014), 3–29; Orthmann, “The Occult Sciences”; Moin, *The Millennial Sovereign*, chapter 4; Anooshahr, “Science at the Court of the Cosmocrat”; Stephan Popp, “Mughal Horoscopes as Propaganda,” *Journal of Persianate Studies* 9 (2016): 45–59; see Tunç Şen and Fleischer, “Books on Astrology” for a fascinating study of the practice of casting horoscopes and drawing almanacs at the Ottoman court between 1470 and 1510.

35 The tables used to cast horoscopes are unfortunately rarely extant. One exception is a horoscope made on the occasion of the future emperor Şāh Jahān’s birth by Faṭḥ Allāh b. ‘Abd al-Raḥmān al-Zubayrī al-Burūjī (MS London, British Library, Lansdown 1245; Charles Rieu, *Catalogue of the Persian manuscripts in the British Museum*. London: British Museum, 1879–83, vol. 2, 791).

36 One painting kept at the Chester Beatty Library (Dublin) of the episode of the prince Salīm’s birth in the *Akbar-nāma* shows a Muslim astrologer holding an astrolabe (accession number: In 03.143; viewable on https://viewer.cbl.ie/viewer/image/In_03_143/1/LOG_0000/);

also helped determining the auspicious day and hour for enthronements as in the case of Jahāngīr.³⁷ Indian astrologers regularly cast horoscopes in the Indic art of *jyotiṣa* and offered their advice to emperors on important matters.³⁸ The birth-horoscope (*janmapatrī*) cast by Viśvanātha, son of Divākara, for prince Ḥurram, the future Šāh Jahān, is still extant.³⁹ Šāh Jahān's interest in astronomy was apparent from an astrolabe dedicated to him, recently described by S.R. Sarma.⁴⁰ Occult sciences more generally held particular significance for Mughal emperors and princes.⁴¹ Muḥammad Ġawṭ, in whose lodge Mullā Farīd's master, Niẓām al-Dīn, resided in his early years, was greatly esteemed by emperor Humāyūn and noted for his expertise on occult subjects, in particular lettrism.⁴² Like Muḥammad Ġawṭ and his other mentor Faṭḥ Allāh Šīrāzī, Mullā Farīd was a dedicated lettrist as is testified by his royal and princely chronograms. More significantly, the prologue of his masterpiece *Zīj-i Šāh Jahānī* is permeated with Pythagorean and lettrist ideas.⁴³ Occult sciences, often overlooked by scholars, were indeed central to the Islamicate cosmological vision and formed a substantial part of scientific activity in early modern Persianate societies.⁴⁴ Matthew Melvin-Koushki has recently offered groundbreaking

another painting maybe by Bishandas of the same episode kept at the Museum of Fine Art, Boston shows a Muslim astrologer holding an astrolabe alongside a Sanskrit astrologer probably composing a horoscope (accession number: 14.657; viewable on <https://collections.mfa.org/objects/148503/birth-of-prince-salim>). See also Orthmann, "Circular Motions," 102.

- 37 Ḥwāja Kāmgar Ḥusaynī, *Ma'āṭir-i Jahāngīrī*, ed. 'Adrā 'Alavī (Aligarh: Asia Publishing House, 1978), 62.
- 38 Sarma, "Jyotiṣarāja at the Mughal court"; Christopher Minkowski, "Learned Brahmins and the Mughal Court: The Jyotiṣas," in *Religious Interactions in Mughal India*, ed. Vasudha Dalmia and Munis D. Faruqī (New Delhi: Oxford University Press, 2014), 102–34.
- 39 Anonymous, *A Descriptive Catalogue of Sanskrit Manuscripts, Acquired and Deposited in the Sanskrit University Library (Sarasvati Bhavana)*, volume 1X: *jyautiṣa MSS.* (Benares: Dept. of Publications, Sanskrit University, 1963), vol. 9, 260–1. no. 37080; the manuscript is dated from 1887.
- 40 Sreeramula Rajeswara Sarma, "A Monumental Astrolabe Made for Šāh Jahān and Later Reworked with Sanskrit Legends," *Medieval Encounters* 23 (2017): 198–262.
- 41 On Šāh Jahān's firstborn son Dārā Šīkōh's engagement with occult practices, see Supriya Gandhi, *The emperor Who Never Was: Dara Shukoh in Mughal India* (Cambridge, Mass., London: The Belknap Press of Harvard University Press 2020).
- 42 See Orthmann, "The Occult Sciences" for a partial translation of Muḥammad Ġawṭ's lettrist interpretation of the names of Allāh.
- 43 Matthew Melvin-Koushki has a forthcoming article contextualizing this aspect of the *Zīj-i Šāh Jahānī* (personal communication).
- 44 On the influence of Qazwīnī's *Wonders and Rarities* on Islamicate culture and its study of the cosmos interlacing nature and magic, see Travis Zadeh, *Wonders and Rarities:*

explorations into the vast Persian occult-scientific literature, such as that of the Timurid scientist Ibn Turka (d. 835/1431–2).⁴⁵

In India, as in other parts of the Islamicate world, astronomical works composed in Samarqand were held in great esteem, and Mullā Farīd’s astronomical works contain extensive citations from Uluġ Bīg’s *zīj*. Besides the many copies of the *Zīj-i Uluġ Bīg* itself which are kept in Indian manuscript collections, several commentaries on this text were circulating in India⁴⁶ and a few others were composed on Indian soil. Mullā Čānd, astronomer of Humāyūn and later Akbar, wrote a simplified version (*tashīl*) of the *Zīj-i Uluġ Bīg*.⁴⁷ In this work, Mullā Čānd inserted a few more explanatory sections and revised several tables to take into account the time elapsed since the compilation of the original. A few decades later, ‘Abd al-Raḥīm b. Šāliḥ Muḥammad dedicated a commentary on the *Zīj-i Uluġ Bīg* to Šāh Jahān.⁴⁸

As can be expected, Islamicate *zījes* were part of the holdings of the Mughal Imperial libraries. A front page from a copy of the *Zīj-i Īlḥānī* bears the seals of several Mughal royal librarians from between the reigns of Akbar and Awrangzīb. Remarkably, it bears the seal of the librarian of Šāh Jahān’s library, ‘Ināyat Ḥān, author of an abridged history of his reign.⁴⁹ A manuscript copy of the *Zīj-i Uluġ Bīg* kept in Paris is also reported to originate from the imperial library.⁵⁰ These two famous observational *zījes*, the *Zīj-i Īlḥānī* and the *Zīj-i Uluġ Bīg*, provided astrologers with the astronomical data they needed to cast

The Marvelous Book That Traveled the World and Mapped the Cosmos (Cambridge, MA: Harvard University Press, 2023).

- 45 Matthew Melvin-Koushki, “Being with a Capital B: Ibn Turka on Ibn ‘Arabī’s Lettrist Cosmogony,” in *Islamic Thought and the Art of Translation: Texts and Studies in Honor of William C. Chittick and Sachiko Murata*, ed. Mohammed Rustom (Leiden: Brill, 2022), 150–77.
- 46 Ansari, “Survey,” 293; Ansari also gives a very instructive survey of the Islamicate scientific works found in manuscript form in Indian and Pakistani libraries.
- 47 Ansari, “Survey,” 582: “A unique copy of this simplified Zīj is extant in the CPM (Jaipur), MS (Arabic and Persian) No. 6. The manuscript bears the seal of one ‘Abd al-Khāliq (“a slave of Shāh Jahān”), dated AH 1038/A.D. 1628–29.” Mullā Čānd is also known to have prepared horoscopes for Akbar and Jahāngīr.
- 48 ‘Abd al-Raḥīm b. Šāliḥ Muḥammad, *Šarḥ-i Zīj-i Uluġ Bīgī*, MS Lucknow, Jamia Sultaniya Library, MS no. unknown, foll. 1v–22v; his three other extant works were dedicated to Ḥalīl Allāh Ibrāhīm ‘Ādil Šāh of Bijapur (D.N. Marshall, *Mughals in India: A Bibliographical Survey, Vol. 1—Manuscripts* (Bombay: Asia Publishing House 1967), 21).
- 49 <https://www.christies.com/en/lot/lot-2034406>; the present whereabouts of this manuscript are unknown.
- 50 Paris, Bibliothèque nationale de France, MS Supp. persan 366; see John Seyller, “The Inspection and Valuation of Manuscripts in the Imperial Mughal Library,” *Artibus Asiae* 57, no. 3–4 (1997): 319; Francis Richard, *Catalogue des manuscrits persans, Bibliothèque nationale de France, Département des manuscrits. Tome 11: Supplément persan. Première partie*,

their horoscopes. Among the horoscopes cast for Akbar that were transcribed by Abū l-Faẓl, Mullā Čānd's horoscope was, unsurprisingly, based on the *Zij-i Uluġ Bīg*. Whereas other astrologers, such as Mawlānā Ilyās al-Ardabīlī, still drew their data from the much older *Zij-i Īlhānī*.⁵¹

All of Mullā Farīd's extant works deal with astronomy and astrology: the *Sirāj al-istiḥrāj*, the *Zij-i Raḥīmī*, the *Zij-i Šāh Jahānī* and two horoscopes. Mainly known for his scientific output, Mullā Farīd was also noted for his piety⁵² and wrote a commentary (*šarḥ*) on the Quranic sura *al-tīn* (Quran 95).⁵³ The *Ma'āṭir-i Raḥīmī* also reproduces a short verse composition by him containing in chronograms the dates of birth, enthronement and death of Timurid kings from Tīmūr to Jahāngīr.⁵⁴ Besides his merits as a mathematician and astronomer, Mullā Farīd was an expert letrist indeed and never lost an occasion to ingratiate himself with kings and princes with his witty chronograms, a practice highly appreciated in the Persianate courts of the time. His verse chronogram composed for the date of Jahangir's enthronement was deemed particularly brilliant by 'Abd al-Raḥīm Ḥān-i Ḥānān, who reproduces it in the *Ma'āṭir-i Raḥīmī* with several other chronograms composed in Safavid Iran. The *Ma'āṭir-i Raḥīmī* also records chronograms that Mullā Farīd created for 'Abd al-Raḥīm Ḥān-i Ḥānān and his sons.⁵⁵ This same chronicle transcribes the prologue of a lost composition on letrism (*jafr*) entitled *Zill-i lawḥ-i mahfūz*.⁵⁶

Mullā Farīd's first known astronomical work, the *Sirāj al-istiḥrāj*, was composed in 1006/1597–8,⁵⁷ possibly in Lahore.⁵⁸ Despite profuse praise,

1–524; *Deuxième partie, 525–1000* (Rome: Istituto per l'Oriente C.A. Nallino, 2013), vol. 1, 501–3.

51 Orthmann, "Circular Motions," 104; According to A. Tunç Şen and Cornell H. Fleischer ("Books on Astrology, Astronomical Tables, and Almanacs in the Library Inventory of Bayezid II," in *Treasures of Knowledge: An Inventory of the Ottoman Palace Library (1502/3–1503/4)*. Volume 1: Essays, ed. Gülrü Necipoğlu, Cemal Kafadar and Cornell H. Fleischer. Leiden: Brill, 2019, 773) the *zij* most used to cast horoscopes at the Ottoman court between 1570–1610 was Wābkanawī's *Zij al-muḥaqqaq*; only second came the *Zij-i Uluġ Bīg* and the *Zij-i Īlhānī*.

52 Nahāvandī, *Ma'āṭir-i Raḥīmī*, vol. 3, 15.

53 Hamadānī, *Ṭabaqāt-i Šāh Jahānī*, 47.

54 Nahāvandī, *Ma'āṭir-i Raḥīmī*, vol. 3, 11–14.

55 Nahāvandī, *Ma'āṭir-i Raḥīmī*, vol. 3, 16–7.

56 Nahāvandī, *Ma'āṭir-i Raḥīmī*, vol. 3, 12–3.

57 The year of composition can be obtained by adding the abjad values of the dotted letters in the title *Sirāj al-istiḥrāj* (ج خ ج).

58 Mullā Farīd gives in two instances precise planetary coordinates for Lahore: Mullā Farīd, *Sirāj al-istiḥrāj*. MS London, British Library, 10 Islamic 476, foll. 127r, 132r. Mullā Farīd could also be giving the information for Lahore because of its status as the imperial capital at the time.

the dedicatee is not named explicitly, but it might very well have been ‘Abd al-Raḥīm Ḥān-i Ḥānān who became Mullā Farīd’s patron in exactly the same year. This short treatise became a popular introduction to astronomy as the number of manuscripts and later citations show.⁵⁹ Some of the material in the *Sirāj al-istiḥrāj* was reused in the introductions (*muqaddima*) of Mullā Farīd’s two *zījes*, the *Zīj-i Raḥīmī* and the *Zīj-i Šāh Jahānī*. The *Sirāj al-istiḥrāj* contains detailed calculations and advice on how to construct an almanac. According to the prologue, the objective of the treatise is to help “the derivation of the true positions of planets and such” (*istiḥrāj-i taqāvim-i kavākib u gayruh*) in a detailed and clear fashion with “examples” (*mitāl*) for every calculation. Indeed, the *Sirāj al-istiḥrāj* was clearly aimed at providing its readers with practical clues to rapidly compute mean and true positions of planets or to predict specific astronomical events (Moon phases, conjunctions, eclipses, etc.), information that were necessary to draw a horoscope or compose an almanac for a given year. Interestingly, besides the dates in the Hijri calendar, it also contains a few dates in the Ilāhī calendar instituted by Akbar, which shows that it was in use by astronomers.

In the first section (*qism*) of the introduction, Mullā Farīd gives general definitions of *zījes*, almanacs (*taqvim*) and observation (*raṣad*) and explains their

59 At least eleven copies are described in manuscript catalogues: Cambridge, King’s College Library, MS King’s Pote 223 (Edward Granville Browne, *A Supplementary Handlist of the Muhammadan Manuscripts, Including All Those Written in the Arabic Character, Preserved in the Libraries of the University and Colleges of Cambridge* (Cambridge: Cambridge University Press, 1922), 306); Hyderabad, Telangana Government Oriental Manuscripts Library and Research Institute (ex-Āṣafiya), MS riyāzī 198 (Rosenfeld and İhsanoğlu, *Mathematicians*, 358); Hyderabad, Osmania University Library, MS 1172 (Rosenfeld and İhsanoğlu, *Mathematicians*, 358); Lahore, Punjab University Library, MS Ph III 83/2004 (‘Ārif Nawšāhī, *Fihrist-i nushahā-yi ḥaṭṭī-yi fārsī-yi kitābhāna-yi markazī-yi dānišgāh-i panjāb, lāhūr (pākistān) (majmū‘ahā-yi āzād, pīr-zāda, šīrānī, kayfī va ‘umūmī)* (Tehran: Markaz-i piṣūhišī-yi mirāt-i maktūb, 1390/2011–2), vol. 1, 669); London, British Library, MS 10 Isl. 476, foll. 118r–149r (Hermann Ethé, *Catalogue of Persian Manuscripts in the Library of the India Office* (Oxford: Printed for the India Office by H. Hart), 1903–37, vol. 1, 1230); Mosul, private collection of Dr Dāwūd al-Jalbī (Sālim‘Abd al-Razzāq Aḥmad, *Fihris maḥṭūṭāt maktab al-awqāf al-‘amma fi l-mawṣil* (Mosul: Maṭābī‘i jāmi‘at al-mawṣil, 1983), vol. 6, p. 232); Oxford, Bodleian Library, MS Fraser 180 (Eduard Sachau and Hermann Ethé, *Catalogue of the Persian, Turkish, Hindūstānī, and Pushtū Manuscripts in the Bodleian Library* (Oxford: Clarendon Press, 1889–1930), vol. 1, 941); Saint Petersburg, National Library of Russia, MS PNS 512/3 (Rosenfeld and İhsanoğlu, *Mathematicians*, 358); Tashkent, Academy of Sciences of Uzbekistan, MS 6413 (A.A. Semenov, ed., *Sobranie vostochnykh rukopisei Akademii Nauk Uzbekskoi SSR* (Tashkent: Akademiia Nauk, 1952–87), vol. 9, 255); two Iranian manuscripts are also described in Farīd Qāsimlū and Faribā Pāyраванд Tābit, eds., *Fihristvāra-yi muštarak-i nushahā-yi ḥaṭṭī-yi riyāzī dar kitābhānahā-yi irān* (Tehran: Dānišgāh-i āzād-i islāmī, 1387/2008–2009), 643.

utility. He includes an interesting etymology of the word *zīj*. In this section, Mullā Farīd specifies that he is quoting from the *Zīj-i muḥaqqaq-i Sulṭānī*, which is a well-known *zīj* by Šams al-Munajjim Muḥammad Wābkanawī (fl. early fourteenth century) and is one of the only two extant *zīj*es based on the observations carried out at the Maragha observatory.⁶⁰ A comparison between the two texts makes it plain that this entire section is taken verbatim from Wābkanawī's *zīj*.⁶¹ These preliminary definitions from Wābkanawī were reused by Mullā Farīd in later astronomical works, the *Zīj-i Raḥīmī* and the *Zīj-i Šāh Jahānī*. It is worth noting Wābkanawī's definitions seem to have also inspired other Indian authors such as Maḥmūd Šāh Ḥalījī (878/1473–4) in his *Zīj-i jāmi'* and Abū l-Faẓl in his *Ā'in-i Akbarī*.⁶² Other influences are noticeable in the *Sirāj al-istiḥrāj*. For example, the third and fourth *qisms* of the introduction, on the method of interpolation between two lines in a table and on time divisions, draw extensively from the *Zīj-i Uluḡ Bīg* but add new information such as the division of time in Indic astronomy.⁶³

The popularity of the *Sirāj al-istiḥrāj* must have stemmed from its clear language and abundance of examples. The *Kaššāf iṣṭilāḥāt al-funūn wa-l-'ulūm* (1158/1745–6), an important Arabic dictionary of technical terms written by the Indian lexicographer Muḥammad A'lā Tahānawī, quotes six definitions of astronomical and mathematical terms from the *Sirāj al-istiḥrāj*.⁶⁴ The definition of *zīj* was also quoted by the Indian lexicographer Muḥammad Ġiyāt al-Dīn Rāmpūrī in his *Ġiyāt al-luḡāt*.⁶⁵ More surprisingly, Mullā Farīd's description of

60 Benno van Dalen, "Wābkanawī: Shams al-Munajjim [Shams al-Dīn] Muḥammad ibn 'Alī Khwāja al-Wābkanawī [Wābkanawī]," in *The Biographical Encyclopedia of Astronomers*, ed. Thomas Hockey et al. (New York: Springer, 2007), 1187–8.

61 Mullā Farīd, *Sirāj al-istiḥrāj*, foll. 119v–120r = Šams al-Munajjim Muḥammad Wābkanawī, *Zīj-i muḥaqqaq-i Sulṭānī*, ms Tehran, Majlis Library, no. 6435, pp. 13–14; ms Istanbul, Süleymaniye Kütüphanesi, Ayasofya 2689, foll. 9v–10r (*maqāla* 1, *bāb* 1, *dar bayān-i ānki raṣad u zīj u taqvim ċi bāšad u dar dānistan-i inhā ċi fāyida buvad*)

62 Maḥmūd Šāh Ḥalījī, *Zīj-i jāmi'*, ms Oxford, Bodleian Library, Greaves 6, foll. 3rv; it is quite evident for the definitions of *raṣad* (observation), *taqvim* (almanac) and *zīj*; see also the Persian text and Latin translation in John Greaves, *Astronomica quaedam ex traditione Shah Cholgi persae: una cum hypothesis planetarum* (London: J. Fleisher, 1652), 1–4. The definitions of *raṣad* and *zīj* in the *Ā'in-i Akbarī* are less recognizable and were probably enhanced in Abū l-Faẓl's typical florid and complex style (*Ā'in-i Akbarī*, vol. 1 part 2, pp. 265–6).

63 Mullā Farīd, *Sirāj al-istiḥrāj*, foll. 121v–122r.

64 These are the definitions of *raṣad*, *zīj*, *sā'a*, *ta'dil*, *taqvim*, and *buht* (Muḥammad A'lā Tahānawī, *Kitāb Kaššāf iṣṭilāḥāt al-funūn wa-l-'ulūm*, ed. Muḥammad Wajih, 'Abd al-Ḥaqq, and Gulām Qādir (Calcutta: Asiatic Society of Bengal, 1862), pp. 551, 610, 676, 1023, 1226, 1553) (= Mullā Farīd, *Sirāj al-istiḥrāj*, fol. 121r).

65 Ġiyāt al-Dīn Rāmpūrī, *Ġiyāt al-luḡāt*, ed. Muḥammad Dabir Siyāqī (Tehran: Kānūn-i ma'rifat, 1337/1958–9), vol. 1, 516.

the division of the nychthemeron into sixty parts by Indian astronomers⁶⁶ was used in the first modern Arabic encyclopedia published by Buṭrus al-Bustānī in 1875 in Beirut.⁶⁷

Mullā Farīd's first *zīj*, the *Zīj-i Raḥīmī* is a Persian computational *zīj* based on the *Zīj-i jadīd-i Sultānī* by Uluġ Bīg.⁶⁸ Only one copy is extant in the Mar'aṣī Najafī library in Mashhad (Iran).⁶⁹ The material of the *Zīj-i Raḥīmī* is predominantly inspired by the *Zīj-i Uluġ Bīg*, the text and structure of which it most often reproduces verbatim. However, the introductory section (*muqaddima*) and a few other chapters are additions.⁷⁰ Most of this additional material also features in the *Zīj-i Šāh Jahānī* but sometimes in a revised form. Ansari has remarked that the *Zīj-i Raḥīmī* contains new tables in comparison to the *Zīj-i Uluġ Bīg*: "A large number of tables have been added in order to simplify (*tashīl*) the calculation of ephemerides (*taqwīm*) of Sun, Moon, and Saturn. In fact, the author has clearly explained two methods for the calculation, by not using or using Tashīl; in the latter case the interpolation between the entries of a table are not required (ff. 113b, 114a)."⁷¹

The authorship and chronology of the *Zīj-i Raḥīmī* are difficult to disentangle. If Mullā Farīd is clearly the main author of this *zīj*, his brother Mullā Ṭayyib seems to have had a hand in giving it its final form. Furthermore, there were probably several states of redaction spanning more than a decade, and the Mashhad manuscript contains the final version of the text, which is the only one available to us. According to the prologue of the text, this *zīj* was started by "Mawlānā Farīd al-Dīn Mas'ūd" on the commission of the Mughal amīr 'Abd al-Raḥīm Ḥān-i Ḥānān. Indeed, the *Ma'āṭir-i Raḥīmī* (1025/1616–7) lists a *zīj* named after 'Abd al-Raḥīm Ḥān-i Ḥānān among Mullā Farīd's works.⁷² Based on internal evidence, Ansari dates the composition of the *Zīj-i Raḥīmī* to around 1617–8: "As Mullā Farīd tabulated the equation of time (*ta'dīl al-ayyām*)

66 Mullā Farīd, *Sirāj al-istiḥrāj*, fol. 122v.

67 Buṭrus al-Bustānī, *Dā'irat al-ma'ārif* (Beirut: Maṭba'a al-adabiyya, 1887), 380: article on "hour" (*sā'a*). This division of the nychthemeron into 60 units is also found in Fayzī's translation of the *Lilāvati* (Sreeramula Rajeswara Sarma and Maryam Zamani, "On the Persian Translation of Bhāskara's *Lilāvati* by Abu'l Faiz Faizī at the Court of Akbar," *The Indian Journal of History of Science* 43, no. 3 (2019): 275).

68 This text is briefly described by Ansari 2015.

69 Mullā Farīd, *Zīj-i Raḥīmī*, ms Mashhad, Mar'aṣī Najafī library, 5554; According to Ansari ("Survey," 583), this manuscript "ends abruptly on fol. 227 with the table for the first equation of Saturn, reckoned from the zodiacal sign Gemini (*jawzā*)."

70 Arzoumanov and Misra, "Calendars, compliments, and computations."

71 Ansari, "Survey," 583.

72 *Ma'āṭir-i Raḥīmī*, vol. 3, p. 14: *zījī nūz ba ism-i īn darviš-nihād šāfi-žamīr ki ġaraž-i aṣlī az taḥrīr-i īn risāla ḥālāt-i iṣān ast nivišta and.*

for the Sun and Moon for the year AH1026 / AD1617 (ff. 152b, 153a), it appears that he might have been compiling the ZR around that year.⁷³ Still according to the prologue of the *Zij-i Raḥīmī*, after the death of the amīr (October 1st, 1627), his daughter Jānān Bīgam ordered “Ṭayyib Ibrāhīm Dihlavī” to complete the work of his brother Mullā Farīd. Initially daunted by the enormous task, Mullā Ṭayyib explains somewhat mysteriously that his doubts were overcome by the abjad number corresponding to the title (288). He also explains that he added “introductory parts” (*muqaddimāt*) which his “dear brother” had not included in his draft (*tasvīd*).

The *Zij-i Šāh Jahānī* is Mullā Farīd’s most important composition. It ensured its author’s fame as Šāh Jahān’s main astronomer. Very similar to the *Zij-i Raḥīmī*, it is also based on the *Zij-i Uluḡ Bīg*, and Ghori finds it “very much improved in comparison with Uluḡ Bīg’s *zīj*.”⁷⁴ It has recently been surveyed alongside Nityānanda’s Sanskrit translation.⁷⁵

Three Mughal chronicles give a precious account of the composition of the *Zij-i Šāh Jahānī*: ‘Abd al-Ḥamīd Lāhōrī’s *Bādšāh-nāma*, ‘Ināyat Ḥān’s *Mulaḥḥaṣ-i Šāh Jahān-nāma*⁷⁶ and Kanbōh’s *‘Amal-i Šālīḥ*.⁷⁷ This project was initiated by the prime minister Āṣaf Ḥān and involved the participation of Mullā Ṭayyib and several unnamed astronomers. Despite these chronicles converging to date the *Zij-i Šāh Jahānī* to the year 1039/1629–30,⁷⁸ it has been remarked that the epoch year of the tables is 1041/1631–2, which would imply a later date of completion.⁷⁹

According to ‘Abd al-Ḥamīd Lāhōrī, the *Zij-i Šāh Jahānī* is a “a computational *zīj* comprising the mending of the questions arising from the inspectors of observational calculations, the removal of the differences born of the passage of days since past *zījes*, the rectification of tables and of copyists’ errors, the simplification of calculations and the correction of calculators’ errors” (*zīj-i ḥisābī muštamil bar tadārūk-i masāyilhā-yi vāqī’a az mubāšīrān-i a’ṣmāl-i raṣadī u raḥī-i tafāvuthā-yi nāšīya az tamādī-yi ayyām dar zījāt-i māziya u taṣṣīḥ-i jadāvil u ḥaṭāhā-yi nāsiḥān u tashīl-i a’ṣmāl u iṣlāḥ-i aglāt-i muḥāsibān*).⁸⁰ In

73 Ansari, “Survey,” 582.

74 Ghori, “Development of Zij Literature,” 35; see Arzoumanov, and Misra, “Calendars, Compliments, and Computations” for an overview of the similarities and differences between the *Zij-i Šāh Jahānī*, the *Zij-i Raḥīmī*, and the *Zij-i Uluḡ Bīg*.

75 Arzoumanov, and Misra, “Calendars, Compliments, and Computations.”

76 *Bādšāh-nāma*, vol. 1, pp. 287–8; *Mulaḥḥaṣ-i Šāh Jahān-nāma*, p. 82.

77 *‘Amal-i Šālīḥ*, vol. 1, pp. 361–2.

78 Lāhōrī dated it to the second regnal year of Šāh Jahān (1629) and ‘Ināyat Ḥān included the description of the *zīj* in his account of the events of the month of Rabī’ 1039 (1629).

79 Ansari, “Survey,” 585, quoting the unpublished survey of Benno van Dalen (H6 (zs X204)).

80 *Bādšāh-nāma*, pp. 286–7.

Kanbōh's simpler terms, the *Zij-i Šāh Jahānī* aimed "at simplifying derivation and calculation" (*bā'it-i suhūlat-i istihrāj u āsānī-yi 'amal*).⁸¹

Chroniclers also mention that this *zīj* was approved by Šāh Jahān and that orders were given to translate it into Sanskrit. 'Ināyat Ḥān reports that "orders were given for Indian astronomers to translate it into the language of Hindustan with the approval of Persian astronomers" (*ḥukm šud ki nujūmīyān-i hindūstān ba istiṣvāb-i munajjimān-i furs ba zabān-i hindūstān tarjuma namāyand*).⁸²

Besides the extant manuscripts, information on the reception of the *Zij-i Šāh Jahānī* is scarce. A short passage is quoted by Muḥammad A'lā Tahānawī in the Arabic technical lexicon *Kaššāf iṣtilāḥāt al-funūn wa-l-'ulūm* in his definition of *muqawwim 'adad* ("preceding number in a sequence").⁸³ In Mirzā Ḥayr Allāh's *Zij-i Muḥammad Šāhī* composed for Sawāī Jai Singh (c.1735), it is mentioned as a "simplified *zīj*" (*tashīl*) next to Mullā Čānd's *tashīl*.⁸⁴ A precious late reference shows that the *Zij-i Šāh Jahānī* was still popular with astronomers well into the nineteenth century. In a mixed astronomical manuscript dating from c.1862, Pandit Gawrī Šankar "Kawl" quotes from the "*Zij-i tashīl-i Šāh Jahānī*"⁸⁵ to calculate the difference of culmination of the Sun between the Indian and the Hijrī calendars.⁸⁶ This passage gives a rare example of a precise use of an astronomical text for practical purposes, since after this short citation from the *Zij-i Šāh Jahānī*, Gawrī Šankar "Kawl" applies Mullā Farīd's method of calculation to the current Hijrī year 1279/1862–3.

Besides his mathematical production, two extant horoscopes show Mullā Farīd's activity as a court astrologer and his reach across South Asian Islamicate courts. His first horoscope was cast on the occasion of the birth of the son of Abū l-Faḥ Ibrāhīm 'Ādil Šāh of Bijapur in the year 1022/1613–4.⁸⁷ Thus, like his mentor Faḥ Allāh Šīrāzī, Mullā Farīd was also providing his services to the rulers of Bijapur. The second horoscope, transcribed in Lāhōrī's *Bādšāh-nāma*, gives the horoscope (*zā'iča*) of the ascendant (*ṭālī'*) of Šāh Jahān on the date

81 *'Amal-i Šālīḥ*, vol. 1, pp. 361–2.

82 *Mulaḥḥaṣ-i Šāh Jahān-nāma*, p. 82.

83 *Kaššāf iṣtilāḥāt al-funūn wa-l-'ulūm*, p. 1226.

84 *Zij-i Muḥammad Šāhī*, fol. 2r.

85 *Yāddāsthāi dar 'ilm-i hayat*, Lahore, Punjab University Library, MS Aph III 8, pp. 103–104; Nawšāhī, vol. 1, p. 680.

86 = *Zij-i Šāh Jahānī*, part 1, chapter 7; see transcription and translation of this passage in Jean Arzoumanov and Anuj Misra, "Calendars, Compliments, and Computations."

87 MS Berlin, Berliner Staatsbibliothek, no. Petermann II, 264, foll. 23v–sqq; Wilhelm Pertsch, *Verzeichniss der persischen Handschriften der königlichen Bibliothek zu Berlin* (Berlin: A. Asher and Co., 1888), 153.

of his enthronement.⁸⁸ It explains in much detail the auspicious omens determined by the planetary positions within the twelve zodiacal houses (*buyūt*) “in the fashion of Greek astronomers” (*ba ṭawr-i aḥtar-šināsān-i yūnānī*).

Beyond their practice of Islamicate astrology, Mullā Farīd and Mullā Ṭayyib had also first-hand experience of Indic astrological procedures, those in particular belonging to Indic catarchic astrology (*muhūrtaśāstra*). *Muhūrtaśāstra* is the science of determining propitious and unpropitious moments (*muhūrta*) for performing certain acts.⁸⁹ Śrīpati’s *Jyotiṣaratnamālā* (c.1050), which, as noted above, was translated by Mullā Ṭayyib, was the first great Sanskrit treatise dedicated to *muhūrtas* and its layout became the model for subsequent works. Islamicate astrology also features its own tradition of catarchic astrology called *iḥṭiyārāt* (“elections, choices”), which determines good (*sa’d*) and bad (*naḥs*) moments for performing a specific action. Remarkably, some elements of the science of *iḥṭiyārāt* were consciously borrowed from the Indian *muhūrtaśāstra*.⁹⁰ As shown below, *karaṇas* were indeed appropriated by Muslim astrologers. *Karaṇas* belong to the *pañcāṅga* (San “five limbs”), according to which *muhūrtas* can be calculated, and which count lunar days (*tithis*), lunar mansions (*nakṣatra*), *karaṇas*, weekdays, and the angle between Sun and Moon (*yoga*). *Karaṇas* measure half a lunar day (*tithi*) each; seven are said to be “movable” and are repeated in cycles eight times across the lunar month followed by five said “fixed” *karaṇas*, which only occur at the end of the lunar month.

An intriguing dossier runs across Mullā Farīd and Mullā Ṭayyib’s works, concerning the *bust* hours, an ancient system of Islamicate prognostication, which they identified with the inauspicious hours called *bhadra* belonging to Indic catarchic astrology. Despite the overwhelmingly Islamicate character of Mullā Farīd’s works, the presence of a chapter on “*bust* and *bhadra*” in his *Zij-i Šāh Jahānī* confirms his attraction to Sanskrit astrology, something which he obviously shared with his brother Mullā Ṭayyib. This interest in Sanskrit sciences was not uncommon among Indian Muslim scholars.⁹¹ Varāhamihira’s *Bṛhatsamhitā*, a Sanskrit encyclopedia on prognostication, had been translated

88 ‘Abd al-Ḥamīd Lāhōrī, *Bādšāh-nāma*, ed. Kabīr al-Dīn Aḥmad and ‘Abd al-Raḥīm (Calcutta: Asiatic Society of Bengal, 1867–8), vol. 1, 97–100; it is summarily described in Popp, “Mughal horoscopes,” 56. Notably, Mullā Farīd’s teacher Faṭḥ Allāh Šrāzī had also cast a horoscope for Akbar (Orthmann, “Circular Motions,” 104).

89 David Pingree, *Jyotiḥśāstra: Astronomical and Mathematical Literature* (Wiesbaden: Otto Harrassowitz, 1981), 101–9.

90 David Pingree, “Eḳṭiārāt,” in *Encyclopaedia Iranica* 8:3, ed. by Ehsan Yarshater (London: Routledge and Kegan Paul, 1998), 445–48.

91 On Persian *zījes* describing Indic astronomy, see Ansari 2009, “Survey.” Among them, the so-called *Zij-i Muzaḥḥar Šāhī* (1525) was edited by Āftāb Aṣḡar (Aṣḡar 1980).

in the fourteenth century by ‘Abd al-‘Azīz Šams-i Tahānīsārī.⁹² In 1587, Fayzī, Akbar’s poet-laureate and Abū l-Faẓl’s brother supervised the translation of Bhāskara’s *Līlāvātī*.⁹³ ‘Aṭā’ Allāh Rašīdī, member of a prominent family of scholars, architects and engineers, translated Bhāskara’s mathematical treatise *Bījagaṇita* from Sanskrit to Persian and dedicated it to Šāh Jahān.⁹⁴

The so-called *bust* hours are described in al-Bīrūnī’s famous Arabic book on India (*Kitāb mā li-l-hind*), where he writes a full account of the “*bust* hours” in his chapter on *karaṇas*, the auspicious and inauspicious times in India astrology associated with the lunar month:

The Hindus attribute to some of the *karaṇas* dominants, as is their custom. Further they give rules showing what during each *karaṇa* must be done or not, rules which are similar to collection of astrological prognostics.⁹⁵

Continuing on the subject of *karaṇas*, al-Bīrūnī remarks:

Wishing to remind the reader of something relating to the *karaṇas* which he perhaps has forgotten, we must tell him that Alkindī and others like him have hit upon the system of the *karaṇas*, but one which was

92 Orthmann 2017.

93 Sarma and Zamani, “On the Persian Translation of Bhāskara’s *Līlāvātī*.”

94 Charles Ambrose Storey, *Persian Literature: A Bio-Bibliographical Survey. Vol. II. Part 1. A. Mathematics, B. Weights and measures, C. Astronomy and Astrology, D. Geography* (London: Luzac, 1958), 15; Marshall, *Mughals in India*, 345–7; see S.M. Razaullah Ansari (“Persian Translations of Bhāskara’s Sanskrit Texts and Their Impact in the Following Centuries,” in *Bhāskara-prabhā: Sources and Studies in the History of Mathematics and Physical Sciences*, ed K. Ramasubramanian, T. Hayashi, and C. Montelle. Singapore: Springer, 2019, 377–91) for a cursory survey of the Persian translations of Bhāskara’s works; on this family, see the account by Sulaymān Nadvī (“Lāhōr kā ēk muhandis ḥāndān jis ne tāj ōr lāl qil’a banāyā,” *Rū’idād-i idāra-yi ma’ārif-i islāmīya: ajlās-i avval mun’aqida-yi lāhōr 15–16 aprīl 1933*, (Lahore: Majlis-i ‘āmila-yi idāra-yi ma’ārif-i islāmīya, 1933), 1–50); ‘Aṭā’ Allāh Rašīdī was also associated with Dārā Šikōh to whom he dedicated a treatise on mensuration and arithmetic (D.N. Marshall, *Mughals in India: A Bibliographical Survey, Vol. 1—Manuscripts, Supplementary Part*, (New Delhi: Munshiram Manoharlal, Indian Council of Historical Research, 1996), 10–11). His father Aḥmad Mī’mār Lāhōrī had designed the Taj Mahal, and his brother Ḥayr Allāh Ḥān Muhandis had penned in 1747 a commentary on Ptolemy’s *Almagest* (Storey, *Persian Literature*, 37). His other brother Luṭf Allāh Muhandis translated Šūfī’s *Šuwar al-kawākib* into Persian (Storey, *Persian Literature*, 16).

95 Abū Rayḥān Muḥammad b. Aḥmad al-Bīrūnī, *Alberuni’s India: An Account of the Religion, Philosophy, Literature, Geography, Chronology, Astronomy, Customs, Laws and Astrology of India about A.D. 1030*, ed and transl. Edward Sachau (London: K. Paul, Trench, Trübner & Co., 1910), 198.

not sufficiently explained. They did not comprehend the method of those who use the *karaṇas*. At one time they trace them back to Indian, another time to Babylonian origin, declaring all the time that they are altered on purpose and corrupted by the inadvertence of the copyists. They have invented a calculation for them which proceeds in a better order than even the original method itself. But thereby the thing has become something totally different from what it originally was. Their method is this: they count half days, beginning with new Moon. The first twelve hours they regard as belonging to the Sun, as *burning*, i.e. unlucky, the next twelve hours as belonging to Venus, the following twelve hours as belonging to Mercury, and so on according to the order of the planets. Whenever the order returns to the Sun, they call his twelve hours *the hours of Albist*, i.e. *viṣṭi*.⁹⁶

Sachau interprets the Arabic *bust* as coming from the Sanskrit *viṣṭi*, which is known in Indian astrology. So does Pingree, who finds these periods of 12 hours similar to the Indian *karaṇas* described by Varāhamihira but notes that “the Indian method of determining their lords is completely different” and that “the origin method of assigning lords according to the descending order of the planets (that is, in accordance with their lordships of the hours) is not apparent.”⁹⁷ It is indeed probable that the *bust* hours of the Arabic astrologers reflect the seventh movable *karaṇa*, called *viṣṭi* or *bhadrā*, which is particularly inauspicious and is presided by Yama, the god of death. The fifth chapter (*adhyāya*) of the *Jyotiṣaratnamālā* describes the *karaṇas* and mentions a method for determining the position of the beginning and end of the *viṣṭi karaṇa*.⁹⁸ In his influential *Muhūrtacintāmaṇi* composed in Benares in 1600, Rāma, a contemporary of Mullā Farīd and Mullā Ṭayyib, gives more details on determining the position of the *viṣṭi/bhadrā karaṇa*.⁹⁹

Despite Bīrūnī’s attribution to al-Kindī, I have not been able to locate any direct reference to *bust* hours in al-Kindī’s works. However, a similar system

96 al-Bīrūnī, *Alberuni’s India*, 200–1.

97 David Pingree, “The Indian and Pseudo-Indian Passages in Greek and Latin Astronomical and Astrological Texts,” *Viator* 7 (1976): 176.

98 Śrīpatibhaṭṭa, *Jyotiṣaratnamālā*, ed. Vihārīlāśarma (Jammu: Śrīraṇavīrakendriyaśaṣṭa skṛta-vidyāpīṭham, 1978), 22, verse 5:8; see also Pavel Poucha, “La Jyotiṣaratnamālā ou Guirlande des joyaux d’astrologie de Śrīpatibhaṭṭa,” *Archiv orientální* 16 (1946): 301, verse 5:9; the translation of this verse is given in Rama, *Daivagye Acharya Shriram’s Muhurta Chinta Mani*, tr., commentary and annotation Girish Chand Sharma (New Delhi: Sagar Publications, 1996), 35.

99 Rama, *Daivagye Acharya Shriram’s Muhurta Chinta Mani*, 31–6 (I thank Martin Gansten for this reference); see Pingree, *Jyotiḥśāstra*, 105–6.

is described by al-Kindī in his book on astrology *Al-Arbaʿūn bāban*, which contains a long description of elections (*iḥtiyārāt*). In the chapter on war, al-Kindī describes the alternation between “combust” (*muḥtaraqa*) hours lasting 12 hours starting from the new Moon and non-combust hours in a 84-hour cycle.¹⁰⁰ These inauspicious combust hours are similar to the inauspicious *bust* hours, which are located under the rulership of the Sun. Al-Kindī does not however associate planetary rulers with this system of hours, nor does he mention any Indian origin.¹⁰¹ Other authors such as al-Qabīṣī and Bīrjandī consider the *bust* hours and the combust hours as equivalent. Besides al-Bīrūnī, the only Arabic astrological treatise known to describe these *bust* hours is Abū l-Ṣaqr ʿAbd al-ʿAzīz b. ʿUṭmān b. ʿAlī al-Qabīṣī al-Mawṣilī’s (Alcabitius in Latin; fl. second half of the tenth century) *Kitāb al-Mudḥal ilā šināʿat aḥkām al-nujūm* (“Book of the Introduction to the Craft of Astrology”). Al-Qabīṣī’s description is very similar to later Persian descriptions. He describes this *al-bust* system as being practiced in India (*hind*).¹⁰² Pseudo-Majrīṭī’s *Ġāyat al-ḥakīm*, an important Arabic book on magic known in Europe by its Latin name *Picatrix*, briefly mentions the existence of “combust” hours (*muḥtaraqa*) at the end of its description of lunar mansions and their astrological effects but does not give any detail.¹⁰³

Later on, this system of *bust* hours became part and parcel of Islamicate astronomy. It appears for example in a classic Persian work on astrology,

100 al-Kindī, *Mudḥal ilā ʿilm al-nujūm wa huwa al-kitāb al-musammā al-Arbaʿūn bāban*, ms Jerusalem, Khalidi Library, no. 996, fol. 43v; al-Kindī, *The Forty Chapters of al-Kindī: Traditional Horary and Electional Astrology*, transl. and ed. Benjamin N. Dykes (Minneapolis: The Cazimi Press, 2011), 178–9.

101 In other astrological texts, Al-Kindī is keen to acknowledge the Indian origin for a technique, e.g., the use of Indian lunar mansions in a text on weather forecasting, that has reached us in Hebrew and Latin (Gerrit Bos and Charles Burnett, *Scientific Weather Forecasting in the Middle Ages: The Writings of al-Kindī* (Abingdon: Routledge, 2000), 20–1).

102 Al-Qabīṣī (Alcabitius), *The Introduction to Astrology*, ed. of the Arabic and Latin text and English translation by Charles Burnett, Keiji Yamamoto, and Michio Yano (London-Turin: The Warburg Institute-Nino Aragno Editore, 2004); for the Arabic text and the English translation, see 136–9, for the Latin translation, see pp. 347–349 (where *al-bust* is transcribed in strikingly different manners in the various manuscripts); this passage by al-Qabīṣī is discussed in Pingree, “The Indian and Pseudo-Indian Passages,” 176, 191; a description of the *bust* hours system is also found in a Greek manuscript (edited in Pingree, “The Indian and Pseudo-Indian Passages,” 191, appendix 10).

103 Edition of the Arabic text: Pseudo-Majrīṭī, *Ġāyat al-ḥakīm*, ed. Hellmut Ritter (Glückstadt: Druck J.J. Augustin, 1927), 26; German translation: Pseudo-Majrīṭī, “*Picatrix*”: *das Ziel des Weisen von Pseudo-Majrīṭī*, tr. Hellmut Ritter and Martin Plessner (London: The Warburg Institute, University of London, 1962), 24.

Niẓām al-Dīn ‘Abd al-‘Alī Bīrjandī’s (d. 934/1527–8) *Bīst bāb dar ma’rifat-i taqvīm*. Bīrjandī’s treatise was extremely popular in the Persianate world and its commentary by Muẓaffar b. Muḥammad Qāsim Junābādī was dedicated to emperor Šāh ‘Abbās I (r. 1588–1629).

The *bust* hours: Indian sages (*ḥukamā-yi hind*) have set a circle which is divided into seven parts. They have attributed each part to one planet and named it the *bust* of this planet. The duration of each part is twelve seasonal hours (*sā’at-i zamānī*). Thus the duration of the whole circle is eighty-four seasonal hours. The circle starts from the time of the true new Moon (*ijtimā’-i ḥaqīqī*) and the first twelve seasonal hours are connected to the Sun. After that, the next twelve hours are related to Venus, and so on according to the order of the spheres [i.e., Mercury, Moon, Saturn, Jupiter, Mars] [...] Every time the period returns to the Sun, it is called absolute (*muṭlaq*) *bust* by Indian sages. *Bust* is to be taken in the sense of passage (*sayr*) as given in [the dictionaries] *Al-Qāmūs* and [*Lisān al-’a’rāb*]. They consider these [*bust* hours] as combust hours (*sā’at-i muḥtaraqa*). These [hours] are abhorred in elections (*iḥtiyārāt*).¹⁰⁴

Bīrjandī goes on to quote an excerpt from Faḥr al-Dīn Rāzī’s *Iḥtiyārāt-i ‘alā’īya* and gives instructions on how to construct tables containing the *bust* hours. The *Iḥtiyārāt-i ‘alā’īya* indeed contains a chapter on *bust* hours, where Rāzī lists the actions recommended for every planet, the hours of the Sun being the most inauspicious. However, Faḥr al-Dīn Rāzī does not mention the Indian origin of the *bust* hours.¹⁰⁵ By the sixteenth century, *bust* hours had become a classic feature in Persian astrology and a part of the supplementary materials that could be added to an almanac. An example is given by an Indian almanac dating from 968/1560–1 kept at the Rampur Reza Library, which contains the *bust* hours amongst several other prognostication systems attributed to India and China.¹⁰⁶ Mullā Ṭayyib’s *Risāla dar ḥall-i taqvīm* summarizes this chapter from Bīrjandī’s *Bīst bāb dar ma’rifat-i taqvīm* but gives it a peculiar twist.¹⁰⁷ According to him, the *bust* hours “are called *bhadra* by Brahmanas” (*sā’at-i*

104 Niẓām al-Dīn ‘Abd al-‘Alī Bīrjandī, *Bīst bāb dar ma’rifat-i taqvīm*, MS Tehran, Majlis Library, 112, foll. 67v–68v: *bāb 12: dar ma’rifat-i manāzil-i qamar u sā’āt-i bust*.

105 Faḥr al-Dīn Rāzī, *Iḥtiyārāt-i ‘alā’īya*, MS Istanbul, Süleymaniye Kütüphanesi, Ayasofya 2689, foll. 33v–34v; on the context of this work, see Frank Griffel, *The Formation of Post-Classical Philosophy in Islam* (New York: Oxford University Press, 2021), 297.

106 Anonymous, *Almanac (968/1527–8)*, MS Rampur, Rampur Reza Library, 1216, fol. 7v.

107 Mullā Ṭayyib, *Risāla dar ḥall-i taqvīm*, MS Rampur, Rampur Reza Library, 1217: *aṣl 15: dar bayān-i sā’āt-i bust*.

bust ki ān rā brahmanān bhadrā gūyand). He also adds that this practice comes from India and Iran (*vilāyat*), whereas Bīrjandī was only referring to it as an Indian practice.

‘Abd al-‘Azīz Šams Tahānīsārī’s fourteenth-century Persian translation of Varāhamihira’s *Bṛhatsaṃhitā* contains a few lines on *bhadrā/viṣṭi*. Chapter 92 on “*Karan gun*, that is on the prognostications associated with the *karans*” (Persian *dar bayān-i karan gun ya’ni bayān-i aḥkām-i karan*) translates chapter 100 on the “Qualities of the *karaṇas*” (Sanskrit *karaṇagunādhyāya*) dealing with auspicious and inauspicious *karaṇas* in the lunar month. The Persian translation is more detailed than the Sanskrit root text (*mūla*) and lists “*bhadrā*” (written بهدرا) amongst the seven movable *karan* (Sanskrit *karaṇa*) (fol. 293v) before giving the detailed list of *karaṇas* in their order of succession in the lunar month. Tahānīsārī goes on to describe the property of each *karaṇa* and writes: “In *bhadrā*, that is *viṣṭi karaṇa* (Persian *bišt karan*),¹⁰⁸ good actions should not be undertaken; actions such as killing enemies, giving poison, burning someone’s house, and waging war are suitable.”¹⁰⁹ Sastri’s translation of the original Sanskrit writes: “Nothing done in Vishti leads to beneficial results, but attacking enemies, administering poison and other such things do succeed.”¹¹⁰

Mullā Ṭayyib’s *Muntaḥab-i ratan mālā*, also contains a discussion on the auspicious and inauspicious times of the lunar month. It describes the fundamentals of the *muhūrtaśāstra* system based on a “commentary” (*ṣarḥ*) on the *Ratnamālā*. His chapter on “the actions that are elected on days associated with one of the seven planets” explains on which *horās* (Persian *hūrā*) associated with a planet one should perform certain actions.¹¹¹ Mullā Ṭayyib lists the different *muhūrtas* (“moments”) according to the *pañcāṅga*. The following chapter lists a range of actions and the conditions (*mašrūṭāt*) recommended for their performance according to the “five limbs.”¹¹² In these chapters, *bhadra karaṇas* are duly mentioned by Mullā Ṭayyib among the *muhūrtas*.

The *Sirāj al-istiḥrāj*, Mullā Farīd’s popular introduction to astronomy, contains yet another definition of *bust*. This time, Mullā Farīd clearly compares the *bust* hours with *bhadra*, an Indian astrological concept designating certain

108 The manuscript reads *بششت* but it is most certainly a scribal mistake for *بشت*.

109 ‘Abd al-‘Azīz Šams Tahānīsārī, *Tarjuma-yi Kitāb-i Bārāhī*, Ms London, British Library, 10 Islamic 1262, fol. 295v: *dar bhadrā ya’ni bišt karan kārḥā-yi nikū našāyad kardan u kuṣṭan-i dušmanān u zahr dādan u ātiš zadan az ḥāna-yi kasī u ḥarb kardan u mānand-i ān šāyad*.

110 Varāhamihira, *Brihat Samhita*, ed. and transl. V. Subrahmanya Sastri and M. Ramakrishna Bhat (Bangalore: Soobbiah and sons, 1946), 749: *na hi viṣṭikṛtaṃ vidadhāti śubhaṃ parighātivīṣādiṣu siddhikaram*.

111 Mullā Ṭayyib, *Muntaḥab-i ratan mālā*, Ms Rampur, Rampur Reza Library, no. 1649, pp. 6–8.

112 Mullā Ṭayyib, *Muntaḥab-i ratan mālā*, pp. 8–36.

inauspicious hours during the month. Mullā Farīd was clearly familiar with Indian astrology and could either read almanacs himself or obtain information from *jyotiṣas*.

On *bust hours*: The *bust* hours are called in their language *bhadra* [Sanskrit *bhadra* “auspicious”]. They are counted in *tithis*, so that *bhadra* happens after three and a half *tithis*, starting from the new Moon (*ijtimā*), which is the beginning of their month. However, they don’t write down the *bust* at the beginning and the end of the month, since they hold these two times to be inauspicious (*naḥs*) and there is no need to write them down. During these times, they consider necessary abstaining from electing (*iḥtiyār*) [the time] for a good action (*ḥasana*). In the moments which they write down as *bhadra* in their almanacs (*taqvīm*) [...]. They extend their inauspiciousness to the thirty *gharīs* [Sanskrit *ghaṭī* “one sixtieth of a sidereal day”] which are counted after.¹¹³

Strangely enough, the chapter on *bust* in the *Zīj-i Raḥīmī* is much shorter and does not contain this comparison with *bhadra* hours.¹¹⁴ On the other hand, the *Zīj-i Šāh Jahānī* contains a summarized version of the description in the *Sirāj al-istiḥrāj*, but adds a few details. The inclusion of this chapter on *bust* and *bhadra* in the *Zīj-i Šāh Jahānī* is particularly striking since it occurs in a section discussing mathematical astronomy. Otherwise, the *Zīj-i Šāh Jahānī* does not contain any exposé on Indian astronomical and astrological theory. Mullā Farīd probably obtained his information on *bhadra* and Indian almanacs from Indian astrologers, which shows the intimacy that Mullā Farīd had with Indian astrological practice. Since the *Zīj-i Šāh Jahānī* was an official commission, it also indicates that Indian astrology was deemed by Mullā Farīd worthy of the interest of his patron Āṣaf Ḥān and his addressee Šāh Jahān. Even if Šāh Jahān’s interest in Indian astrology does not seem recorded in sources, Mullā Farīd’s chapter on *bhadra* is another indication that Indian astrology was still being practiced at court, as in his predecessors’ time.

Bhadra is similar to *bust*, except that they count its circle in *tithis*, so that three and a half *tithis* after the new Moon, it will be again *bhadra*. They

113 Mullā Farīd, *Sirāj al-istiḥrāj*, Mullā Farīd. *Sirāj al-istiḥrāj*. MS London, British Library, 10 Islamic 476, foll. 126rv; Mullā Farīd. *Sirāj al-istiḥrāj*, MS Tashkent, Academy of Sciences of Uzbekistan, 6413, fol. 22v. The original text seems better preserved in the Tashkent manuscript, but remains difficult to read.

114 Mullā Farīd, *Zīj-i Raḥīmī*, MS Mashhad, Mar‘ašī Najafī library, 5554, fol. 116r: *dar bayān-i sā‘āt-i bust*.

do not write *bhadra* for the beginning and end of the month. Since these two times are inauspicious (*naḥs*) because of their being directly under the beams (*taḥt al-ṣu'ā*), the mention “*bhadra*” won't be needed.¹¹⁵

In Nityānanda's Sanskrit translation, this chapter is entitled “On the calculation of the *horā* of *busta* and *bhadrā*” (*bustabhadrayor horānayanam*). Mullā Farīd's insight into the proximity between *bust* and *bhadrā* is thus confirmed by Nityānanda, who in his translation frustratingly omits this short paragraph and instead writes “the knowledge of *bhadrā* is quite well-known” (*atha bhadrājñānam tu prasiddham eva*). The practically minded Nityānanda was evidently not satisfied with Mullā Farīd's account and added calculation on the correspondence between this 84-hour cycle and the Islamic lunar month: since a complete month contains a bit more than eight full cycles, Nityānanda specifies that “it is not pure and has a remainder of one and a half day.”¹¹⁶

A survey of the works of Mullā Farīd and Mullā Ṭayyib allows a nuanced if sketchy reconstruction of their long and fruitful intellectual career. Among the two brothers, Mullā Farīd was most able to combine brilliant scholarly credentials with the talents of a seasoned courtier, crafting witty chronograms and supplying horoscopes to princes and kings from Deccan to Delhi. Besides these renowned figures, many now forgotten astronomers were plying their trade across princely courts. Up-to-date practical astronomical tools would have been in high demand across the land, as they allowed administrators and religious scholars to handle the necessary calendrical computations, and astrologers to quickly cast accurate horoscopes. But astronomy was not only about converting dates or making predictions, it was also about contributing to the symbolic apparatus bolstering Šāh Jahān's claims to imperial dominion. The central place of astral sciences in North Indian courtly environments encouraged a culture shared by Hindu and Muslim astrologers across Indic and Islamicate traditions. This intellectual exchange is documented by Mullā Farīd's and Mullā Ṭayyib's engagement with Indic astrological texts and practices. Scientific translations and multilingualism were also a larger phenomenon in North Indian courts. When commissioned to translate the *Zīj-i Šāh Jahānī* in his *Siddhāntasindhu*, Nityānanda, from the 1630s onwards,

115 Mullā Farīd, *Zīj-i Šāh Jahānī*, MS Oxford, Bodleian Library, Ind. Inst. Pers. 12, foll. 82rv: *dar bayān-i sāt-i bust u bhadra*.

116 Nityānanda, *Siddhāntasindhu*, MS Jaipur, Maharaja Sawai Man Singh II Museum Library, Khasmohor Collection, 4962, fol. 103v: *evam aṣṭacakra-parivartaiḥ saṃpūrṇo māso naśuddhyati kiṃtu māsānte sārhadīnam avaśiṣyate*.

started to introduce Islamic astronomy to a Sanskrit audience.¹¹⁷ He later reworked the material from his translation in his *Sarvasiddhāntarāja* to present it in a more classical form that would be acceptable to Sanskrit pandits.¹¹⁸ Despite being grounded in two different astronomical traditions, both Mullā Farīd's and Nityānanda's works would be reunited a century later during the last efflorescence of mathematical astronomy in Sanskrit and Persian at the court of the Maharaja of Jaipur Savāi Jaisingh (1688–1743).

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- 117 On the earlier adaptation of Persian astronomy in the Sanskrit *tājika* tradition, see David Pingree, "Tājika: Persian Astrology in Sanskrit," in *From Astral Omens to Astrology: From Babylon to Bikāner* (Rome: Istituto Italiano per l'Africa e l'Oriente, 1997), 79–90.
- 118 Nityānanda's production has been studied extensively by Anuj Misra. See for example *Learning with Spheres: The Golādhyāya in Nityānanda's Sarvasiddhāntarāja* (Abingdon: Routledge, 2023).

References

- ‘Abd al-Raḥīm Ḥān-i Ḥānān. *Star-lore; Being an Account of the Disposition of the Planets of the 12 Houses of the Horoscopes*. Ed. and transl. by S.D. Udhrain. Delhi: Sagar Publications, 1973.
- Abū l-Faẓl. *Ā’in-i Akbarī*. Ed. by H. Blochmann. 2 vol. Calcutta: Baptist Mission Press, 1872–7.
- Abū l-Faẓl. *Āin-i akbari of Abul Fazl-i-Allami, Second Edition*. Transl. by H.S. Jarrett, and rev. by Jadunath Sarkar. Vol. 2–3. Calcutta: Asiatic Society of Bengal, 1948–1949.
- Abū l-Faẓl. *Akbarnāma*. Ed. by Mawlavī ‘Abd al-Raḥīm. 3 vol. Calcutta: The Urduo guide, 1877–86.
- Abū l-Faẓl. *The Akbarnāma, vol. 3*. Transl. by H. Beveridge. Calcutta: Asiatic Society of Bengal, 1939.
- ‘Abd al-Raḥīm b. Šāliḥ Muḥammad. *Šarḥ-i Zīj-i Uluġ Bigī*. ms Lucknow, Jamia Sultaniya Library, ms no. unknown [microfilm available at Noor Microfilm Center, Delhi no. 171/5/3].
- Aḥmad, Sālim ‘Abd al-Razzāq. *Fihris maḥṭūṭāt maktab al-awqāf al-‘amma fi l-mawṣil*, vol. 6. Mosul: Maṭābi‘ jāmi‘at al-mawṣil, 1983.
- Alam, Muzaffar. *The Mughals and the Sufis: Islam and Political Imagination in India, 1500–1750*. Albany: State University of New York Press, 2021.
- al-Bīrūnī, Abū Rayḥān Muḥammad b. Aḥmad. *Alberuni’s India: An Account of the Religion, Philosophy, Literature, Geography, Chronology, Astronomy, Customs, Laws and Astrology of India about A.D. 1030*. Ed and transl. by Edward Sachau. 2 vol. London: K. Paul, Trench, Trübner & Co., 1910.
- al-Bustānī, Buṭrus. *Dā’irat al-ma‘ārif*, vol. 9. Beirut: Maṭba‘a al-adabiyya, 1887.
- al-Ḥasanī, ‘Abd al-Ḥayy b. Faḥr al-Dīn. *Al-I‘lām bi-man fi tāriḥ al-hind min al-a‘lām al-musammā bi-Nuzhat al-ḥawāṭir wa-bahjat al-masāmi‘ wa-l-nawāzīr*. 8 vol., Beirut: Dār Ibn Ḥazm 1999.
- al-Kindī. *Mudḥal ilā ‘ilm al-nujūm wa huwa al-kitāb al-musammā al-Arba‘ūn bāban*. ms Jerusalem, Khalidi Library, 996. [<https://www.vhmm.org/readingRoom/view/510196>].
- al-Kindī. *The Forty Chapters of al-Kindī: Traditional Horary and Electional Astrology*. Transl. and ed. by Benjamin N. Dykes. Minneapolis: The Cazimi Press, 2011.
- Al-Qabīṣī (Alcabitius). *The Introduction to Astrology*. Ed. of the Arabic and Latin text and English translation by Charles Burnett, Keiji Yamamoto, and Michio Yano. London-Turin: The Warburg Institute-Nino Aragno Editore, 2004.
- Anonymous. *A Descriptive Catalogue of Sanskrit Manuscripts, Acquired and Deposited in the Sanskrit University Library (Sarasvati Bhavana), volume IX: jyautiṣa MSS.*, Benares: Dept. of Publications, Sanskrit University, 1963.

- Anonymous. *Almanac* (968/1527–8). MS Rampur, Rampur Reza Library, 1216.
- Anonymous. *Fihrist-i nushahā-yi ḥaṭṭī-yi kitābhāna-yi riẓā—rāmpūr: jild-i avval*. Rampur: Rampur Reza Library, 1996.
- Anooshahr, Ali. “Šīrāzī Scholars and the Political Culture of the Sixteenth-Century Indo-Persian World.” *The Indian Economic and Social History Review* 51, no. 3 (2014): 331–52.
- Anooshahr, Ali. “Science at the Court of the Cosmocrat: Mughal India, 1531–56.” *The Indian Economic and Social History Review* 54, no. 3 (2017): 295–316.
- Ansari, S.M. Razaullah. “On the Transmission of Arabic-Islamic Astronomy to Medieval India.” *Archives Internationales d’Histoire des Sciences* 45, no. 135 (1995): 273–97.
- Ansari, S.M. Razaullah. “Reception of Indian Astronomical Treatises and Handbooks in Sanskrit by Muslim Scholars of Medieval India.” In *Science in India*. Ed. by J.V. Narlikar. Project of the History of Science, Philosophy and Culture, vol. 13, part 8. New Delhi: Viva Books, 2009, 251–74.
- Ansari, S.M. Razaullah. “Survey of Zījēs Written in the Subcontinent.” *Indian Journal of History of Science* 50, no. 4 (2015): 575–601.
- Ansari, S.M. Razaullah. “Persian Translations of Bhāskara’s Sanskrit Texts and Their Impact in the Following Centuries.” In *Bhāskara-prabhā: Sources and Studies in the History of Mathematics and Physical Sciences*. Ed. by K. Ramasubramanian, T. Hayashi, and C. Montelle. Singapore: Springer, 2019, 377–91.
- Arzoumanov, Jean, and Misra, Anuj. “Calendars, Compliments, and Computations: A Comparative Survey of the Canon in the Persian *Zīj of Šāh Jahān* and in its Sanskrit Translation, the *Siddhāntasindhu*. *History of Science in South Asia* (forthcoming).
- Aṣṣar, Āftāb. “Zīj-i Muẓaffar Šāhī.” *Majalla-yi taḥqīq-yi kullīya-yi ‘ulūm-i islāmīya u adabīyat-i šarqīya, Panjāb yūnīversitī, Lāhōr* 3, no. 1 (1980): 113–52.
- Badā’ūnī, ‘Abd al-Qādir. *Muntakhabu-’t-tawārīkh*. Transl. by W. Haig. Vol. 3. Calcutta: Asiatic Society of Bengal, 1925.
- Beeston, Alfred Felix Landon. *Catalogue of the Persian, Turkish, Hindustani, and Pushtu Manuscripts in the Bodleian Library, Part III: Additional Persian Manuscripts*. Oxford: Clarendon Press, 1954.
- Bīrjandī, Niẓām al-Dīn ‘Abd al-‘Alī. *Bīst bāb dar ma’rifat-i taqīm*. MS Tehran, Majlis Library, 112.
- Bos, Gerrit, and Burnett, Charles. *Scientific Weather Forecasting in the Middle Ages: The Writings of al-Kindī*, Abingdon: Routledge, 2000.
- Browne, Edward Granville. *A Supplementary Handlist of the Muhammadan Manuscripts, Including All Those Written in the Arabic Character, Preserved in the Libraries of the University and Colleges of Cambridge*. Cambridge: Cambridge University Press, 1922.
- Chauduri, Jatindrabimal. *Muslim Patronage of Sanskrit Learning: Part 1*. Calcutta: Prācyavāṇi, 1954.

- Diamond, Debra, ed., *Yoga: The Art of Transformation*. Washington, DC: Arthur M. Sackler Gallery, Smithsonian Institution, 2013.
- Ethé, Hermann. *Catalogue of Persian Manuscripts in the Library of the India Office*. 2 vol. Oxford: Printed for the India Office by H. Hart, 1903–37.
- Faḥr al-Dīn Rāzī. *Iḥtīyārāt-i alāʾiyya*. Ms Istanbul, Süleymaniye Kütüphanesi, Ayasofya 2689.
- Flatt, Emma. *The Courts of the Deccan Sultanates: Living Well in the Persian Cosmopolis*. Cambridge: Cambridge University Press, 2019.
- Franke, Heike. “Die persischen Übersetzungen des *Laghuyogavāsiṣṭha*.” In *The Mokṣopāya, Yogavāsiṣṭha and Related Texts*. Ed. by Jürgen Hanneder. Aachen: Shaker Verlag, 2005, 113–53.
- Gandhi, Supriya. *The emperor Who Never Was : Dara Shukoh in Mughal India*. Cambridge, Mass., London: The Belknap Press of Harvard University Press, 2020.
- Gawrī Śankar Kawl. *Yāddāsthāi dar ‘ilm-i hay’at*. Ms Lahore, Punjab University Library, Ms Aph III 8.
- Ghori, S.A. Khan. “Development of Zij Literature in India.” *Indian Journal of the History of Science*, 20 (1985): 21–48.
- Greaves, John. *Astronomica quaedam ex traditione Shah Cholgii persae: una cum hypothesibus planetarum*. London: J. Flesher, 1652.
- Griffel, Frank. *The Formation of Post-Classical Philosophy in Islam*. New York: Oxford University Press, 2021.
- Ḥaljī, Maḥmūd Šāh. *Zij-i jāmi‘*, Ms Oxford, Bodleian Library, Greaves 6.
- Hamadānī, Muḥammad Kašmīrī. *Ṭabaqāt-i Šāh Jahānī: ṭabaqa-yi avval*. Ed. by Muḥammad Aslam Ḥān. Delhi: Baḥš-i fārsī, dānišgāh-i dihlī, 1990.
- Ḥusaynī, Ḥwāja Kāmgar. *Ma‘āṭir-i Jahāngīrī*. Ed. by ‘Adrā ‘Alavī, Aligarh: Asia Publishing House, 1978.
- Ilāhdiya Čištī. *Sīyar al-aqtāb*. Lucknow: Naval Kishore, 1881.
- ‘Ināyat Ḥān, Mīrzā Muḥammad Ṭāhir Ḥān Ašnā. *Mulaḥḥaṣ-i Šāh Jahān-nāma*. Ed. Jamīl al-Raḥmān, New Delhi: Markaz-i taḥqīqāt-i fārsī, rāyzanī-yi farhangī-yi sifarat-i jumhūrī-yi islāmī-yi īrān, 2009.
- Kṛṣṇa Daivajña. *The Jataka-padhaty-udaharana*, ed. Jatindra Bimal Chaudhuri, Calcutta: J.B. Chaudhuri, 1955.
- Lāhōrī, ‘Abd al-Ḥamīd. *Bādšāh-nāma*. Ed. by Kabīr al-Dīn Aḥmad and ‘Abd al-Raḥīm. 3 vol. Calcutta: Asiatic Society of Bengal, 1867–8.
- Lefèvre, Corinne. “Aṣaf Khān.” In *Encyclopaedia of Islam, THREE*. Edited by Kate Fleet, Gudrun Krämer, Denis Matringe, John Nawas, Everett Rowson. Leiden: Brill. First published online: 2008. <http://dx.doi.org/10.1163/1573-3912_ei3_COM_26356> Accessed 27 September 2022.
- Lefèvre, Corinne. “The Court of ‘Abd-ur-Raḥīm Khān-i Khānān as a Bridge Between Iranian and Indian Cultural Traditions.” In *Culture and Circulation: Literature in*

- Motion in Early Modern India*. Ed. by Thomas de Bruijn and Allison Busch. Leiden: Brill, 2014, 75–106.
- Mar‘ašī, Sayyid Maḥmūd, Šāliḥī, Muḥammad ‘Alī, and Muttaqī, Ḥusayn, eds. *Fihrist-i nuṣṣahā-yi ḥaṭṭī-yi kitāb ḥāna-yi buzurḡ-i ḥaẓrat-i āyat allāh al-‘uzmā mar‘ašī najafī, ganjīna-yi jahānī-yi maḥṭūṭāt-i islāmī-yi īrān, qum*. Vol. 35. Qom: Kitāb ḥāna-yi ‘umūmī-yi āyat allāh mar‘ašī najafī, 2011–12.
- Marshall, D.N. *Mughals in India: A Bibliographical Survey, Vol. 1—Manuscripts*, Bombay: Asia Publishing House, 1967.
- Marshall, D.N. *Mughals in India: A Bibliographical Survey, Vol. 1—Manuscripts, Supplementary Part*, New Delhi: Munshiram Manoharlal, Indian Council of Historical Research, 1996.
- Melvin-Koushki, Matthew. “Being with a Capital B: Ibn Turka on Ibn ‘Arabī’s Lettrist Cosmogony.” In *Islamic Thought and the Art of Translation: Texts and Studies in Honor of William C. Chittick and Sachiko Murata*. Ed. by Mohammed Rustom, Leiden: Brill, 2022, 150–77.
- Minkowski, Christopher. “Learned Brahmins and the Mughal Court: The Jyotiṣas.” In *Religious Interactions in Mughal India*. Ed. by Vasudha Dalmia and Munis D. Faruqui. New Delhi: Oxford University Press, 2014, 102–34.
- Mirzā Ḥayr Allāh. *Zij-i Muḥammad Šāhī*. MS Tehran, Majlis Library, 428.
- Misra, Anuj. “Persian Astronomy in Sanskrit: A Comparative Study of Mullā Farīd’s *Zij-i Šāh Jahānī* and its Sanskrit Translation in Nityānanda’s *Siddhāntasindhu*.” *History of Science in South Asia* 9 (2021): 30–127.
- Misra, Anuj. *Learning with Spheres: The Golādhyāya in Nityānanda’s Sarvasiddhāntarāja*. Abingdon: Routledge, 2023.
- Mīvātī, Ḥabīb al-Raḥmān Ḥān. *Tadkīra-yi šūfīyān-i mīvāt*. Mewat: Mewat Academy, 1985.
- Miyān Šāhib, Muḥammad. *Pānīpat ōr buzurḡān-i pānīpat*. Lahore: Jam‘īya Publishings, 2000.
- Moin, A. Azfar. *The Millennial Sovereign: Sacred Kingship and Sainthood in Islam*. New York: Columbia University Press, 2011.
- Muḥammad b. Rustam b. Qubād. *Tārīḥ-i Muḥammadī*. MS London, British Library, Or. 1824.
- Muḥammad Šāliḥ Kanbōh. *Amal-i Šāliḥ al-mawsūm ba Šahjahān-nāma*. Ed. Ġulām Yazdānī. 2 vol. Calcutta: Asiatic Society of Bengal, 1923–7.
- Mullā Farīd. *Sirāj al-istiḥrāj*. MS London, British Library, 10 Islamic 476, foll. 118r–149r.
- Mullā Farīd. *Sirāj al-istiḥrāj*. MS Tashkent, Academy of Sciences of Uzbekistan, 6413, foll. 16v–40v.
- Mullā Farīd. *Zij-i Raḥīmī*. MS Mashhad, Mar‘ašī Najafī library, 5554.
- Mullā Farīd. *Zij-i Šāh Jahānī*. MS Oxford, Bodleian Library, Ind. Inst. Pers. 12.
- Mullā Ṭayyib. *Muntaḥab-i ratan mālā*. MS Rampur, Rampur Reza Library, 1649.

- Mullā Ṭayyib. *Risāla dar ḥall-i taqvīm*. MS Rampur, Rampur Reza Library, 1217.
- Nahāvandī, ‘Abd al-Bāqī. *Ma‘ātir-i Raḥīmī*. Ed. by Hidāyat Ḥusayn. 3 vol. Calcutta: Asiatic Society of Bengal, 1910–31.
- Nadvī, Sulaymān. “Lāhōr kā ěk muhandis ḥāndān jis ne tāj ōr lāl qil‘a banāyā.” *Rū‘idād-i idāra-yi ma‘ārif-i islāmīya: ajlās-i avval mun‘aqida-yi lāhōr 15–16 april 1933*. Lahore: Majlis-i ‘āmila-yi idāra-yi ma‘ārif-i islāmīya, 1933, 1–50.
- Nair, Shankar. *Translating Wisdom: Hindu-Muslim Intellectual Interactions in Early Modern South Asia*. Oakland: University of California Press, 2020.
- Nawšāhī, ‘Ārif. *Fihrist-i nuṣṣahā-yi ḥaṭṭī-yi fārsī-yi kitābhāna-yi markazī-yi dānišgāh-i panjāb, lāhūr (pākistān) (majmū‘ahā-yi āzād, pīrzāda, šīrānī, kayfī va ‘umūmī)*. Tehran: Markaz-i piṣṭūhišī-yi mīrāt-i maktūb, 1390/2011–2.
- Ninomiya, Ayako [二宮文子], Mashita, Hiroyuki [真下裕之], and Wada, Ikuko [和田郁子]. “アブル・ファズル著『アーイーニ・アクバリ』訳注(9)” [Translation of Abū l-Faḏl’s *Ā‘īn-i akbarī*]. 神戸大学文学部紀要 [Bulletin of the Faculty of Letters, Kobe University] 48 (2021): 107–45.
- Nityānanda. *Siddhāntasindhu*. MS Jaipur, Maharaja Sawai Man Singh II Museum Library, Khasmohor Collection, 4962.
- Niṣām al-Dīn Aḥmad. *The Ṭabaqāt-i Akbarī*. Vol. 2. Transl. by B. De. Calcutta: Asiatic Society, 1936.
- Orthmann, Eva. “Circular Motions: Private Pleasures and Public Prognostication in the Nativities of the Mughal Emperor Akbar.” In *Horoscopes and Public Spheres: Essays on the History of Astrology*. Ed. by Günther Oestmann, H. Darrel Rutkin, and Kocku von Stuckrad. Berlin: Walter de Gruyter, 2005, 101–14.
- Orthmann, Eva. “Ideology and State-Building: Humāyūn’s Search for Legitimacy in a Hindu-Muslim Environment.” In *Religious interactions in Mughal India*. Ed. by Vasudha Dalmia and Munis D. Faruqui. New Delhi: Oxford University Press, 2014, 3–29.
- Orthmann, Eva, “Tarjuma-yi Kitāb-i Bārāhī (Occult Sciences).” In *Perso-Indica: An Analytical Survey of Persian Works on Indian Learned Traditions*. Ed. by F. Speziale and Carl W. Ernst. 2017. <http://www.perso-indica.net/work/tarjuma-yi_kitab-i_barahi-1> Accessed February 13, 2023.
- Orthmann, Eva. “The Occult Sciences at the Mughal Court During the Sixteenth Century.” In *The Empires of the Near East and India: Source Studies of the Safavid, Ottoman, and Mughal Literate Communities*. Ed. by Hani Khafipour. New York, Columbia University Press, 2019, 384–400.
- Pertsch, Wilhelm. *Verzeichniss der persischen Handschriften der königlichen Bibliothek zu Berlin*. Berlin: A. Asher and Co., 1888.
- Pingree, David. *Census of the Exact Sciences in Sanskrit: Series 1, Volume 2*. Philadelphia: American Philosophical Society, 1971.

- Pingree, David. "The Indian and Pseudo-Indian Passages in Greek and Latin Astronomical and Astrological Texts." *Viator* 7 (1976): 141–96.
- Pingree, David. *Jyotiḥśāstra: Astronomical and Mathematical Literature*. Wiesbaden: Otto Harrassowitz, 1981.
- Pingree, David. "Tājika: Persian Astrology in Sanskrit," in *From Astral Omens to Astrology: From Babylon to Bīkāner*. Rome: Istituto Italiano per l'Africa e l'Oriente, 1997, 79–90.
- Pingree, David. "Ektīārāt." In *Encyclopaedia Iranica* 8, no. 3. Ed. by Ehsan Yarshater. London: Routledge and Kegan Paul, 1998, 445–48.
- Pingree, David. *A Descriptive Catalogue of the Sanskrit Astronomical Manuscripts Preserved at the Maharaja Man Singh II Museum in Jaipur, India*. Philadelphia: American Philosophical Society, 2003.
- Pollock, Sheldon. "Sanskrit Literary Culture from the Inside Out." In *Literary Cultures in History: Reconstructions from South Asia*. Ed. by Sheldon Pollock, Berkeley: University of California Press, 2003, 39–130.
- Popp, Stephan. "Mughal Horoscopes as Propaganda." *Journal of Persianate Studies* 9 (2016): 45–59.
- Poucha, Pavel. "La Jyotiṣaratnamālā ou Guirlande des bijoux d'astrologie de Śrīpatibhaṭṭa." *Archiv orientální* 16 (1946): 277–309.
- Pseudo-Majrīṭī. "Picatrix": *das Ziel des Weisen von Pseudo-Mağrīṭī*. Transl. into German by Hellmut Ritter and Martin Plessner. London: The Warburg Institute, University of London, 1962.
- Pseudo-Majrīṭī. *Ġāyat al-ḥakīm*. Ed. by Hellmut Ritter. Glückstadt: Druck J.J. Augustin, 1927.
- Qāsimlū, Farīd, and Tābit, Farībā Pāyраванд, eds. *Fihristvāra-yi muštarak-i nuṣṣahā-yi ḥaṭṭī-yi ri-yāzī dar kitābhānahā-yi īrān*. Tehran: Dāniṣgāh-i āzād-i islāmī, 1387/2008–2009.
- Rama. *Daivagye Acharya Shriram's Muhurta Chinta Mani*. Transl., commentary and annotation by Girish Chand Sharma. New Delhi: Sagar Publications, 1996.
- Rāmpūrī, Ġiyāt al-Dīn. *Ġiyāt al-luġāt*. Ed. by Muḥammad Dabir Siyāqī. Tehran: Kānūn-i ma'rīfat, 1337/1958–9.
- Richard, Francis. *Catalogue des manuscrits persans, Bibliothèque nationale de France, Département des manuscrits. Tome II: Supplément persan. Première partie, 1–524; Deuxième partie, 525–1000*. Rome: Istituto per l'Oriente C.A. Nallino, 2013.
- Rieu, Charles. *Catalogue of the Persian Manuscripts in the British Museum*. 3 vol. London: British Museum, 1879–83.
- Rosenfeld, Boris Abramovich and Ekmeleddin, İhsanoğlu. *Mathematicians, Astronomers, and Other Scholars of Islamic Civilization and Their Works (7th–19th c.)*. Istanbul: Research Center for Islamic History, Arts and Culture, 2003.

- Sachau, Eduard, and Ethé, Hermann. *Catalogue of the Persian, Turkish, Hindūstānī, and Pushtū Manuscripts in the Bodleian Library*. 2 vol. Oxford: Clarendon Press, 1889–1930.
- Šāhnavāz Ḥān. *Ma'āṭir al-umarā*. Ed. by 'Abd al-Raḥīm and Mīrzā Ašraf 'Alī. 3 vol. Calcutta: Asiatic Society of Bengal, 1888–91.
- Šāhnavāz Ḥān. *Ma'āṭir al-umarā*. Transl. by H. Beveridge and rev. by Baini Prashad. 2 vol. Calcutta: Asiatic Society of Bengal, 1941–52.
- Salemann, Carl, and Rosen, Victor. *Indices alphabetici codicum manu scriptorum persicorum, turcicorum, arabicorum qui in Bibliotheca imperialis literarum Universitatis petropolitanae adservantur*. St Petersburg: Imperial Academy of Sciences, 1888.
- Sarma, Sreeramula Rajeswara. "Jyotiṣarāja at the Mughal court." In *Studies on Indian Culture, Science, and Literature: Being Prof. K.V. Sarma Felicitation Volume Presented to Him on His 81st Birthday*. Ed. by Natesa Gangadharan, Krishna V. Sarma, S.A.S. Sarma, and S.S.R. Sarma. Chennai: Sree Sarada Education Society Research Centre, 2000, 363–71.
- Sarma, Sreeramula Rajeswara. "A Monumental Astrolabe Made for Shāh Jahān and Later Reworked with Sanskrit Legends." *Medieval Encounters* 23 (2017): 198–262.
- Sarma, Sreeramula Rajeswara, and Zamani, Maryam. "On the Persian Translation of Bhāskara's *Līlāvati* by Abu'l Faiẓ Faiẓī at the Court of Akbar." *The Indian Journal of History of Science* 43, no. 3 (2019): 269–85.
- Šaṭṭārī, Muḥammad Ġawṭī. *Gulzār-i abrār*. Ed. Muḥammad Ḍakī. Patna: Khuda Bakhsh Oriental Library, 1994.
- Semenov, A.A., ed. *Sobranie vostochnykh rukopisei Akademii Nauk Uzbekskoi SSR*. 11 vols. Tashkent: Akademiia Nauk, 1952–87.
- Seyller, John. "The Inspection and Valuation of Manuscripts in the Imperial Mughal Library." *Artibus Asiae* 57, no. 3–4 (1997): 243–349.
- Śrīpatibhaṭṭa. *Jyotiṣaratnamālā*. Ed. by Vihārīlāśarma. Jammu: Śrīraṇavīrakendriya-saṃskṛta-vidyāpīṭham, 1978.
- Storey, Charles Ambrose. *Persian Literature: A Bio-Bibliographical Survey. Vol. II. Part 1. A. Mathematics, B. Weights and measures, C. Astronomy and Astrology, D. Geography*. London: Luzac, 1958.
- Tahānawī, Muḥammad A'lā. *Kitāb Kaššāf iṣṭilāḥāt al-funūn wa-l-'ulūm*. Ed. by Muḥammad Wajīh, 'Abd al-Ḥaqq, and Ġulām Qādir. 2 vol. Calcutta: Asiatic Society of Bengal, 1862.
- Tahānisarī, 'Abd al-'Azīz Šams. *Tarjuma-yi Kitāb-i Bārāhī*. MS London, British Library, 10 Islamic, 1262.
- Truschke, Audrey. "Regional Perceptions: Writing to the Mughal Court in Sanskrit." In *Cosmopolitismes en Asie du Sud. Sources, itinéraires, langues (XVI^e–XVIII^e siècle)*. Ed. by Corinne Lefèvre, Ines Županov, and Jorge Flores. Paris: Editions de l'EHESS, 2015, 251–74.

- Tunç Şen, A., and Fleischer, Cornell H. "Books on Astrology, Astronomical Tables, and Almanacs in the Library Inventory of Bayezid II." In *Treasures of Knowledge: An Inventory of the Ottoman Palace Library (1502/3–1503/4). Volume 1: Essays*. Ed. by Gülru Necipoğlu, Cemal Kafadar and Cornell H. Fleischer. *Muqarnas Supplements*, Volume 14. Leiden: Brill, 2019, 767–821.
- van Dalen, Benno. "Wābkanawī: Shams al-Munajjim [Shams al-Dīn] Muḥammad ibn 'Alī Khwāja al-Wābkanawī [Wābkanawī]." In *The Biographical Encyclopedia of Astronomers*. Ed. by Thomas Hockey et al. New York: Springer, 2007, 1187–8.
- Varāhamihira. *Brihat Samhita*. Ed. and transl. by V. Subrahmanya Sastri and M. Ramakrishna Bhat. Bangalore: Soobbiah and sons, 1946.
- Wābkanawī, Šams al-Munajjim Muḥammad. *Zij-i muḥaqqaq-i Sulṭānī*. MS Istanbul, Süleymaniye Kütüphanesi, Ayasofya, 2689.
- Wābkanawī, Šams al-Munajjim Muḥammad. *Zij-i muḥaqqaq-i Sulṭānī*. MS Tehran, Majlis Library, 6435.
- Zadeh, Travis. *Wonders and Rarities: The Marvelous Book That Traveled the World and Mapped the Cosmos*. Cambridge, MA: Harvard University Press, 2023.