History of Science in South Asia

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Calendars, Compliments, and Computations
A Comparative Survey of the Canon in the Persian Zīj-i Šāh Jahānī and in its Sanskrit translation, the Siddhāntasindhu

Jean Arzoumanov ⓘD et Anuj Misra ⓘD

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Résumé de l'article

Various studies in recent times have shown how sociohistorical proclivities played an important role in the acceptance or rejection of cross-cultural ideas in Mughal scientific discourses. The cultural patronage of the Mughal courts financed the production and propagation of certain scientific texts deemed intellectually and politically expedient. Among such texts were two seventeenth-century astronomical table-texts, Mullā Farīd's Persian Zīj-i Šāh Jahānī and its Sanskrit translation in Nityānanda's Siddhāntasindhu, both produced at the court of the Mughal Emperor Šāh Jahān.

In this paper, we present, for the very first time, a comparative survey of the canon (text) of these two works to reveal the intimacy between the translated Sanskrit and its Persian original. The paper includes brief biographies of both astronomers, a summary of the salient features of the canons, a description of the manuscripts utilised and our transcription and transliteration schemes, along with a detailed comparison of the individual chapters in these canons. We also provide separate appendices with discussions on select aspects from these chapters. We note that this paper forms the first part in a two-part study, with a second forthcoming paper surveying the tables in these two texts (accompanied with mathematical annotations).

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1 INTRODUCTION

1.1 CULTURES OF ASTRONOMY AT THE MUGHAL COURT

I N RECENT YEARS, many studies have brought to light the complex nature of scientific discourses at the Mughal courts where political and philosophical preferences have variously influenced the admission and admonition of cross-cultural ideas.[1] Modern biographical studies of Mughal royals and elites have also discussed their proclivity for sponsoring scholarship across different disciplines.[2] In the astral sciences, the Islamicate tradition of composing *zīj*es (in Arabic and Persian) continued to enjoy patronage under the Mughal rule (see, e.g., Ghori 1985; Ansari 2015),[3] and contemporaneously, important Sanskrit mathematical works were also translated into Persian under Mughal sponsorship (see, e.g., Ansari 2019: pp. 384–86, that describes the Mughal architect ʿAṭāʾ Allāh Rušdī's Persian translation *Tarjuma-yi Bījganit* (*c.* 1634/35) of Bhāskara II's *Bījagaṇita*, an acclaimed twelfth-century Sanskrit treatise on Algebra). By and large, the support of the mathematical sciences—astronomy being one among the quadrivium of the mathematical sciences along with number theory, geometry and musical theory—came to be institutionalised in the Mughal world as scientific patronage became a means to legitimise the intellectual authority of the Mughal state.[4]

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1 For example, see the studies of Gansten (2020), Misra (2021; 2022*a*), and Plofker (2022) in the astral sciences; of Moin (2012), Amanat (2014), Melvin-Koushki (2019), and Orthmann (2019) in the occult sciences; of Speziale (2018), Parpia (2019), Schlein (2019), and Tiefenauer (2019) in the life sciences; and more generally, of Alam and Subrahmanyam (2011), Haider (2011), Busch (2019), and Nair (2020) on the socio-philosophy of science in early modern Mughal India. For recent studies on the development of the secular sciences in pre-Mughal times, e.g., during the Delhi Sultanate (1206–1526), see Siddiqui (2012), Ray (2019), and Habib (2022).

2 See, inter alia, Anooshahr (2017) (on Humāyūn), Wink (2012) (on Akbar), Balabanlilar (2020) (on Jahāngīr), Calabria (2018) (on Šāh Jahān), Gandhi (2020) (on Dārā Šikūh), Lefèvre (2014) (on ʿAbd al-Raḥīm Ḫān-i Ḫānān), and more expansively, see Ojha (1961), Sahay (1968), Soucek (1987), Kozlowski (1995), and Truschke

(2016) for larger discussions on Mughal patronage. Also see Sharma (2009), Busch (2010; 2011), Kinra (2015), and Sharma (2017) for studies on the literary arts in early modern India, especially, on the Mughal patronage of vernacular and Persianate poetry, and Orsini and Schofield (2015), Koch and Anooshahr (2019), and Truschke (2021) for essays on the Mughal milieu rendered through imperial iconography and subaltern narratives.

3 In Islamicate astronomy, a *zīj* (ARA pl. *zījāt*) is a handbook of astronomical, mathematical, calendrical, and geographical tables with accompanying text (called canon) on its technical use and theoretical underpinning. See Mercier (2008) and Van Brummelen (2014) for encyclopedic descriptions of a *zīj*.

4 See Brentjes (2009) for a more capacious study of patronage of the mathematical sciences in the Islamicate world (including in the Mughal sultanate), and the social and material consequences of various forms of

It is, perhaps, not surprising then to find two early-seventeenth century astronomers, a Muslim scholar named Mullā Farīd and his Hindu counterpart Pandit Nityānanda Miśra, working under the injunctions of Emperor Šāh Jahān's court to translate the former's Persian *Zīj-i Šāh Jahānī* into the latter's Sanskrit *Siddhāntasindhu*. Here, the act of commissioning the translation of a typical Persian *zīj* into an atypical Sanskrit *siddhānta* (a traditional scientific treatise) is as much an activity of consolidating power as it may be of acculturating knowledge.[5] In this study, we present, for the very first time, a comparative survey of the entire canon (text) in Mullā Farīd's *Zīj-i Šāh Jahānī* and Nityānanda Miśra's *Siddhāntasindhu* in an effort to illustrate the intimacy between the translated Sanskrit and its Persian original.

We note here at the outset that this study only surveys the canons in these two texts, which, in keeping with the genre of astronomical table-texts, include a vast number of tables of various kinds (like, e.g., calendrical, mathematical, astronomical, geographical, etc.). A detailed survey of the tables from these texts, along with apposite mathematical discussions, is to follow in an ensuing publication that would form the second and final part of our comprehensive survey of the *Zīj-i Šāh Jahānī* and the *Siddhāntasindhu*.

Presently, we begin this study (in § 1.2) with a brief biography of Mullā Farīd and his *Zīj-i Šāh Jahānī*, followed by a similar biographical sketch of Nityānanda Miśra and his *Siddhāntasindhu* (in § 1.3), before summarising some of the more salient features of the canons of these two texts (in § 1.4). This is followed by a description of the manuscripts utilised in our study (in § 2), and of our transcription and transliteration schemes (in § 3). Lastly, we present (in § 4) a detailed comparative survey of the individual chapters from the canon in the Persian *Zīj-i Šāh Jahānī* and the Sanskrit *Siddhāntasindhu*, typeset in parallel columns to allow for easy comparison. At the very end of this article, we describe certain aspects from select chapters in fuller detail in individual appendices.

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institutional support. More broadly, see Steele (2015) and Šprajc (2016) for studies on the intimacy between astronomy and politics in various scientific civilisations, and Rezavi (2007) and Tabrez (2019) for the social history of education under the Mughal rule.

5 As a comparable example of the phenomenon of acculturation, see Wade (1998) that offers an ethnomusicological and art historical study on how music from the Persian cultural sphere was Indianised at the Mughal courts. Conversely, many Persianate scholars at the Mughal courts were also familiar with Sanskrit knowledge systems: for example, as Singhania (2009) shows, the *Āᵓīn-i Akbarī* of Abū l-Fażl-i ᶜAllāmī, the grand vizier and biographer of Emperor Akbar (r. 1556–1605), contains many technical discussions that reveal how its author was intimately acquainted with Sanskrit astronomical ideas.

1.2   MULLĀ FARĪD AND HIS *ZĪJ-I ŠĀH JAHĀNĪ*

MULLĀ FARĪD AL-DĪN MASᶜŪD ḤĀFIẒ IBRĀHĪM DIHLAVĪ (commonly known as Mullā Farīd) is described in several court chronicles as a prominent astronomer active during the reigns of the Mughal emperors Jahāngir (r. 1605–27) and Šāh Jahān (r. 1628–58). According to the chronicle *Maʾāṯir-i Raḥīmī* of ᶜAbd al-Bāqī Nahāvandī, Mullā Farīd was given pride of place among the scholars at the court of the Mughal minister and general ᶜAbd al-Raḥīm Ḫān-i Ḫānān (d. 1627), having been hired by Ḫān-i Ḫānān in 1597/8 (AH 1006) and still on his payroll as late as 1616/17 (AH 1025) (MR, pp. 14–15 in Vol. 3).

Later in his career, Mullā Farīd attached himself to the service of the Mughal minister Āṣaf Ḫān, who instructed him to compose the *Zīj-i Šāh Jahānī*, a computational *zīj* modelled on Uluġ Bīg's celebrated *Zīj-i jadīd-i Sulṭāni* but set to an epoch corresponding to the vernal equinox of the regnal year of Emperor Šāh Jahān enthronement (i.e., the epoch of 21 March 1628 that marked the beginning of the *tārīḫ ilāhī-yi Šāh Jahānī* 'the divine era of Šāh Jahān'). Several Persian chronicles mention that Mullā Farīd was assisted in this task by his brother Mullā Ṭayyib, a noted astronomer and astrologer in his own right (see, e.g., AṢ, p. 361 in Vol. 1, and also MŠJn, p. 82, where Mullā Farīd is said to have been assisted by an unnamed brother).

According to the *Ṭabaqāt-i Šāh Jahānī* (also quoted in the *Nuzhat al-ḫawāṭir*), Mullā Farīd died in 1629/30 (AH 1039) (TŠJ, p. 48, and Nḫ, p. 601). In fact, the *Tārīḫ-i Muḥammadī* gives an even more precise Hijri date of 2 Rabīᶜ al-Avval in the year 1039 (corresponding to October 19, 1629) (TM, f. 162v), but, according to Ghori (1985: 34), this date is incorrect since the positions of the stars in the *Zīj-i Šāh Jahānī* are calculated for the year 1631/2 (AH 1041).[6]

1.2.1   *The Zīj-i Šāh Jahānī, its origins and structure*

While the *Zīj-i Šāh Jahānī* is overwhelmingly based on the fifteenth-century *zīj* of Uluġ Bīg (i.e., the *Zīj-i jadīd-i Sulṭāni* or more commonly, the *Zīj-i Uluġ Bīg*), it does, however, contain notable differences compared to its medieval precursor. To a large extent, these differences are a product of the changing times (along with a change of meridian) as the tradition of composing *zīj*es advanced in early modern Mughal India. In fact, some of the novelty in Mullā Farīd's *Zīj-i Šāh Jahānī* can be traced back to his earlier works, in particular, his *Zīj-i Raḥīmī* (1617/8 or AH 1026) that also bears resemblance to the *Zīj-i Uluġ Bīg* and, in many ways, may be thought of as an earlier version of the *Zīj-i Šāh Jahānī*.[7] Much of what is found

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6 A more comprehensive biography of Mullā Farīd and his milieu can be found in Arzoumanov (2023).

7 Mullā Farīd's *Zīj-i Raḥīmī* is briefly described in Ansari (2015). At the present

time, the only known extant copy of this work is held at the Marᶜašī Najafī library in Mashhad (Iran). As Ansari describes, this manuscript "ends abruptly on fol. 227 with the table for the first equation of Saturn,

in Mullā Farīd's *Zīj-i Šāh Jahānī* appears first in his *Zīj-i Raḥīmī*, although there are notable differences between the two texts.[8] For example, the introduction (*muqaddama*) of the *Zīj-i Šāh Jahānī* is significantly longer in comparison to the one found in the *Zīj-i Raḥīmī*, and includes heterogeneous content collated from earlier works along with newer additions.[9]

The introduction of the *Zīj-i Raḥīmī* contains, inter alia, a description of the difference between observational and computational *zīj*es; definitions of what constitutes *raṣad* 'observation', a *zīj-i ḥisābī* 'computational *zīj*', and a *taqvīm* 'almanac or ephemerides'; a praise of Uluġ Bīg's astronomical tables; and an extolment of ʿAbd al-Raḥīm's Ḫān-i Ḫānān's name and titles in chronograms (*tārīḫ*, pl. *tavārīḫ*) along with a comparison of these chronograms to other numbers (like, e.g., astronomical parameters) found elsewhere in the text. Going beyond, the introduction of the *Zīj-i Šāh Jahānī* contains additionally a list of older computational *zīj*es, discussions on the etymology of the word *zīj*, the meaning of *tashīl* 'facilitation or simplification', and the purposes of *taqvīm*, *zīj*es, and *raṣad*.

Interestingly, some of these preliminary definitions—like those of *taqvīm*, *zīj*, and *raṣad*—appear to be taken from Mullā Farīd's earliest known work, the *Sirāj al-istiḫrāj* (1597/8 or AH 1006) even as their discussions are somewhat amplified in the *Zīj-i Raḥīmī* (and then again, in the *Zīj-i Šāh Jahānī*).[10]

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reckoned from the zodiacal sign Gemini (*Jawzāʾ*)" Ansari 2015: p. 583. Over all, the *Zīj-i Raḥīmī* appears to contain newer tables compared to the *Zīj-i Uluġ Bīg* on which it is largely based upon; this is supported by Ansari's observation that "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)" Ansari 2015: p. 583. Ansari also suggests that the *Zīj-i Raḥīmī* was composed around 1617/8, noting that as "Mullā Farīd tabulated the equation of time (*Taʿdīl al-Ayyām*) for the Sun and Moon for the year AH1026 / AD1617 (ff. 152b, 153a), it appears that he might have been compiling *ZR* [the *Zīj-i Raḥīmī*] around that year" Ansari 2015: p. 582.

8 Beyond minor differences in numbering, the structure and order of certain chapters in the *Zīj-i Uluġ Bīg* and Mullā Farīd's two *zīj*es are noticeably different: the twenty-second chapter from the second discourse

(i.e., *maqāla* 2: *bāb* 22) in the *Zīj-i Raḥīmī* is a conflation of the twenty-second chapter from the second discourse (i.e., *maqāla* 2: *bāb* 22) and the twelfth chapter from the third discourse (i.e., *maqāla* 3: *bāb* 12) of the *Zīj-i Uluġ Bīg*, and this chapter then appears as the thirteenth chapter in the third discourse (i.e., *maqāla* 3: *bāb* 13) of the *Zīj-i Šāh Jahānī*.

9 Of particular note is the adaption of the section on *zīj*es from Abū l-Fażl's *Āʾīn-i Akbarī* (*c.* sixteenth century) in the first part (*qism*) of the introduction of the *Zīj-i Šāh Jahānī*. For example, Mullā Farīd provides here an account of earlier astronomers (starting from Antiquity) who made observations, and this account corresponds to an identical description given by Abū l-Fażl in his *Āʾīn-i Akbarī* (cf. AA, p. 266 in Vol. 1, Part 2 and remark 2 in [§ ID.1] on page 116).

10 The *Sirāj al-istiḫrāj* is a short treatise that enjoyed popularity as an introductory text to astronomy as the relatively large number of extant manuscripts and ancillary citations seem to suggest; see Arzoumanov (2023) for a fuller discussion on Mullā Farīd's *Sirāj al-istiḫrāj* relative to his complete oeuvre.

As further examples, the praise of Uluġ Bīg in (the first part of) the introduction of the *Zīj-i Šāh Jahānī* is significantly longer than what is similarly found in (the second part of) the *Zīj-i Raḥīmī*; and in (the second part of) the introduction of the *Zīj-i Šāh Jahānī*, Mullā Farīd argues for the superiority of the *Zīj-i Šāh Jahānī* over previous *zīj*es—a novel addition compared to the *Zīj-i Raḥīmī*.

Also, in (the third part of) the introduction of the *Zīj-i Šāh Jahānī*, Mullā Farīd offers a numerological excursus on the name of his new patron Emperor Šāh Jahān instead of his earlier sponsor ʿAbd al-Raḥīm Ḫān-i Ḫānān whose name he has already analysed in (the third part of) the introduction of his *Zīj-i Raḥīmī*. And finally, towards the very end of the introduction of the *Zīj-i Šāh Jahānī* (in the fourth part), Mullā Farīd discusses the calculative corrections, inventions, and additions to the *Zīj-i Uluġ Bīg* that he now introduces in his *Zīj-i Šāh Jahānī* for the very first time.

Overall, comparing the other discourses (*maqāla*) of the *Zīj-i Raḥīmī* and the *Zīj-i Šāh Jahānī*, we find that, in the first discourse, the *Zīj-i Raḥīmī* follows the *Zīj-i Uluġ Bīg* near verbatim, while the *Zīj-i Šāh Jahānī* contains many new chapters (*bāb*) like, e.g., the one introducing the divine era of Šāh Jahān (*tārīḫ ilāhī-yi Šāh Jahānī*) (see Appendix § G), and another describing the methods to convert various calendrical eras to this new era of Šāh Jahān. Notably, the first discourse of the *Zīj-i Šāh Jahānī* contains two new chapters on the Indian (Vikram Saṃvat and Śālivāhana) calendrical era (*tārīḫ-i hindī*) (see Appendix § H) and its conversion to and from the Islamic (Hijri) era.

At the end of its first discourse, the *Zīj-i Raḥīmī* contains a table listing the festivals (according to the different calendrical eras) that is more expansive compared to the festivals listed in the *Zīj-i Uluġ Bīg*. However, in his *Zīj-i Šāh Jahānī*, Mullā Farīd augments this table of festivals by including Hindu festivals based on the Indian eras (see Appendix § I). Also, while the second chapter in the third discourse (i.e., *maqāla* 3: *bāb* 2) of the *Zīj-i Raḥīmī* includes a chapter on the horoscope and numerology of ʿAbd al-Raḥīm's Ḫān-i Ḫānān, the same chapter in the third discourse of the *Zīj-i Šāh Jahānī* now includes the horoscope and numerology of Emperor Šāh Jahān.

The ninth and fourteenth chapters from the third discourses (i.e., *maqāla* 3: *bāb*s 9 and 14) of the *Zīj-i Raḥīmī* and the *Zīj-i Šāh Jahānī* both contain identical discussions on the Indian astrological concepts of *bust* and *bhadra*, and on the ominous planet *al-Kayd* of Islamic astrology respectively. Here, the contents of both these chapters are reproduced near-verbatim in the *Zīj-i Šāh Jahānī* from the *Zīj-i Raḥīmī*.

And finally, the second chapter in the forth discourse (i.e., *maqāla* 4: *bāb* 2) of the *Zīj-i Šāh Jahānī* on the Islamicate idea of the 'ascendant of the world' (i.e., the ascendant at the Aries ingress) is completely new and not found in the *Zīj-i Raḥīmī*.

1.3 NITYĀNANDA AND HIS *SIDDHĀNTASINDHU*

VERY SOON AFTER MULLĀ FARĪD COMPLETED HIS *ZĪJ-I ŠĀH JAHĀNĪ*, or perhaps near-contemporaneously towards the end, a Hindu Pandit named Nityā-nanda Miśra (fl. 1630/50) was commissioned by Āṣaf Ḫān, the prime minister (*vazīr-i aᶜẓam*) of Šāh Jahān, to translate into Sanskrit Mullā Farīd's Persian *zīj*. The circumstances surrounding this commission are described by the seventeenth-century Mughal historian Mīrzā Muḥammad Ṭāhir Ḫān Āšnā (alias ᶜInāyat Ḫān) in his abridged chronicle of Emperor Šāh Jahān, the *Mulaḫḫaṣ-i Šāhjahān-nāma* (MŠJn, p. 82):

چون متضمن فواید بسیار و ضوابط و قواعد بی شمار بود تا فایده آن عموم
بهم رسانند حکم شد که نجومیان هندوستان باستصواب منجمان فرس بزبان
هندوستان ترجمه نمایند.

čūn mutażammin-i favāyid-i bisyār u żavābiṭ-i bī-šumār būd tā fāyida-yi ān ᶜumūm ba ham rasānand ḥukm šud ki nujūmīyān-i hindūstān ba istiṣvāb-i munajjimān-i furs ba zabān-i hindūstān tarjuma namāyand.

Since [this Persian *zīj*, i.e., the *Zīj-i Šāh Jahānī*] contained many ad-vantages and countless rules, an order was given that Indian astro-nomers translate it into the language of Hindustan with the approval of Persian astronomers so that the public may profit from it.[11]

In fact, Nityānanda describes the story of his patronage in the preface (*granthārambha*) of this commissioned Sanskrit translation, the *Siddhāntasindhu*:

तस्य प्रेरणया नृपालमुकुटालङ्कारचूडामणि-
र्मामाज्ञापितवान्सुतन्त्रकरणे लोकोपकाराय यत् ॥
श्रीमच्छाहजहाँप्रकाशममलं सिद्धान्तसिन्धुं स्फुटम्
नित्यानन्द इति प्रसिद्धगणकः कर्तुं समीहे ततः ॥ २४ ॥

*tasya preraṇayā nṛpālamukuṭālaṅkāracūḍāmaṇir
mām ājñāpitavān sutantrakaraṇe lokopakārāya yat ||
śrīmacchāhajahāṁprakāśam amalaṃ siddhāntasindhuṃ sphuṭam
nityānanda iti prasiddhagaṇakaḥ kartuṃ samīhe tataḥ || 24 ||*

Since he who is the crown jewel in the head ornament of kings [i.e., Āṣaf Ḫān] ordered me by his command to compose a beautiful treat-ise for the benefit of men, for that reason this Nityānanda, a celeb-rated mathematician, endeavoured to compose the *Siddhāntasindhu* that is pure and precise resembling [the tables of] the venerable Šāh Jahān. 24

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11 Henceforth, unless otherwise indicated, all English translations of the Persian and Sanskrit text quoted in this paper are the au-thors' own.

There is little known about Nityānanda's life by way of historical testimony beyond the names of his patrilineal ancestors and the place of his origin (in Indrapurī or Old Delhi). A brief biographical account of Nityānanda's life and works (reconstructed from the scant colophonic information available on him) is described in Misra (2022*a*: 11–12).

However, the patronage of Hindu astronomers/astrologers (*jyotiṣa*s) at the Mughal courts is certainly well documented (see, e.g., Minkowski 2014), and to a large extent, their presence was legitimised by the endorsement of the astral sciences by successive Mughal emperors. Misra (2021: 32–43) provides a concise sociohistorical account of the culture of translating astronomy in early-modern Persianate India, and in particular, Nityānanda's advent as a Hindu mathematician-astronomer (*gaṇaka-jyotiṣa*) in service of the Mughal court of Šāh Jahān.

1.3.1   The Siddhāntasindhu, its novelty and enterprise

Nityānanda called his Sanskrit translation the *Siddhāntasindhu* 'An ocean of doctrinal truths', and in many ways, his text was as much a recipient of the intellectual endowments of the Mughal milieu as he himself was of the material benefaction of Mughal sponsorship.

The *Siddhāntasindhu* is a complex scholastic, scientific, and sociocultural experiment of bringing Islamicate ideas into the discourse of Sanskrit astronomy of seventeenth-century Mughal India. The structure of its canon mimics that of a Persian *zīj* with a preface (*granthārambha*, lit. the beginning of a book), an introduction (*granthamukha*, lit. the mouth of a book), and four distinct parts (*kāṇḍa*s, lit. joints of the stalk or stem of a plant); see Table 1.

At the very outset, this arrangement is novel compared to anything seen in any of the Sanskrit astronomical texts prevalent at the time. In traditional Sanskrit *siddhānta*s, technical (calculative) topics were often discussed under topical headings (*adhikāra*)—like those on calculating the mean positions of planets (*madhyama*), their true positions (*spaṣṭa*), the 'three questions' of determining the direction, place, and time (*tripraśna*), etc.—subsumed under a chapter on computations (*gaṇitādhyāya*). However, in his *Siddhāntasindhu*, Nityānanda imitates the arrangement of the chapters of the Persian original with perhaps an ambition of transmitting the organisation of Islamicate astronomy as well as the prestige of Mughal patronage. In fact, this latter intention is evident in an original Sanskrit composition Nityānanda includes at the beginning of the preface of his *Siddhāntasindhu* (see **§ P.1** on page 106). In it, he exalts Šāh Jahān's imperial lineage and regnal calendar in metrical Sanskrit poetry in an effort to impress upon the reader the magnanimity of his patron's being.[12]

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12 A critical edition with an annotated English translation of this original San-

Throughout the *Siddhāntasindhu*, Nityānanda translates Mullā Farīd's Persian passages in an ad hoc mixture of Sanskrit prose and metrical verses, and in several instances, augments his translations with additional explanatory statements not found in the Persian original (see, e.g., Misra 2021: 57–60 that compares the structure of the chapter on computing the true declination of a celestial object in Mullā Farīd's *Zīj-i Šāh Jahānī*, Discourse II.6 and Nityānanda's *Siddhāntasindhu*, Part II.6). In many ways, these pedagogical additions reveal Nityānanda's own conception of the intended utility of his text as a propaedeutic for Sanskrit astronomers attempting to learn Islamicate astronomy.[13] Also, the fluency of his translations attests to his intimacy with the Persian language in much the same way as its thoroughness testifies to his knowledge of astronomy. Over all, the *Siddhāntasindhu* is Nityānanda's bold enterprise in using language, logic, and mathematics to transcreate a new treatise in Sanskrit astronomy with ideas originating in several older works of Islamicate astronomy.

1.4   HIGHLIGHTS FROM THE CANONS OF THE *ZĪJ-I ŠĀH JAHĀNĪ* AND THE *SIDDHĀNTASINDHU*

T ABLE 1 DESCRIBES THE DIVISIONS OF THE CANON in Mullā Farīd's *Zīj-i Šāh Jahānī* and Nityānanda's *Siddhāntasindhu* in parallel. The distribution of the chapters in the introduction and the four discourses/parts of these two texts is described in Table A1 (in Appendix A).[14]

Among the many features of the canons of both these texts, the following are some of the more salient observations that come to the fore.

1. Nityānanda begins his *Siddhāntasindhu* with a preface (*granthārambha*) that includes a Sanskrit prolegomenon (*prathamāvasara*) not found in Mullā Farīd's *Zīj-i Šāh Jahānī*; see [§ P.1]. In it, he summarises the different calendrical eras described in this text and proposes a system of converting between them (Misra forthcoming).

2. In translating Mullā Farīd's Persian passages into Sanskrit, Nityānanda's language often appears to be grounded in the linguistic and cultural ambit of his source. For instance, instead of *Indianising* the foreign content, he

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skrit prolegomenon from the preface of Nityānanda's *Siddhāntasindhu* is to appear in Misra (forthcoming).

13 In fact, in his second text the *Sarva-siddhāntarāja* (1639), he transforms his exposition of Islamicate astronomy to suit the more traditional paradigms of a Sanskrit *siddhānta*—in essence, anonymising the origins of 'foreign' ideas by ascribing them to divine revelations in lieu of human

authorship—and by doing so, attempts to cater to his learner's autochthonous sensibilities better; see Misra (2022b: 71–83).

14 To allow for comparative cross-referencing, we have enumerated the individual chapters (like, e.g., "[§ ID.5]"), enclosing them in square brackets to indicate that they are modern editorial additions and not those made by any of the scribes of the Sanskrit or Persian manuscripts.

composes his Sanskrit passages in a manner that reflects its adventitious origins: prime examples of this can be seen in his Sanskrit translations of the praises to Allah (in [§ P.2]) and to prophet Muḥammad (in [§ P.3]), and in his Sanskrit eulogy to Šāh Jahān (in [§ P.4]) wherein he emulates the original Persian meter and terminal rhyme in his metrical encomium (Arzoumanov and Misra forthcoming).

That said, on certain occasions, particularly when translating technical computations, Nityānanda has chosen to culturally appropriate the context of the calculation to suit his local readership: for example, in translating Mullā Farīd's computation of Qibla (i.e., the direction of Mecca), he changes the locus from Mecca to Kāśī and then proceeds to explain the procedure identically: see [§ II.20].

3. For the most part, Nityānanda provides precise translations to reflect the linguistic fidelity of his work in relation to its source. For example, in his exhaustive translations of technical and non-technical material in the first part of the introduction (in [§ ID.1]), he renders into Sanskrit Mullā Farīd's discussion on the etymology of the Persian word *zīj* (see Appendix § D), or in translating the praise of Uluġ Bīg, he translates the string of effusive Persian epithets applied to the Samarqand astronomer using corresponding Sanskrit appositives.

More astutely, he transcribes into Devanāgarī Persian proper names, titles of works, and certain technical terms (e.g., PER: *zīj* 'tables' to SAN: *jīca* or PER: *raṣad* 'observation' to SAN: *rasada*) in a manner that perhaps reflects some of the ways in which Persian was spoken at the Mughal courts of his time; see, e.g., the list of earlier Greek and Muslim astronomers (in [§ ID.1]); the lists of earlier Islamicate *zīj*es (in Appendix § B) and simplification tables (in Appendix § C); or statements on the utility of *zīj*es, almanacs, and observations (in Appendix § E).

4. For technical topics like, e.g., the definitions of various calendrical terms in different calendar systems (see Appendix § F), Nityānanda translates formal Persian expressions using apposite Sanskrit equivalents. In the fourth part of the introduction (in [§ ID.4]), he translates into Sanskrit the 101 technical additions/improvements Mullā Farīd has self-admittedly made to the *Zīj-i Uluġ Bīg*, drawing upon his extensive knowledge of Sanskrit astronomy to identify equivalent terms for Islamicate astronomical concepts. In fact, his mastery of the vocabulary of Sanskrit astronomy is evident by looking at his translations of the technical topics in the twenty-two chapters of the second part (see [§ II.1]–[§ II.22]) and the fifteen chapters of the third part (see [§ III.1]–[§ III.15]) of his *Siddhāntasindhu*.

5. However, Nityānanda's translations are not always exhaustive: in some instances, entire passages (or sections) are completely omitted. For example,

Nityānanda does not translate Mullā Farīd's statements on the numerology of the name 'Šāh Jahān' on account of its irrelevancy; see [§ ID.3].

Similarly, in the first part of the *Siddhāntasindhu* (in [§ I]) describing the different calendrical eras—including the newly instituted era of Šāh Jahān (see Appendix § G)— Nityānanda does not translate into Sanskrit Mullā Farīd's Persian descriptions of the Chinese-Uyghur calendrical era (see [§ I.9] of the *Zīj-i Šāh Jahānī*). More significantly, he also omits translating Mullā Farīd's descriptions of the Hindu calendrical eras (see Appendix § H), presumably believing Sanskrit reader were already familiar with these topics.

In contrast, in the tenth chapter of the first discourse of the *Zīj-i Šāh Jahānī*, Mullā Farīd includes a unique calendar of festivities following the prevalent Muslim and Hindu traditions (see Appendix § I), which Nityānanda notably excludes from his translation.

6. In Nityānanda's *Siddhāntasindhu*, each of the three parts of the text terminates with a colophon; see [§ I.col], [§ II.col], and [§ III.col]). No corresponding colophons are found at the ends of the three discourses of Mullā Farīd's *Zīj-i Šāh Jahānī*.

7. Lastly, the canon in Mullā Farīd's *Zīj-i Šāh Jahānī* is a remarkably composite text that weaves together passages from the *Zīj-i Uluġ Bīg*—copied (near-)verbatim in several instances—and material from other Persian texts, as well as the author's earlier works. The Indian context of this *zīj* is made very apparent by Mullā Farīd's discussions of, inter alia, the Hindu calendrical eras (in [§ I.7]), Indian religious festivals (in [§ I.10]), and inauspicious hours (i.e., *bust* and *bhadra*) according to Indian astrology (in [§ III.9]); see (Arzoumanov 2023). The author's augural and ample descriptions of the 'divine era of Šāh Jahān' (in [§ P.3], [§ ID.3], and more elaborately in [§ I.1]) also serve as an excellent historical example of promotional and sponsored scientific content.

Table 1: Structure of the canon in Mullā Farīd's *Zīj-i Šāh Jahānī* vis-à-vis the canon in Nityānanda's *Siddhāntasindhu*.

Zīj-i Šāh Jahānī	*Siddhāntasindhu*
[§ P] **Preface**	[§ P] ग्रन्थारम्भ (*granthārambha*) **'Preface'**
	(*continued*)

(continued)

Containing

1. a حمد (*ḥamd*) 'Praise of God' (in [**§ P.1**]);
2. a نعت (*naᶜt*) 'Praise of the Prophet' (in [**§ P.2**]);
3. a praise of Šāh Jahān and his regnal era (in [**§ P.3**]); along with
4. a praise of Āṣaf Ḫān and the commissioning of a new *zīj* named after Šāh Jahān (in [**§ P.4**]).

Containing

1. the प्रथमावसर (*prathamāvasara*; lit. the first occasion), i.e., the Prolegomenon (in [**§ P.1**]);
2. the यवनोक्तमङ्गलाचरण (*yavanokta-maṅgalācaraṇa*, lit. a benediction according to the Muslims, in [**§ P.2**])—a Sanskrit translation of the Islamic *ḥamd*;
3. the भगवद्भक्तवचन (*bhagavadbhakta-vacana*, lit. the sayings of the Devotee of God, i.e., of the Prophet, in [**§ P.3**])—a Sanskrit translation of an Islamic *naᶜt*, citing hadiths;
4. a praise of Šāh Jahān and his regnal era (in [**§ P.4**]); along with
5. a praise of Āṣaf Ḫān and the commissioning of a new *siddhānta* named after Šāh Jahān (in [**§ P.5**]).

[**§ ID**] مقدمه (*muqaddama*) 'Introduction'

In پنج قسم (*panj qism*) 'five parts' ([**§ ID.1–§ ID.5**]).

[**§ ID**] ग्रन्थमुख (*granthamukha*) 'Introduction'

In पञ्चप्रकार (*pañcaprakāra*, lit. five kinds), i.e., in five parts ([**§ ID.1–§ ID.5**]).

(continued)

[§ I] مقاله اولین (*maqāla-yi avvalīn*) 'First discourse'

In ده باب (*dah bāb*) 'ten chapters' ([§ I.1–§ I.10]).

[§ II] مقاله دوم (*maqāla-yi duvum*) 'Second discourse'

In بیست و دو باب (*bīst u dū bāb*) 'twenty-two chapters' ([§ II.1–§ II.22]).

[§ III] مقاله سیوم (*maqāla-yi sīvum*) 'Third discourse'

In پانزده باب (*pānzdah bāb*) 'fifteen chapters' ([§ III.1–§ III.15]).

[§ IV] مقاله چهارم (*maqāla-yi čahārum*) 'Fourth discourse'

Contains the باب اول (*bāb-i avval*) 'first chapter' ([§ IV.1]) with هفت فصل (*haft faṣl*) 'seven sections' ([§ IV.1.i–§ IV.1.vii]), and a final باب دوم (*bāb-i duvum*) 'second chapter' ([§ IV.2]).

[§ I] प्रथमकाण्ड (*prathamakāṇḍa*) 'First part'

In सप्ताध्याय (*saptādhyāya*) 'seven chapters' ([§ I.1–§ I.7]), with section-terminal colophon ([§ I.col]).

[§ II] द्वितीयकाण्ड (*dvitīyakāṇḍa*) 'Second part'

In द्वाविंशत्यध्याय (*dvāviṃśatyādhyāya*) 'twenty-two chapters' ([§ II.1–§ II.22]), with section-terminal colophon ([§ II.col]).

[§ III] तृतीयकाण्ड (*tṛtīyakāṇḍa*) 'Third part'

In पञ्चदशाध्याय (*pañcadaśādhyāya*) 'fifteen chapters' ([§ III.1–§ III.15]), with section-terminal colophon ([§ III.col]).

A corresponding fourth part is absent (according to the only near-complete MS Kh; see page).

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2   MANUSCRIPT SOURCES

2.1   THE *ZĪJ-I ŠĀH JAHĀNĪ* OF MULLĀ FARĪD

B Y CONSERVATIVE ESTIMATES, there are about twelve manuscripts of the *Zīj-i Šāh Jahānī* that are variously complete in their extent. These manuscripts are held at different libraries across India, Iran, Russia, Tajikistan, the United Kingdom, and Uzbekistan.[15]

2.1.1   *Manuscripts consulted*

In preparing this comparative survey, we consulted seven manuscripts of the *Zīj-i Šāh Jahānī* that were fully or partially complete. These are briefly described in Table 2

Table 2: Description of the manuscripts of the *Zīj-i Šāh Jahānī*.

Siglum	Manuscript Description
D	MS 2007 from the Rudaki Institute of Language, Literature, Oriental and Writing Heritage, Dushanbe, 403 folia, Persian Nastaliq, decorated headpiece (*sarlawḥ*) above the text on first folio, *c.* seventeenth century. See ROSEN-İHSAN (p. 358).
H	MS *riyāżī fārsī* 302 from the Telangana Government Oriental Manuscripts Library and Research Institute, Hyderabad, 412 folia, Persian Nastaliq, *c.* eighteenth century. (From the ex-Āṣafīya collection.)
	Acknowledgement: We are very grateful to Dr Kaveh F. Niazi for providing us a complete digital copy of this manuscript gratis.
L	MS Or. 372 from the British Library, London, 419 folia, 31 lines per folio, 13 ¾ × 8 ½ inches, Persian Nastaliq in red and black ink, *c.* seventeenth century. See RIEU (pp. 459b–60b).
O	MS Ind. Inst. Pers. 12 from the Bodleian Library, Oxford, 380 folia, 25 lines per folia, 13 ¼ × 9 ⅜ inches, Persian Nastaliq in red and black ink, *c.* seventeenth century. See BEESTON (p. 61b, no. 2735).
	Acknowledgement: We are very grateful to Alasdair Watson, the Bahari Curator of Persian Collections at the Bodleian Library, for providing us a complete digital copy of this manuscript gratis.

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15 A fuller catalogue description of the extant manuscripts of Mullā Farīd's *Zīj-i Šāh Jahānī* can be found at `https://ceemsa.hypotheses.org/manuscripts_zij_i_shah_jahani`.

(continued)

Q MS 14012 from the Marᶜašī Najafī Library, Qom, 409 folia, 29 × 20 cm, Persian Nastaliq written within red and golden ruled margins, decorated headpiece (*sarlawḥ*) above the text on first folio, copied on 10 Ḏū l-qaᶜda 1082 (March 8, 1672) by Muḥammad Saᶜīd b. ᶜAbd al-ᶜAzīz b. Muḥammad Ṣādiq Zāhid. See MARASHI (pp. 457–7; [mis]catalogued as *Zīj-i Raḥīmī*).

R MS 1218 from the Rampur Raza Library, Rampur, 344 folia, Persian Nastaliq, *c*. eighteenth century. See RAMPUR (p. 344; [mis]catalogued with the accession number '1222').

S MS Leningrad Univ. no. 97 from the Maxim Gorky Scientific Library of St Petersburg University, St Petersburg, 428 folia, Persian Nastaliq, *c*. eighteenth century. See SMANN-ROSEN (p. 16).

Acknowledgement: We very gratefully acknowledge Dr Milana A. Azarkina, the Head of the Asia and Africa Department of the Scientific Library of St. Petersburg State University, for her invaluable assistance in providing us a complete digital copy of this manuscript gratis.

2.2 THE *SIDDHĀNTASINDHU* OF NITYĀNANDA MIŚRA

According to most reliable catalogues, there are just a handful of near-complete manuscripts of the *Siddhāntasindhu* currently extant.[16]

MMSM (pp. 138–143) describes four manuscripts held at the Maharaja Sawai Man Singh II Museum Library at the City Palace in Jaipur that are perhaps the best preserved copies of this text; namely, MSS 4960, 4961, and 4962 from the Khasmohor (HIN: *ḳhās muhar*, lit. special seal) collection and MS 23 from the Museum collection. These three Khasmohor manuscripts are also referenced in CESS (A3, p. 173b) as (presumably identical to) three Jaipur (II) manuscripts of 441 ff, 536 ff, and 442 ff,[17] and in CESS (A5, p. 184a) as 'Jaipur (Khasmohor)

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16 A post-colophonic note (in vernacular Hindi) at the end of two manuscripts (MSS Khasmohor 4960 and Museum 23) of the *Siddhāntasindhu* lists nine historical recipients (seventeenth-century Mughal elites) among whom copies of this text were distributed; see Misra (2021: 50–51). However, at the present time, there are only five near-complete manuscripts of the text extant. A fuller catalogue description of the extant manuscripts of Nityānanda's *Siddhāntasindhu* can be found

at https://ceemsa.hypotheses.org/ manuscripts_siddhantasindhu.

17 CESS (A3, p. 173b) describes three Jaipur (II) manuscripts of 441 ff, 536 ff, and 442 ff. David Pingree, in CESS (A2, p. 29b), identified the Jaipur (II) collection as the 'List of MSS. by Dr. Kunhan Raja of the Jaipur Pothikhana in poss. of V. Raghavan. Handwritten'. In the introduction to his *A Descriptive Catalogue of the Sanskrit Astronomical Manuscripts Preserved at the Maharaja Man Singh II Museum in Jaipur, In-*

4960; 4961; and 4962'. The MS 23 from the Museum collection is also listed in MJM (p. 58, Serial No. 249E).

Beyond these four manuscripts, there is a few other manuscripts of the *Siddhāntasindhu* catalogued in CESS (A3, p. 173b and A5, p. 184a). Almost all of them are fragmentary copies, with the exception of RORI (Alwar) 2627 (= MS Alwar 2014) held at the Rajasthan Oriental Research Institute in Jodhpur that is attested as being complete; see RORI (pp. 602–603, Serial No. 5401E).

2.2.1   *Manuscripts consulted*

In preparing this comparative survey, we consulted three manuscripts of the *Siddhāntasindhu*, of which one is a near-complete copy and two are fragmentary copies.[18] These are briefly described in Table 3.

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dia, Pingree describes some of the manuscripts in the Pothikhana collection, instituted by Sawai Jai Singh II, as copies of those from the Khasmohor collection; see MMSM (pp. xiii). Therefore, it is quite likely that these three Jaipur (II) manuscripts from the Pothikhana (HIN: *pothī ḳhānā*, lit. library) collection are copies of the three manuscripts from the Khasmohor collection described above, even though the individual manuscripts in these two collections attest to slightly different total number of folia.

18 The majority of the near-complete manuscripts of the *Siddhāntasindhu* are held at the Maharaja Sawai Man Singh II Museum Library at the City Palace in Jaipur as a part of the Khasmohor/Museum collection. Despite repeated entreaties over the last several years, we have been unsuccessful in obtaining complete copies of any of these manuscripts, except one (Khasmohor 4960). Regrettably, the board of trustees of the City Palace Museum refuse to provide complete copies of any of the manuscripts in their holdings, and even substantial partial copies (in any digital format) are rarely given to visiting scholars.

Table 3: Description of the manuscripts of the *Siddhāntasindhu*.

Siglum	Manuscript Description

Al   MS 2627 (catalogued under Serial No. 5401 E, identical to MS 2014) from the Alwar collection held at the Rajasthan Oriental Research Institute in Jodhpur, 441 folia, 25/26 lines per folia, 28 × 37.5 cm, Sanskrit Nāgarī, writing parallel to the shorter edge and enclosed within framed margins on each folio, bound to the left, copied in 1855 (1912 Vikram Saṃvat), identified as a collection of tables (*sāraṇī-saṃgraha*). See RORI (Alwar) (pp. 604–05) and CESS (A3, p. 173b, and A5, p. 184a).

Acknowledgement: We are very grateful to Prof. Kim Plofker for providing me digitised photocopies of 145 folia of this manuscript (containing the text of the preface, the introduction, and the first two parts) to include in this study. These photocopies were originally made for Prof. David Pingree, and the physical copy is stored at the John Hay Library at Brown University (stored in box C-24X, barcode 3-1236-07181-3961, call number 2826).

Kh   MS 4962 from the Khasmohor collection held at the Maharaja Sawai Man Singh II Museum Library at the City Palace in Jaipur, 436 folia (incomplete, with missing ff. 1 and 3 and damaged f. 2), 21–30 lines per folio, 37 × 25 cm, Sanskrit Nāgarī script with red and black ink, writing parallel to the shorter edge and enclosed by double-ruled four-sided margins on each folio, bound to the left with side-sewing stitches and held between red-and-blue striped cloth-covered boards and book flap, property of Jagannātha Jośī acquired for 100 rupees. See MMSM (p. 143)

Acknowledgement: We are very grateful to Dr Chandramani Singh, (retired) Director of the Archives of the Maharaja Sawai Man Singh II Museum Library, for her assistance in acquiring a complete digital copy of this manuscript back in 2014.

(*continued*)

Pg   A collation of photocopies of parts of two different (unidentified) man-
      uscripts of the *Siddhāntasindhu* held at the John Hay Library at Brown
      University (stored in box C-50X, barcode 3-1236-07181-4324, old box
      number 43). According to the 2016 consolidated handlist of manu-
      scripts prepared by Prof. Kim Plofker for the David Pingree collection
      held at the John Hay Library at Brown University, this copy is tagged
      as

      'Important work on Islamic math; mentions Nityananda +
      Shah Jahan, based on Siddhantasindhu.'

      The same identification appears on the first page of this collated photo-
      copy in the handwriting of Prof. David Pingree.

      The first manuscript in this photocopy—with writing parallel to the
      long edge as is conventional for Sanskrit *pothī*-like manuscripts—
      includes the second part (*dvitīyakāṇḍa* or [§ II]) of the canon over ff. 1v–
      6r, until the end of the fourth chapter (*caturthādhyāya* or [§ II.4]). On
      the top of f. 1v, Prof. Pingree suspects this manuscript to be 'BORI 579
      of 1895/1902'; however, this identification is inaccurate according to
      the manuscript catalogue of the Bhandarkar Oriental Research Institute
      (BORI) in Pune.[19]

      Note: We describe this information on the first manuscript for reference;
      we do not, however, include this incomplete manuscript in our compar-
      ative survey.

      The second manuscript in this photocopy—with writing parallel to the
      short edge resembling a Persian bound book—includes, inter alia, the
      entire preface (*grathārambha* or [§ P]), introduction (*granthamukha* or
      [§ ID]), and the first part (*prathamakāṇḍa* or [§ I]) of the canon, as well
      as the second part (*dvitīyakāṇḍa* or [§ II]) until the middle of the fourth
      chapter (*caturthādhyāya* or [§ II.4]) over ff. 1v–18r, 27v, and 28r.[20]

      Note: Our reference to MS Pg in our comparative survey refers to this
      second manuscript from this collation of photocopies.

                                                            (*continued*)

(*continued*)

Remark: The (second) manuscript Pg includes marginal text by the scribe that describe some unconventional palaeographic conventions. For example, at the end of the Fourth part of the Introduction (i.e., [**§ ID.4**]), we find an enumerated list of additions/improvements included in the *Siddhāntasindhu* (translated via a similar list seen in the *Zīj-i Šāh Jahānī*) where the scribe of MS Pg inscribes a ring above the numbers: for instance, ६२ '6̊2' or ७३ '7̊3' on f. 9v. At the end of the list, this convention is explained (in the right margin on f. 10r) as

atra bindūpalakṣaṇāni mayā likhitāni nānyāni

Here, no other cypher marks (*bindu-upalakṣana*) [besides these] are written by me.

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19 The manuscript 'BORI 579 of 1895/1902' is a work entitled *Śaṅkuchāyāyābhuja-sādhanam*, 24 folia, of anonymous authorship.

20 Judging by the photocopy, and based on what is described in the catalogue MMSM (pp. 138–143), we suspect this second manuscript to be either Khasmohor 4960 or Museum 23 held at the Maharaja Sawai Man Singh II Museum Library at the City Palace in Jaipur. However, at the time of writing, we have not been able to identify this manuscript definitively.

3   TRANSCRIPTION AND TRANSLITERATION SCHEMES

W E ADOPT THE FOLLOWING TRANSCRIPTION/TRANSLITERATION SCHEMES in render-
ing the Arabic (ARA), Chinese (CHIN), Hindi (HIN), Persian (PER), Sanskrit
(SAN), and Turkic (TUR) text in the Roman (Latin) script.

1. The text in Arabic, Persian, and Turkic is transcribed into Latin characters
   following the transcription scheme adopted as a part of the *Perso-Indica* re-
   search and publishing project.[21] Table 4 lists this transcription scheme. As
   special notes:

   (a) for Arabic transcription, the article is always transcribed as 'al-' and
       the *alif maqṣūra* is transcribed as '-à' (e.g., مصطفى Muṣṭafà); and
   (b) for Persian transcription, the *iżāfa* is rendered as *-i* or *-yi*; the silent
       و is transcribed (e.g., خواستن *ḫwāstan*); the final ه is not transcribed
       (e.g., نامه *nāma*); and compound words are separated with a dash (e.g.,
       شاهنامه Šāh-nāma).

2. The text in Sanskrit and Hindi is transliterated following the International
   Alphabet of Sanskrit Transliteration (IAST) scheme. In vernacular Hindi
   words (typically, in the Devanāgarī renderings of Persian words), certain
   characters are transliterated into the Latin script using the International
   Organisation for Standardisation (ISO) 15919 scheme, e.g., ड़ी is transliter-
   ated as *ṛī*, ख़ाँ as *khām̐*, etc. Commonly attested words of Indian origin (e.g.,
   Hindu, Brahmin, Mughal, Varanasi, etc.) are presented without diacritics.

   Remarks:

   (a) In transliterating Devanāgarī renderings of certain Persian words, es-
       pecially names, consecutive un-sandhied vowels are indicated with
       a diaeresis on the terminal (second) vowel to show a separation of
       words (*padaccheda*); for example, जीचउलगबेगी (parsed as *jīca-ulaga-
       begī*) is transliterated as *jīcaülagabegī*.
   (b) Nityānanda has (or, at the very least, the scribes of the three manu-
       scripts consulted have) near-consistently made use of certain Deva-
       nāgarī diacritic (from vernacular Hindi) to render particular Persian
       letters. These include ग़ँ (*gam̐*) for غ (*ġ*) and य (*ya*) for ع (ʾ). We pre-
       serve these choices in this paper; see, e.g., the Sanskrit transliterations
       Jīca-bāligam̐ (PER: *Zīj-i bāliġ*) and *Jīca-yilakhānī* (PER: *Zīj-i īlḫānī*) in Ap-
       pendix § B.

3. Chinese words are transliterated into Latin following Pinyin (*hànyŭ pīnyīn*).

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21 See http://www.perso-indica.net.

Table 4: Chart of Latin transcription of Arabic/Persian characters following the transcription scheme of the project *Perso-Indica*. Courtesy: Fabrizio Speziale.

Letter	Latin transcription	Letter	Latin transcription	Letter	Latin transcription
آ	ā	ر	r	ف	f
ب	b	ز	z	ق	q
پ	p	ژ	ž	ک	k
ت	t	س	s	گ	g
ث	t̲	ش	š	ل	l
ج	j	ص	ṣ	م	m
چ	č	ض	ż	ن	n
ح	ḥ	ط	ṭ	و	v/w[†] or ū/aw (as long vowel/diphthong)
خ	ḫ	ظ	ẓ	ه	h
د	d	ع	ʿ	ی	y or ī/ay (as long vowel/diphthong)
ذ	d̲	غ	ġ	أ	ʾ

[†] و is transcribed as 'w' in Arabic syntagms.

4   A COMPARATIVE SURVEY OF THE CANONS

ZŠJ

ff. 1v–2v D

ff. 1v–3r H

ff. 2v–3v L

ff. 4v–6r O

f. 1v Q[†]

pp. 2–5 R[‡]

ff. 1v–2v S

[†] The Qum manuscript contains only the first page of the prologue.

[‡] The two folia are badly damaged and the end is missing.

[§ P]

[Preface][1]

[–]

A corresponding prolegomenon is absent

[§ P]

ग्रन्थारम्भ (*granthārambha*, **lit. the beginning of the book**): **Preface**

[§ P.1]

प्रथमावसर (*prathamāvasara*, lit. the first occasion): Prolegomenon

Begins with:

श्री गणेशाय नमः ।

śrī gaṇeśāya namaḥ |

Obeisance to Gaṇeśa.

Ends with:

इति ग्रन्थारम्भतः प्रथमावसरः ।

iti granthārambhataḥ prathamāvasaraḥ |

Thus ends the prolegomenon from the preface.

Remarks   Contains, inter alia,

1. a benediction (*maṅgalācaraṇa*);
2. the genealogy of Šāh Jahān beginning from Timūr;
3. a (shorter) eulogy of Šāh Jahān and Āṣaf Ḫān;
4. the reasons for translating the Persian *Zīj-i Šāh Jahānī* into the Sanskrit *Siddhāntasindhu*;
5. the conversion between the calendrical eras of Vikramārka (Vikram Saṃvat), Śālivāhana (Śāka), Saljūq King Jalāl al-Dīn Malik Šāh I (*jalālī* or *malakī*),

SS

ff. 1r–5v Al

ff. 2r–7r Kh

ff. 1v–6v Pg

SS

ff. 1r–3r Al

ff. 2rv Kh

  (incomp.)

ff. 1v–3v Pg

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1 Henceforth, any text enclosed in square brackets indicates an editorial addition not found in the original text. As the Persian text sometimes lacks chapter headings, these have been supplied here inside square brackets for comparison with the Sanskrit. Additionally, a dash '–' preceding a manuscript siglum (in the margin) is used to indicate the absence of the corresponding chapter in the respective manuscript.

Rūmī (*rūmī* or *sikandarī*), Hijri (*hijarī*, *arabī*, or *cāndrābdagaṇa*), Yazdgirdī (*yajdajiradī*, *kadīmī*, or *pārasī*), and of Šāh Jahān (*śāhajahānī* or *ilāhī*); and

6. a colophon identifying Nityā-nanda's ancestry.

A critical edition with an annotated English translation of the Sanskrit text of the prolegomenon is to appear in Misra (forthcoming).

ZŠJ

f. 1v D
f. 1v H
f. 2v L
f. 4v O
f. 1v Q
p. 2 R
f. 1v S

[§ P.1]

[حمد (*ḥamd*): Praise of God]

Begins with:

حمد بی حد خالقی را سزد که مهندس
قدرت شامله‌اش در تقویم درجات مخلوقات
دقیقه از دقایق فرو نگذاشت

ḥamd-i bī-ḥadd ḫāliqī rā sazad ki muhandis-i qudrat-i šāmila-š dar taqvīm-i darajāt-i maḫlūqāt daqīqa az daqāyiq furū naguḏāsht

Boundless praise is suitable to the Creator whose comprehensive engineering power did not neglect any small detail (*daqīqa az daqāyiq*, lit. minute by minute) in the adjustment (*taqvīm*, also an 'almanac') of the degrees of the creatures.

[§ P.2]

SS

यवनोक्तमङ्गलाचरण (*yavanoktamaṅgalā-caraṇa*, lit. a benediction according to the Muslims): a Sanskrit translation of the Islamic *ḥamd*

f. 3r Al
f. 4r Kh
f. 3v Pg

Begins with:

अथ यवनोक्तमङ्गलाचरणादिलिखनं । तस्य विश्व-कर्तुरपारमहिमा तद्योग्यो ऽस्ति । यस्य शक्तिरेव शिल्पादिकलाकलापकोविदा सर्वत्र व्यापिका भूतांशपरिस्फुटत्वे कलामेकामपि न तत्याज ।

atha yavanoktamaṅgalācaraṇādilikhanaṃ | tasya viśvakartur apāramahimātadyogyo 'sti | yasya śaktir eva śilpādikalā-kalāpakovidā sarvatra vyāpikā bhūtāṃśa-parisphuṭatve kalām ekām api na tatyāja |

Now, the writing beginning with a benediction spoken by the Muslims. The boundless greatness of that Creator of the world is befitting Him whose very power, an all-pervading [power] adroit in the totality of the arts like [the science of] form etc., did not dismiss even one small part (*ekā-kalā*, lit. one arcminute) in the distinct manifestness (*parisphuṭatva*, contextually, an 'almanac') of the degrees of living beings.

Ends with:

تعالی شانه و عم احسانه

taʿālà šānuhu u ʿamma iḥsānuhu

May the eminence of the Almighty be elevated and His benevolence universal.

End with:

अहो परमेश्वरो महानुभावः सर्वफलप्रदः । इत्येवं रीत्या यवनैः परमेश्वरस्य स्तुतिः कृता ।

aho parameśvaro mahānubhāvaḥ sarva-phalapradaḥ | ityevaṃ rītyā yavanaiḥ parameśvarasya stutiḥ kṛtā |

"O God, the Almighty One, the Giver of all benefactions", thus in this way the praise of God is accomplished by the Muslims according to custom.

ZŠJ
f. 1v D
f. 1v H
f. 2v L
f. 4v O
f. 1v Q
p. 2 R
f. 1v S

[§ P.2]
[نعت (*naʿt*): Praise of the Prophet]

[§ P.3]   SS
भगवद्भक्तवचन   (*bhagavadbhaktavacana*,   ff. 3rv Al
lit. the sayings of the Devotee of God,   ff. 4rv Kh
i.e., of the Prophet): a Sanskrit transla-   ff. 3v–4r Pg
tion of an Islamic *naʿt*, citing hadiths.

Begins with:

و صلوات بی غایت بر مرکز دایره نبوت و قطب سپهر رسالت

u ṣalāt-i bī-ġāyat bar markaz-i dāyira-yi nubuvvat u quṭb-i sipihr-i risālat

Endless blessings be upon the centre of the circle of prophethood (*nubuvvat*) and pole of the celestial sphere of apostleship (*risālat*).

Begins with:

अथ भगवद्भक्तमण्डलकेन्द्ररूपस्य दौत्यकृद्भपञ्जर-ध्रुवसदृशस्य मुनेरुपरिभगवतः कृपानन्तास्ति यत् ।

atha   bhagavadbhaktamaṇḍalakendra-rūpasya   dautyakṛdbhapañjaradhruva-sadṛśasya   muner   upari   bhagavataḥ kṛpānantāsti yat |

Now, endless compassion of God is what is [shown] over the Seer who is the centre of the circle of the prophets of God (*bhagavadbhakta*) [and] resembles the pole of the sphere of asterisms of messengers (*dautyakṛt*).

Ends with:

و علی اصحابه الراشدین المهدیین که از حدیث اصحابی کالنجوم بایهم اقتدیتم اهتدیتم وصف هدایتشان پیدا

u ʿalà aṣḥābihi l-rāšidīn al-mahdiyyin ki az ḥadīṯ aṣḥābī ka-l-nujūm bi-ayyahum

Ends with:

पुनर्दृष्टमार्गाणामन्यमार्गदर्शकानां   भगवद्भक्त-मित्राणामुपरिभगवतः   कृपा   भवन्ति ।   मम मित्राणि   नक्षत्रतुल्यानि   भवन्ति   भो   लोका यमनुसरिष्यथतमवश्यं   प्राप्स्यथेति   भगवद्भक्त-वचनादेतेषां मार्गदर्शित्वकीर्तिः प्रकटास्ति ।

punar   dṛṣṭamārgāṇām   anyamārga-darśakānāṃ   bhagavadbhaktamitrāṇām

iqtadaytum ihtadaytum vaṣf-i hidāyat-ašān paydā

upari bhagavataḥ kṛpā bhavanti | mama mitrāṇi nakṣatratulyāni bhavanti bho lokā yam anusariṣyatha tam avaśyaṃ prāpsyatheti bhagavadbhaktavacanād eteṣāṃ mārgadarśitvakīrtiḥ prakaṭāsti |

And [may God's praise be] on his rightly guided companions whose guidance is described with this hadith: "My companions are like the stars; whomever among them you follow, you will be rightly guided."

Moreover, the compassions of God are over the companions of the Prophet who are the others guides of valid paths. "My companions are like asterisms: O people, whom[ever] you will follow, you will certainly obtain [right guidance in] him," from such a statement of the Prophet [from the hadith,] the glory of guidance of these [companions of the Prophet] is manifest.

ZŠJ
ff. 1v–2r D
f. 2r H
ff. 2v–3r L
ff. 4v–5r O
f. 1v Q
p. 3 R
ff. 1v–2r S

[§ P.3]
[In praise of Šāh Jahān and his regnal era]

Begins with:

اما بعد چون بعنایت بی نهایت حضرت بادشاه علی الاطلاق خدیو کیوان‌رفعت...

ammā baᶜd čūn ba ᶜināyat-i bī-nihāyat-i ḥażrat-i bādšāh-i ᶜalà l-iṭlāq ḫadīv-i kayvān-rafᶜat...

Thus it starts: since by the endless grace of the Absolute Emperor, the King who is Saturn-like in elevation,...

Ends with:

روز دوشنبه² هشتم جمید الثانی سنه ۱۰۳۷ هزار و سی و هفت هجری بر سریر سلطنت و خلافت جلوس فرمودند و مبدء تاریخ جدید سعید الهی شاهجهانی در تقاویم و تواریخ ازین سال خجسته‌مآل نمودند و آغاز نفاذ امور مملکت بران ساعت سعادت‌انجام نهادند و همین تاریخ دستور العمل کارگزاران

[§ P.4]
[In praise of Šāh Jahān and his regnal era]

Begins with:

अथ यदि सकलब्रह्माण्डनायकस्यानन्तकृपया शनिकक्षोच्छ्रायवन्महान्...

atha yadi sakalabrahmāṇḍanāyakasyā-nantakṛpayā śanikakṣocchrāyavan mahān...

Now, if by the infinite grace of the Lord of the entire universe, the Noble One, possessing an elevation like the orbit of Saturn,...

End with:

सप्तत्रिंशदुत्तरसहस्रप्रमिते १०३७ हिजरीशाके वर्तमाने जमीदलसानीमासे मध्यमाख्याष्टमदिवसे सोमवासरे सराज्याभिषेकं प्राप्तवान्सिंहासने तस्थौ ततः प्रभृति शाहजहानी नवीनः समीचीनः शाकः पञ्चाङ्गपत्रेषु लोकव्यवहारेषु च प्रवृत्तस्तदा प्रभृति राज्यकार्यपरिचालनारंभो जातः । पुनरयं शाको राज्यभारग्रहणसमर्थानामभ्यासेन दिक्षु विदिक्षु च प्रसिद्धो ऽभूत् ।

SS
ff. 3v–4v Al
ff. 4v–5v Kh
ff. 4r–5r Pg

بارگاه سلطنت شد چنانچه در اطراف و اكناف
عالم شيوع يافت

rūz-i dū-šanba² haštum-i jumayd al-ṯānī sana 1037 hazār u sī u haft hijrī bar sarīr-i salṭanat u ḫilāfat julūs farmūdand u mabdaʾ-i tārīḫ-i jadīd-i saʿīd-i ilāhī-yi šāh-jahānī dar taqāvīm u tavārīḫ az īn sāl-i ḫujasta-maʾāl namūdand u āġāz-i nafāḏ-i umūr-i mamlakat bar ān sāʿat-i saʿādat-anjām nihādand u hamīn tārīḫ dastūr al-ʿamal-i kār-guzārān-i bārgāh-i salṭanat šud čunānči dar aṭrāf u aknāf-i ʿālam šuyūʿ yāft

On Monday,² the eighth of the month of Jumayd al-ṯānī, the year 1037 of Hegira, [Šāh Jahān] sat on the imperial and caliphal throne. He set the beginning of a new fortunate era [called] the Divine [era] of Šāh Jahān (*ilāhī-yi šāh-jahānī*) in the almanacs (*taqvīm*)and chronicles (*tārīḫ*) [counting] from this auspicious year. He started to implement sovereign affairs on this blessed hour. This same date became administrative practice for the officers of the imperial court since it gained publicity in every part of the world.

Remark Contains, inter alia, ten verses praising Emperor Šāh Jahān and his full regnal name:

saptatriṃśaduttarasahasrapramite 1037 *hijarīśake vartamāne jamīdalasānīmāse madhyamākhyāṣṭamadivase somavāsare sarājyābhiṣekaṃ prāptavān siṃhāsane tasthau tataḥ prabhṛti śāhajahānī navīnaḥ samīcīnaḥ śākaḥ pañcāṅgapattreṣu lokavyavahāreṣu ca pravṛttas tadā prabhṛti rājyakāryaparicālanāraṃbho jātaḥ | punar ayaṃ śāko rājyabhāra-grahaṇasamarthānām abhyāsena dikṣu vidikṣu ca prasiddho 'bhūt |*

In the year 1037 of the Hijri era (*hijarī-śaka*) in the present time, in the month of Jumayd al-ṯānī (*jamīdalasānī*), on the eight day called the middle [of the lunar fortnight], on Monday, obtaining that royal unction, [Emperor Šāh Jahān] was established on the throne, [and] from that moment, the new true era [called] Šāh Jahānī circulated in the almanacs (*pañcāṅgapattra*) and common customs (*lokavyavahāra*), [and] from that point its circulation in state affairs commenced. Moreover, this era became famous in all directions [of the world] on account of [its] use in undertaking and sustaining the weight of the [duties of the] state.

Remark Contains, inter alia, ten verses praising Emperor Šāh Jahān and his full Persian regnal name (in Devanāgarī):

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2 Manuscripts S and L insert here the following:

مطابق اول ٥٥٠ ناقص جلالی

muṭābiq-i avval 550 nāqiṣa jalālī

equal to the first incomplete [year] 550 [of the] Jalālī era

ابو المظفر شهاب الدین صاحب قران ثانی
شاهجهان بادشاه غازی

abū l-muẓaffar šihāb al-dīn ṣāḥib qirān-i ṯānī šāh-jahān bādšāh-i ġāzī

Father of the victorious, Star of faith, Lord of the second conjunction, King of the world (*šāh-jahān*), Emperor, Conqueror.

अबल-मुजफर-शाहिब्बदीन-महम्मद-साहिब-किरान-सानी-शाहजहा-बादिशाह-गाजी

abala-mujaphara-śāhibbadīna-mahammada-sāhiba-kirāna-sānī-śāhajahā-bādiśāha-gājī

ZŠJ
ff. 2rv D
ff. 2r–3r H
ff. 5r–6r O
ff. 3rv L
f. – Q
pp. 3–5 R
ff. 2rv S

[§ P.4]

[In praise of Āṣaf Ḫān and the commissioning of a new *zīj* named after Šāh Jahān]

Begins with:

درین اثنا بخاطر خطیر و ضمیر فیض‌پذیر...

dar īn aṯnā ba ḫāṭir-i ḫaṭīr u żamīr-i fayż-paḏīr...

In this moment, [it came] to the esteemed and gracious mind [of Āṣaf Ḫān]...

Ends with:

ملتمس از محققان و مدققان این فن آن است
که چون بر سهوی و نسیانی که لازم انسان
است اطلاع یابند آنچه از تقویم و تعدیل
خارج باشد بقلم کریم تصحیح فرموده بذیل
عفو در پوشند فمن عفی واصلح فاجره علی
الله

multamas az muḥaqqiqān u mudaqqiqān-i īn fann ān ast ki čūn bar sahvī u nisyānī ki lāzim-i insān ast iṭṭilāᶜ yāband ānči az taqvīm u taᶜdīl ḫārij bāšad ba qalam-i karīm taṣḥīḥ farmūda ba ḏayl-i ᶜafw dar pūšand fa-man ᶜafā wa-aṣlaḥa fa-ajruhu ᶜalà llāh

[§ P.5]

[In praise of Āṣaf Ḫān and the commissioning of a new *siddhānta* named after Šāh Jahān]

Begins with:

एतस्मिनन्तरे प्रसन्नहृदयस्य जगत्प्रयोजितदयस्य महामात्यप्रधानस्य...

etasmin antare prasannahṛdayasya jagatprayojitadayasya mahāmātyapradhā-nasya...

After this event, [Āṣaf Ḫān] of a delightful heart, the one who is compassionately attached to the world, the exalted Prime minister...

Ends with:

अथैतच्छास्त्रसारकोविदान्प्रति विज्ञप्तिश्चेयं केयमुच्यते यदि कुत्रापि मनुष्यधर्मत्वान्मम भ्रान्तिमशुद्धत्वं वा भवन्तः पश्यन्ति तदा कृपालेखन्या शोधनं च कृत्वापराधक्षमण-रूपपटान्तरेण च पिधाय रक्षन्तु । यः कश्चिद-पराधक्षमणं करोति शोधयति चेति तस्मै प्रत्यु-पकारवेतनफलमीश्वरो दास्यतीश्वरो ब्रूते ।

athaitacchāstrasārakovidān prati vijñaptiś ceyaṃ keyam ucyate yadi kutrāpi manuṣyadharmatvān mama bhrāntim aśuddhatvaṃ vā bhavantaḥ paśy-anti tadā kṛpālekhanyā śodhanaṃ ca kṛtvāparādhakṣamaṇarūpapaṭāntareṇa ca pidhāya rakṣantu | yaḥ kaścid aparādha-

SS
ff. 4v–5v Al
ff. 5v–7r Kh
ff. 5r–6v Pg

kṣamaṇaṃ karoti śodhayati ceti tasmai praty upakāravetanaphalam īśvaro dāsya-tīśvaro brūte |

[My] request to scholars who verify and scrutinise this discipline is the following: when they come across the errors and lapses which are inherent in humanity, may they correct with a gentle pen everything that deviates from the almanac (*taqvīm*) and adjustment (*taʿdīl*) [i.e., the corrective equations to mean positions] and hide it under the hem of their pardon. Whoever forgives and corrects, his recompense lies with Allah.

And now what is [my] request towards those learned in the essence of this science [of *jyotiṣa*], this is said: when, anywhere [in this text], they find my error or inaccuracy on account of the inherent nature of man, may they then examine it with a compassionate pen, and having made the correction and having covered it within the hem of [their] patience for transgressions, may they hide it. And thus, whoever patiently endures transgressions and corrects, God (*īśvara*) will give the fruit of favourable returns to him—thus proclaims God.

Remarks   Contains, inter alia,

1. epithetic praise of Āṣaf Ḫān; ending with his titular name:

   مقرب حضرت سلطانی یمین الدوله آصفجاهی آصفخان

   muqarrab-i ḥażrat-i sulṭānī yamīn al-dawla āṣaf-jāhī āṣaf-ḫān

   Intimate of His Imperial Majesty, Right hand of the State Āṣaf Jāhī, Āṣaf Ḫān;

2. statements on the commissioning of a new *zīj* named after Šāh Jahān;

3. the name of its author Mullā Farīd:

   فرید ابراهیم دهلوی

   farīd ibrāhīm dihlavī

Remarks   Contains, inter alia,

1. epithetic praise of Āṣaf Ḫān (*āsaphakhāna*), ending with his titular name:

   प्रभुनिकटवर्तिनो दक्षिणसम्पत्तिरासफ-जाही-आसफ-खान

   prabhunikaṭavartino dakṣiṇa-sampattir-āsapha-jāhī-āsapha-khāna

   Remaining close to the Lord [i.e., near Šāh Jahān], the Right hand of prosperity Āṣaf Jāhī, Āṣaf Ḫān;

2. statements on the commissioning of a new *siddhānta* named after Šāh Jahān;

3. the Sanskrit translation of the name of its author Mullā Farīd:

   मुल्ला-फरीद्-इबराहीम-पुत्र-ढिल्ली-निवासिन्

   mullā-pharīda-ibarāhīma-putra-ḍhillī-nivāsin

Farīd, [son of] Ibrāhīm, of Delhi;

4. thirty distichs on the composition of this *zīj*;

5. the complete title of the *Zīj-i Šāh Jahānī*:

زیج ثانی قران صاحب کارنامه
شاهجهانی

kārnāma-yi ṣāḥib qirān-i ṯānī zīj-i šāh-jahānī

The Great Work of the Second Lord of Auspicious Conjunction, the *Zīj* of Šāh Jahān; and

6. an entreaty to the readers to correct any shortcoming in the text.

Mullā Farīd, son of Ibrāhīm, inhabitant of Delhi;

4. thirty verses in praise of the distinction of this text;

5. the Devanāgarī transcription of the full Persian title of the *Zīj-i Šāh Jahānī*:

कारनामै-साहिब-किरान-सानी-जीच-शाह्-जहानी

kāranāmai-sāhiba-kirāna-sānī-jīca-śāhajahānī; and

6. an appeal to the readers to correct any errors in the text.

ZŠJ
ff. 2v–5v D
ff. 3r–6v H
ff. 3v–6v L
ff. 6r–9v O
f. – Q
pp. 5–8 R
ff. 2v–6r S

[§ ID]

مقدمه (*muqaddama*):
Introduction

Begins with:

در بیان آنچه پیش از شروع این کتاب دانستن آن ضروری است و آن مشتمل است بر پنج قسم

dar bayān-i ānči pīš az šurūᶜ-i īn kitāb dānistan-i ān żarūrī ast u ān muštamil ast bar panj qism

On what needs to be known before starting this book. It contains five parts (*qism*).

[§ ID]

ग्रन्थमुख (*granthamukha*, lit. the mouth of the book): **Introduction**

Begins with:

अथेदं पुस्तकं ग्रन्थमुखेन चतुर्भिः काण्डैश्च निबध्यते । ग्रन्थमुखं किमिति कथ्यते । यद्ग्रन्था-रम्भतः प्रागेवोपेक्षितं भवति तत्पञ्चप्रकारं वर्तते ।

athedaṃ pustakaṃ granthamukhena caturbhiḥ kāṇḍaiś ca nibadhyate | granthamukhaṃ kim iti kathyate | yad-granthārambhataḥ prāgevopekṣitaṃ bhavati tatpañcaprakāraṃ vartate |

Now, this book is bound with the Introduction (*granthamukha*, lit. the mouth of the book) and with four parts (*kāṇḍa*). What is the Introduction, that is [now] said: what is indeed regarded as succeeding the preface (*granthārambha*), that [Introduction] exits in five parts (*pañcaprakāra*, lit. five kinds).

SS
ff. 5v–10r Al
ff. 7r–12r Kh
ff. 6v–10v Pg

ZŠJ
ff. 2v–3v D
ff. 3rv H
ff. 3v–4r L
ff. 6r–7r O
f. – Q
f. – R
ff. 3rv S

[§ ID.1]

قسم اول (*qism-i avval*):
First part

Begins with:

در بیان آنکه رصد و زیج و تسهیل و تقویم چیست و در دانستن آنها چه فایده

dar bayān-i ānki raṣad u zīj u tashīl u taqvīm čīst u dar dānistan-i īnhā či fāyida

On the question of observation (*raṣad*), tables (*zīj*), simplification (*tashīl*) and almanac (*taqvīm*) and on the advantage of knowing them.

[§ ID.1]

प्रथमप्रकार (*prathamaprakāra*, lit. the first kind): First part

Begins with:

प्रथमप्रकारे रसद इति वेधः । जीच इति सिद्धान्तः । तसहील इति सारणी । तकवीम इति ग्रहस्फुटत्वमेतेषां लक्षणं प्रयोजनं च ।

prathamaprakāre rasada iti vedhaḥ | jīca iti siddhāntaḥ | tasahīla iti sāraṇī | takavīma iti grahasphuṭatvam eteṣāṃ lakṣaṇaṃ pra-yojanaṃ ca |

In the first part, the definition and purpose of these [topics such as] *rasada* meaning insight (*vedha*, lit. piercing), *jīca* meaning a canon (*siddhānta*), *tasahīla* meaning a [simplification] table (*sāraṇī*), and *takavīma* meaning

SS
ff. 5v–7r Al
ff. 7r–8v Kh
ff. 6v–8r Pg

the true position of a celestial object (*grahasphuṭatva*) [i.e., an almanac].

Remarks   Contains, inter alia,

1. a definition of the technical term *raṣad*:

مخفی نماند که رصد عبارت است از نظر کردن در احوال اجرام علوی بآلات مخصوصه چون لبنه و سدس فخری و ذات الشعبتین و ذات الثقبتین و ذات الحلقه و ذات الحلق و غیر آنکه حکما بجهت این غرض وضع کرده اند تا بدان آلات دانسته شود مواضع ستارگان در فلک و مقدار حرکات ایشان در طول و عرض و ابعاد آنها از یکدیگر و از زمین و بزرگی و کوچکی اجرام آنها و آنچه بدان ماند

maḫfī namānad ki raṣad ʿibārat ast az naẓar kardan dar aḥvāl-i ajrām-i ʿulvī ba ālāt-i maḫṣūṣa čun libna u suds-i faḫrī u ḏāt al-šuʿbatayn u ḏāt al-ṯuqbatayn u ḏāt al-ḥalqa u ḏāt al-ḥilaq u ġayr-i ān ki ḥukamā ba jihat-i īn ġaraż vażʿ karda and tā badān ālāt dānista šavad mavāżiʿ-i sitāragān dar falak u miqdār-i ḥarakāt-i īšān dar ṭūl u ʿarż u abʿād-i ānhā az yak-dīgar u az zamīn u buzurgī u kūčakī-yi ajrām-i ānhā u ānči badān mānad

It is well known that observation (*raṣad*) designates the action of observing the states of celestial objects with specific instruments, such as the quadrant (*libna*), Faḫr

Remarks   Contains, inter alia,

1. a description of the technical term *rasada* (PER: *raṣad*):

यत्पूर्वाचार्यैं रचितं लिबनै । सुदसफखरी । जातलशावतैन । जातलशुकवतैन । जातलहिलक । जातलहलका । चेत्यादि यन्त्रवेधयोग्यं तेन यन्नक्षत्रग्रहबिम्बसंस्था विलोकनं तद्रसद इत्यभिधीयते । तेनाकाशे दैर्घ्यविस्तारयोः को ऽर्थो मेषाद्यस्फुटत्व-शरयोर्ग्रहसंस्थितभुक्तिपरिमाणं पुनर्ग्रहाणां परस्परान्तरं पुनर्भूगर्भग्रहबिम्बयोरन्तरा-भिधः कर्ण इति पुनर्नक्षत्रग्रहबिम्बन्यूना-धिकत्वमन्यदपि ज्ञातुं शक्यते ।

yatpūrvācāryai racitaṃ libanai | sudasaphakharī | jātalaśāvataina | jātalaśukavataina | jātalahilaka | jātalahalakā | cetyādi yantra-vedhayogyaṃ tena yannakṣatra-grahabimbasaṃsthā vilokanaṃ tadrasada ity abhidhīyate | tenā-kāśe dairghyavistārayoḥ ko 'rtho meṣādyasphuṭatvaśarayor graha-saṃsthitabhuktiparimāṇaṃ punar grahāṇāṃ parasparāntaraṃ punar bhūgarbhagrahabimbayor antarā-bhidhaḥ karṇa iti punar nakṣatra-grahabimbanyūnādhikatvam anyad api jñātuṃ śakyate |

What things like quadrants (*libana*), Faḫr al-Dawla's sextant (*sudasa-phakharī*), the triquetrum (*jātala-śavataina*), the dioptra (*jātala-śukavataina*), the armillary

al-Dawla's sextant [created by al-Ḥujandī] (*suds-i faḫrī*), the triquetrum (*ḏāt al-šuᶜbatayn*), the dioptra (*ḏāt al-ṯuqbatayn*), the armillary ring (*ḏāt al-ḥalqa*), the armillary sphere (*ḏāt al-ḥilaq*) etc., which scientists have invented for this purpose, so that by them they may know the positions of the stars on the sphere, the measure of their movements in longitude and latitude, their distance from one another and from the Earth, their size, big or small, and such things;[3]

sphere (*jātala-hilaka*), the armillary ring (*jātala-halakā*) etc. were conceived by earlier teachers, [they are] useful observational instruments (*yantra-vedha-yogya*, lit. useful in fixing the position of celestial objects by mechanical contrivances). [And] with them, observing the arrangement of the planetary discs and constellations is what is known as *rasada*.[4] What is the use of it in [understanding] the length and breadth in the sky? The measure of the daily motion of the planets in [terms of their ecliptic] latitude and longitude; and the mutual distance between planets; and again the hypotenuse called the distance between the disc of a planet and the Earth's centre, and the largeness or smallness of the discs of the planets and stars; and even other [such things] can be known [by *rasada*];

2. an account of earlier astronomers who made observations: namely,

   (a) Hipparchus (*abarḫus*) who made his observations around 1400 years before the beginning of Ilkhanid observations;

2. an account of earlier astronomers who made observations: namely,

   (a) Hipparchus (*abarakhusa*) [of Nicaea];

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3 See, e.g., S. R. Sarma (2019: 1486) for an account of some of the Indo-Persian astronomical equipment, including the ones listed here.

4 See, e.g., K. V. Sarma (1985: 22) for a list of (near-)identically named astronomical instruments created by Maharaja Sawai Jai Singh (1686–1743) of Jaipur.

(b) Ptolemy (*baṭlamīyūs*), the author of the *Almagest*, who made his observations in Alexandria 280 years after Hipparchus;

(b) Ptolemy (*batlamayūsa*), the author of the *Almagest* (*mujasti*), who made his observations in the city of Alexandria (*sīkandarīya-nagara*) 280 years after Hipparchus;

(c) Caliph al-Maʾmūn (*māmūn ḫalīfa*) who made his observations around 430 years before the beginning of Ilkhanid observations;

(c) The Abbasid Caliph al-Maʾmūn (*māmūn-khalīphai*) who made observations in the region of Baghdad (*bagadāda-deśa*) 690 years after Ptolemy;

(d) Unnamed astronomers who made the Ilkhanid observations (*raṣad-i īlḫānī*) in Maragha;

(d) Unnamed astronomers who made the Ilkhanid observations (*īlakhānī-rasada*) in the city of Maragha (*marāgaṁ-nagara*) 430 years after al-Maʾmūn;

(e) al-Battānī in Syria;

(e) al-Battānī (*battānī*) in Syria (*śāma-deśa*) who worked near-contemporaneously to the time of the Il-ḫanid observations;

(f) [Ibn Yūnus] the author of the *Zīj-i ḥākimī* composed in Egypt;

(f) [Ibn Yūnus] the author of the *hākimī zīj* composed in Egypt (*misara-deśa*) contemporaneous to Il-ḫanid observations;

(g) Ibn al-Aᶜlam in Baghdad;[5] and

(g) Ibn al-Aᶜlam (*ibanala-ālama*) who made observations in the region of Baghdad बगदाद-देश (*bagadāda-deśa*) contemporaneous to Il-ḫa-nid observations;[6] and

(h) Uluġ Bīg the king-astronomer leading the Mīrzāʾī observations in Samarqand;

(h) Mīrzā Uluġ Bīg in the city of Samarqand (*mirajā-ulaga-bega*) who made observations in Samarqand (*samarakanda-deśa*);

3. a praise of Mīrzā Uluġ Bīg, the author of the *Zīj-i Uluġ Bīg* (alias *Zīj-i Sulṭānī*):

3. a praise of Mīrzā Uluġ Bīg, the author of the *Zīj-i Uluġ Bīg* (alias *Zīj-i Sulṭānī*):

سلطان اعظم خاقان اكرم قطب سپهر سلطنت شمس جهان معدلت الجامع بين الدين والدولة العارف بلعلوم والمعقولة والمعقولة مكمل علوم الحساب والعدد كاشف مفصلات التحرير والرصد الغ بیگ میرزا طاب ثراه که از ابای کرام این شهنشاه عالمیان است باتفاق اکثر علمای متبحر که هر یک بی نظیر زمانه بودند بدقایق و لطایف و تحقیقات تمام باتمام رسانیده اند

...किंतु समर्कंदनगरे महाराजाधिराजस्य महोदास्य राज्याकाशध्रुवस्य न्याय-लोकभास्करस्य राज्यलक्ष्मीधर्मग्राहकस्य शब्दयुक्तिशास्त्रप्रवीणस्य गणितकलासर्वज्ञ-कल्पस्य शिल्पशास्त्ररसदशास्त्रसूक्ष्मप्रमेय-प्रकाशकस्य मिरजाउलुगबेगस्य रसदइति को ऽर्थो यन्त्रविशेषैर्ग्रहसमस्तनक्षत्रवेध आसीत् । परमेश्वरस्तस्य स्वर्गवासं करोतु । एतस्यैवास्माकं प्रभोर्महाराजा-धिराजस्य कुले पितामहादिषु पूर्वज आसीत् । तस्मिन्नेव समये महातन्त्र-विद्भिरनन्योपमैर्विषया समुद्रसट्टशौरन्यैरपि मिलित्वा सग्रहादिवेधोविधाय संपूर्णीकृतः ।

sulṭān-i aᶜẓam ḫāqān-i akram quṭb-i sipihr-i salṭanat šams-i jahān-i maᶜdalat al-jāmiᶜ bayna l-dīn wa-l-dawla al-ᶜārif bi-l-ᶜulūm al-manqūla wa-l-maᶜqūla mukam-mil ᶜulūm al-ḥisāb wa-l-ᶜadad

...kiṃtu samarkandanagare mahā-rājādhirājasya mahodāsya rājyākāśa-dhruvasya nyāyalokabhāskarasya rājyalakṣmīdharmagrāhakasya śabda-yuktiśāstrapravīṇasya gaṇitakalā-sarvajñakalpasya śilpaśāstrarasada-

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[5] Mullā Farīd states that none of the above mentioned observations were complete; the only complete set of observations is the Mīrzāʾī observations of Uluġ Bīg.

[6] Like Mullā Farīd, Nityānanda also states that none of the above mentioned observations were complete in all respects; the only complete observations are those made by Mīrzā Uluġ Bīg.

kāšif mufaṣṣalāt al-taḥrīr wa-l-
raṣad uluġ bīg mīrzā ṭāba ṯarāhu
ki az abā-yi kirām-i īn šahanšāh-i
ᶜālamīyān ast ba ittifāq-i aktar-i
ᶜulamā-yi mutabaḥḥir ki har yak bī-
naẓīr-i zamāna būdand ba daqāyiq u
laṭāyif u taḥqīqāt tamām ba itmām
rasānīda and

śāstrasūkṣmaprameyaprakāśakasya
mirajāulugabegasya rasadaïti ko
'rtho yantraviśeṣair grahasamasta-
nakṣatravedha āsīt | parameśvaras
tasya svargavāsaṃ karotu | etasyai-
vāsmākaṃ prabhor mahārājā-
dhirājasya kule pitāmahādiṣu
pūrvaja āsīt | tasminn eva samaye
mahātantravidbhir ananyopamair
vidyayā samudrasadṛśair anyair
api militvā sagrahādivedho vidhāya
saṃpūrṇīkṛtaḥ |

The supreme ruler, the noblest king, the pole of the sphere of kingship, the Sun of the world of justice, the uniter of faith and power, the knower of traditional and rational sciences, the perfector of the sciences of computation and numbers, the unveiler of the details of writing and observation, Uluġ Bīg Mīrzā—May the soil [of his grave] be fragrant—who is amongst the noble fathers of this emperor of men, with the collaboration of the many of the most learned men, every one of whom were peerless in their time, has brought to perfection every subtle and delicate point of research;

...but in the city of Samarqand, the observation (*rasada*) of Mīrzā Uluġ Bīg, the one who is the king among kings; the mighty one; the pole of the sky of kingship; the Sun of the world of justice; the one who seizes the faith and good fortunes of the kingdom; the one versed in the sciences, reasoning, and speech; the one competent knowing all things in the mathematical arts; the illuminator of the subtle topics in the science of *rasada* and of form, was the one who was capable of providing insight [about the true positions of] constellations and all the planets with special [astronomical] instruments. May God give him residence in heaven. He was an ancestor among the grandfathers in the ancestral lineage of my lord [Šāh Jahān], this very King among kings. At that very time, having collaborated with many of those most knowledgeable in the sciences, the ones who are unique in resembling oceans with knowledge, [Uluġ

Bīg] brought to completion the insight beginning with the planets etc. for the sake of piercing [the truth];

4. the definition of observational *zīj*es (*zīj-i raṣadī*):

چون حرکات کواکب بحسب اصول رصدی معلوم کنند و بجداول در کتابی مضبوط گردانند آنرا زیج رصدی خوانند چنانچه زیج الغ بیگ و آنرا زیج سمرقندی و زیج گورگانی نیز گویند و آن مشتمل است بر اعمال تحقیقی مثل جیب یک درجه که بنای عمل جدول جیب و ظل بران است و الی یومنا هذا هیچکس بطریق برهانی استخراج نکرده و همه حکما تصریح کرده اند با آنکه طریق عمل استخراج آن نیافته اند و حیله کرده بدست بتقریب آورده اند و غیر آن از اعمال کثیره

čūn ḥarakāt-i kavākib ba ḥasb-i uṣūl-i raṣadī maꜥlūm kunand u ba jadāvil dar kitābī maż̤būṭ gardānand ān rā zīj-i raṣadī ḫwānand čunānči zīj-i uluġ bīg u ān rā zīj-i samarqandī u zīj-i gūrgānī nīz gūyand u ān muštamil ast bar aꜥmāl-i taḥqīqī miṯl-i jayb-i yak-daraja ki binā-yi ꜥamal-i jadval-i jayb u ẓill bar ān ast u ilà yawminā hāḏā hīč-kas ba ṭarīq-i burhānī istiḫrāj nakarda u hama ḥukamā taṣrīḥ karda and bā ān ki ṭarīq-i ꜥamal-i istiḫrāj-i ān nayāfta and u ḥīla karda ba taqrīb ba dast āvarda and u ġayr-i ān az aꜥmāl-i kaṯīra

4. a description of observational *zijes* or *rasadī-jica* (PER: *zīj-i raṣadī*):

यद्रसदविधानेन ग्रहभुक्तिमानीयकोष्ठकै-र्दृढीकृत्य तन्त्रं लिख्यते तस्य नाम जीचरसदीति व्याख्यायते । यथा जीच-उलगबेगी अस्यैव नाम जीचसमरकन्दी पुनः कोर्गानी चेति कथ्यते । तदिदं पुस्तकं सूक्ष्मसूक्ष्मगणितप्रमेयैर्युतमस्ति यथा प्रत्येकांशस्य जीवा सर्वगणितस्य छाया प्रभृतेर्मूलमस्ति पुनरध यावत्केनापि वासनया सा न कृता किंतु सर्व एवाचार्या एवमेव जगुर्ज्यायाः साधने वासनया प्रकारः केनापि न लभ्यः योज्यानयने प्रकारः कृतः स सर्वो वास्तवेन न किंतु स्थुलः कृतः । अस्मिन्ग्रन्थे सा ज्या प्रत्येक कलाया वासनामार्गेण कृतान्यदपि तथैव । इति रसदीजिचविवरणम् ।

yad rasadavidhānena grahabhukti-mānīyakoṣṭhakair dṛḍhīkṛtya tantraṃ likhyate tasya nāma jīcarasadīti vyākhyāyate | yathā jīcaülagabegī asyaiva nāma jīca-samarakandī punaḥ korgānī ceti kathyate | tad idaṃ pustakaṃ sūkṣmasūkṣmagaṇitaprameyair yutam asti yathā pratyekāṃśasya jīvā sarvagaṇitasya chāyāprabhṛter mūlam asti punar adha yāvat kenāpi vāsanayā sā na kṛtā kiṃtu sarva evācāryā evam eva jagur jyāyāḥ sādhane vāsanayā prakāraḥ kenāpi na labdhaḥ yojyānayane prakāraḥ kṛtaḥ sa sarvo vāstavena na kiṃtu sthulaḥ kṛtaḥ | asmin granthe sā jyā pratyeka kalāyā

When the movements of celestial objects are exposed according to the fundamentals of observation (*uṣūl-i raṣadī*) and ordered in tables inside a book, it is called an observational *zīj*. Such an example is the *Zīj-i Uluġ Bīg*, which is also called the *Zīj-i Samarqandī* and the *Zīj-i Gūrgānī*. It contains verified calculations (*aʿmāl-i taḥqīqī*), like the sine for every degree on which is constructed the calculation of the table of the sine and the tangent. Until now, no one has been able to derive this [table] by means of a demonstration (*ṭarīq-i burhānī*) and scholars have all made it clear. Despite having not found a way to calculate its derivation, they have procured [the table] by approximation using stratagems (*ḥīla*). Besides this there are many calculations [in the *Zīj-i Uluġ Bīg*];

vāsanāmārgeṇa kṛtānyad api tathaiva | iti rasadījicavivaraṇam |

The treatise that is meant to be strengthened following the method of observations (*rasadavidhāna*) [and] is written with tables meant to measure the daily motion of the planets: its name called *jicarasadī* is [now] described. Such an example is the *Zīj-i Uluġ Bīg* (*jīca-ulagabegī*), which is also called *Zīj-i Samarqandī* (*jīca-samarakandī*) and also known as the *Gūrgānī* (*korgānī*) [*zīj*]. This book contains extremely subtle demonstrable computations (*sūkṣma-sūkṣma-gaṇita-prameya*) such as the sine of every degree which is the foundation of all computations beginning with [the computation of] shadow-lengths [i.e., tangents]. Moreover, until now, no one has composed [such a text] supported by demonstration (*vāsanā*); however, all teachers admit in this manner that the kind of computation of sine with demonstration has not been obtained by anyone, and the kind [which is] done in practical calculation (*yojyānayana*), all that is not with exactness but roughly done. In this book [i.e., the *Zīj-i Uluġ Bīg*], the sine for every minute is computed by the method of demonstration; even other [computations in this book] are done in like manner [supported by demonstrations].

5. on the reason of correcting observational *zījes* (*zīj-i raṣadī*) and producing computational *zījes* (*zīj-i ḥisābī*):

و آنکه در ارقام بعضی جداول تفاوت قلیل یافته میشود ظاهرا محاسبان این زیج بمسامحه عمل فرموده باشند و چون تفاوتهای که بمرور ایام در زیج رصدی حادث شده باشد مثل تعدیل الایام و غیره بمعونت حساب بقدر امکان رفع نمایند و آنچه بجهت تساهل دران کمی کرده باشند یا از محاسبان آن وقت سهوی شده باشد درست سازند و خطاهای جداول که بمرور ایام از قلم ناسخان بوقوع آمده باشد تصحیح نمایند و تصرفات بجهت حصول مدعا بآسانی کنند و غیر ذلک آنرا زیج حسابی گویند

u ānki dar arqām-i baᶜžī-yi jadāvil tafāvut-i qalīl yāfta mīšavad ẓāhiran muḥāsibān-i īn zīj ba musāmaḥa ᶜamal farmūda bāšand u čūn tafāvuthāī ki ba murūr-i ayyām dar zīj-i raṣadī ḥādit̲ šuda bāšad mit̲l-i taᶜdīl al-ayyām u ġayruhu ba maᶜūnat-i ḥisāb ba qadr-i imkān rafᶜ namāyand u ānči ba jihat-i tasāhul dar ān kamī karda bāšand yā az muḥāsibān-i ān vaqt sahvī šuda bāšad durust sāzand u ḫaṭāhā-yi jadāvil ki ba murūr-i ayyām az qalam-i nāsiḫān ba vuqūᶜ āmada bāšad taṣḥīḥ namāyand u taṣarrufāt ba jihat-i ḥuṣūl-i muddaᶜā ba āsānī kunand u ġayr d̲ālika ān rā zīj-i ḥisābī gūyand

Thus ends the description of *rasadī-jīca*;

5. a description of the computational *zijes* or *jīca-hisābī* (PER: *zīj-i ḥisābī*):

अथ यत्र केषुचिदङ्केषु कोष्ठगतेषु स्वल्पमन्तरं दृश्यते प्रायो ऽस्य जीचस्य ये गणकाः स्वल्पान्तरदोषममन्यमाना एतादृशं गणितं चक्रुः ततः कियता कालेन गतेन सान्तरमाविर्भूतं यथा द्युफलादिषु परत्रापि तदन्तरं गणितबलेन गणकैर्यथा शक्तिं दूरीक्रियते । पुनर्यत्किं- चिदङ्कनिःशेषग्रहणाभावेनाङ्कस्य न्यूनाधि- कत्वं कृतमस्ति किंवा गणका एवात्र प्रमादयुक्ता बभूवुः किंवा लेखकपरम्परया कोष्ठकेषु लिखितमशुद्धमस्ति तद्गणकैः शोध्यते । वास्तवफलं वा सुगमप्रकारान्त- रेणानीयते तस्य नाम जीचहिसाबीति कथ्यते ।

atha yatra keṣucid aṅkeṣu koṣṭha-gateṣu svalpam antaraṃ dṛśyate prāyo 'sya jīcasya ye gaṇakāḥ svalpāntaradoṣam amanyamānā etādṛśaṃ gaṇitaṃ cakruḥ tataḥ kiyatā kālena gatena sāntaram āvirbhūtaṃ yathā dyuphalādiṣu paratrāpi tadantaraṃ gaṇita-balena gaṇakair yathā śaktiṃ dūrīkriyate | punar yatkiṃcid aṅka-niḥśeṣagrahaṇābhāvenāṅkasya nyū-nādhikatvaṃ kṛtam asti kiṃvā gaṇakā evātra pramādayuktā babhūvuḥ kiṃvā lekhaka-paramparayā koṣṭhakeṣu likhitam aśuddham asti tad gaṇakaiḥ śodhyate | vāstavaphalaṃ vā sugamaprakārāntareṇānīyate tasya nāma jīcahisābīti kathyate |

When, apparently, the calculators of a *zīj* [re]calculate with lenity the small discrepancies found in the numbers given in some tables; when they correct as much as possible with the help of calculation the discrepancies that arise in the observational *zīj*es because of the passing of time such as the equation of time etc.; when they correct things which are lacking in that [*zīj*] because of indulgence/negligence or are errors made by calculators at that time; when they rectify the mistakes which have crept in the tables through the pen of copyists with the passing of time; when they simplify the sums [needed] to grasp the intended [subject] etc., this is called a computational *zīj*;

Now, when, for the most part, a very small difference is seen in some digits [written] in the cells of this *zīj* [with] which mathematicians, on account of not regarding the error of these very small differences, made calculations like this, then with even a little elapsed time that difference becomes evident just as is in [the case of] the equation of time etc. and elsewhere; that difference is [then] removed by [other] mathematicians by the strength of calculations to the best of one's ability. Moreover, [if] on account of not completely accepting whatever little digits there is the state of deficiency or excess in [their] work, or [if] the mathematicians just became negligent here, or [if] by following the tradition of scribes, the writing is erroneous in the tables, [then] that is rectified by mathematicians. Or [if] the true result is calculated by another simplified manner, [then] the name of that [*zīj*] is said to be *jīca-hisābī*;

6. a list of earlier Islamicate *zīj*es: see Appendix § B;

6. a Devanāgarī transcription of the Persian names of earlier Islamicate *zīj*es: see Appendix § B;

7. a discussion on the etymology of the word *zīj* going from Persian to Arabic: see Appendix § D;

7. a Devanāgarī (Sanskrit) translation of the discussion on the etymology of the word *jīca* (*zīj*) going from Persian to Arabic: see Appendix § D;

8. a definition of simplification tables (*tashīl*), beginning with

8. a description of the [simplification] tables (*sāraṇī*s), beginning with

چون تصرفات در بعضی جداول مثلا تعدیلات کواکب و غیره بجهت آسانی عمل کنند و آن خالی از مساهله نباشد آنرا تسهیل نامند

čūn taṣarrufāt dar baʿżī-yi jadāvil maṯalan taʿdīlāt-i kavākib u ġayruhu ba jihat-i āsānī ʿamal kunand u ān ḫālī az musāhala nabāšad ān rā tashīl nāmand

When in some tables, the usages such as the equations of celestial objects etc., are simplified by calculation and are exempt from negligence, this is called simplification (*tashīl*);

यत्र कोष्ठकेषु केषुचित्किंचिद्गणितमुत्पाद्य यथा ग्रहशीघ्रमन्दफलमन्यदपि सुगमार्थं स्थूलमपि लिख्यते सा सारणी ।

yatra koṣṭhakeṣu keṣucit kiṃcid-gaṇitam utpādya yathā graha-śīghramandaphalam anyad api sugamārthaṃ sthūlam api likhyate sā sāraṇī |

When in some tables, having made whatever computation such as the slow and fast corrective equations of the planets and also other [similar computations], [the correction] is written for the sake of ease even though inexact, that is a [simplification] table (*sāraṇī*);

and ending in

and ending in

کتابی که مشتمل بر اعمال تسهیلی و تحقیقی باشد و همه اعمال زیج در وی بود آنرا زیج گویند نه تسهیل چنانچه زیج خاقانی که همه اعمال تحقیقی و تسهیلی در وی است و زیج عمده از علیشاه خوارزمی صاحب اشجار و اثمار که در احکام نجوم است و زیج مظهری از ملا مظهر و مقصود ازین تفصیل آنکه فرق کنند میان زیج رصدی و زیج حسابی و تسهیل تا یکی را بنام دیگری نخوانند

kitābī ki muštamil bar aʿmāl-i tashīlī u taḥqīqī bāšad u hama aʿmāl-i zīj dar vay buvad ān rā zīj gūyand na tashīl čunānči zīj-i ḫāqānī ki hama aʿmāl-i taḥqīqī u tashīlī dar vay ast u zīj-i ʿumda az ʿalī-šāh ḫwārazmī ṣāḥib-i ašjār u aṯmār ki dar aḥkām-i

यस्मिन्ग्रन्थे स्थूलसूक्ष्मगणितानि भवन्ति तस्य नाम जीच इति । एतन्नाम सारिणी नेति यथा जीचखाकानी पुनः सजरे समरकर्तुरली शाहख्वारजमी पुनः मुल्लामजहरीति नाम्नो जीचमजहरी । प्रयोजनमिदमेवात्र जीचरसदीजीचहिसाबी-सारणीनां यथाभेदो भवति ।

yasmingranthe sthūlasūkṣma-gaṇitāni bhavanti tasya nāma jīca iti | etannāma sāriṇī neti yathā jīcakhākānī punaḥ sajare samarakarturalī śāhakhvārajamī punaḥ mullāmajaharīti nāmno jīcamajaharī | prayojanam idam

nujūm ast u zīj-i maẓharī az mullā maẓhar u maqsūd az īn tafsīl ānki farq kunand miyān-i zīj-i raṣadī u zīj-i ḥisābī u tashīl tā yakī rā ba nām-i dīgarī naḫwānand

A book which contains calculations both simplified and verified and contains all the calculations of a *zīj* is called *zīj* and not *tashīl* 'simplification'. Such is the case of the *Zīj-i Ḫāqānī*, which contains every simplified and verified calculations, also of the *Zīj-i ʿumda* by ʿAlī Šāh Ḫwārazmī, the author of [the book] *Trees and Fruits* (*ašjār u aṯmār*) which is on astrology, and of the *Zīj-i Maẓharī* by Mullā Maẓhar. The objective of this division is to separate between observational *zīj*es, computational *zīj*es and simplifications so that they are not called by each other's name;

Note: This section includes a list of earlier Islamicate simplification tables (*tashīl*): see Appendix § C;

9. a definition of an almanac (*taqvīm*):

چون از زیج مواضع ستارگان در
روزیهای یکسال بیرون آرند در طول و
عرض و اتصالات ایشان را با یکدیگر
و طالعهای فصول و اجتماعات و
استقبالات و قرانات و کسوف و رؤیه
اهله و مانند آن در دفتر نویسند آنرا
تقویم خوانند و تقویم در لغت راست
داشتن و قیمت کردن است

evātra jīcarasadījīcahisābīsāraṇīnāṃ yathābhedo bhavati |

The book in which there are [both] rough and exact computations is called *zīj* (*jīca*) by name. Its name is not [the simplification] table (*sāraṇī*): for example, the *Zīj-i Ḫāqānī* (*jīca-khākānī*), and [the one] by the author of *sajare-samara* (PER: *ašjār u aṯmār*) ʿAlī Šāh Ḫwārazmī (*alī-śāha-khvārajamī*), and again the *Zīj-i Maẓharī* (*jīca-majaharī*) by the one named Mullā Maẓharī (*mullā-majaharī*). Here, the very purpose [of this division] is to make evident the distinction between the [simplification] tables (*sāraṇi*s), the observational *zīj*es (*jīca-rasadī*), and the computational *zīj*es (*jīca-hisābī*);

Note: This section includes the Devanāgarī transcriptions of the Persian names of earlier Islamicate simplification tables (*sāraṇī*): see Appendix § C;

9. a description of an almanac (*pañcāṅgapattra*):

अथ यत्र जीचतः सर्ववर्षस्य दिनेषु ग्रहाणां स्फुटत्वं शरश्च ग्रहाणां परस्परमित्तशालानि ऋतुप्रारम्भलग्नं पूर्णमासीलग्नममावस्यालग्नं ग्रहाणामेककलायां संयोगः किराननामा चन्द्रग्रहणं सूर्यग्रहणं चन्द्रदर्शनं लिख्यते तन्नाम तकवीमेति पञ्चाङ्गपत्त-मित्यर्थः । क्रमपरिपाद्या यथास्थानरक्षणं तकवीमशब्दस्येत्यर्थम् ।

čūn az zīj mavāžiᶜ-i sitāragān dar rūzīhā-yi yak-sāl bīrūn ārand dar ṭūl u ᶜarż u ittiṣālāt-i īšān rā bā yak-dīgar u ṭāliᶜhā-yi fuṣūl u ijtimāᶜāt u istiqbālāt u qirānāt u kusūf u ḥusūf u ruᵓya-yi ahilla u mānand-i ān dar daftar navīsand ān rā taqvīm ḫwānand u taqvīm dar luġat rāst dāštan u qīmat kardan ast

atha yatra jīcataḥ sarvavarṣasya dineṣu grahāṇāṃ sphuṭatvaṃ śaraśca grahāṇāṃ parasparam ittaśālāni ṛtuprārambhalagnaṃ pūrṇamāsīlagnam āmāvasyālagnaṃ grahāṇām ekakalāyāṃ saṃyogaḥ kirananāmā candragrahaṇaṃ sūryagrahaṇaṃ candradarśanam likhyate tannāma takavīmeti pañcāṅgapattram ityarthaḥ | krama-paripāḍyā yathāsthānarakṣaṇaṃ takavīmaśabdasyetyartham |

When one extracts the positions of celestial objects for every day in a year inside a volume with their longitudes, latitudes, their mutual conjunctions/applications (*itti-ṣālāt*), the ascendants of the seasons (*ṭāliᶜhā-yi fuṣūl*), their conjunctions (*ijtimāᶜāt*), oppositions (*istiqbālāt*), conjunctions (*qirānāt*), the solar and lunar eclipses, the sighting of the new Moons, and similar matters, it is called almanac (*taqvīm*). And *taqvīm* literally means to 'straighten', to 'fix'; and

Now, [extracted] from the *zīj*, [the book] where, for the days of every year, the true position [i.e., longitude] and latitude of the planets; the mutual [Tājika configuration of] conjunctions/applications (SAN: *itta-śāla*, PER: *ittiṣāl*) of the planets; the ascendant of the beginning of the seasons (*ṛtu-prārambha-lagna*); the ascendant of the the night of full Moon; the ascendant of the night of new Moon; the conjunction (*saṃyoga*), called *kirāna* (PER: *qirān*) by name, of the planets at a moment of time; the lunar eclipse; the solar eclipse; [and] the visibility of [the disc of] the Moon is written, that is called *takavīma* (PER: *taqvīm*) meaning the almanac (*pañcāṅga-pattra*). For this purpose, the regular root of the word *takavīma* is [to be understood] as the preservation of the appropriate place; and

10. on the advantage (*fāyida*) of almanacs (*taqvīm*) and *zīj*es, and

10. on the use (*prayojana*) of almanacs (*takavīma*) and *zīj*es, and of

of observation (*raṣad*): see Appendix § E.

observations (*rasada*): see Appendix § E.

[§ ID.2]

قسم دوم (*qism-i duvum*):
Second part

[§ ID.2]
द्वितीयप्रकार (*dvitīyaprakāra*, lit. the second kind): Second part

Begins with:

Begins with:

در حالات و صفات این زیج که بر همه
زیجهای سابقه ترجیح بآن یافته

dar ḥālāt u ṣifāt-i īn zīj ki bar hama zījhā-yi sābiqa tarjīḥ ba ān yāfta

अथ द्वितीयप्रकारे ऽस्य जीचस्य प्रशंसा यत्सर्वेभ्यो जीचेभ्यो माहात्म्यं प्राप्नोति तथाहि ।

atha dvitīyaprakāre 'sya jīcasya praśaṃsā yatsarvebhyo jīcebhyo māhātmyaṃ prāpnoti tathāhi |

On the characteristics of these tables which make them superior to earlier tables.

Now, in the second part, the praise of this *zīj*, which, amongst all [other] *zīj*es, obtains magnanimity thusly.

Ends with:

Ends with:

اکنون بر جمیع دولت‌خواهان و بندگان آن
حضرت واجب و لازم است که این کتاب
را رواج دهند و مکرر نویساننده در اطراف
و اکناف عالم مشهور گردانند به در
اندک مدت در جمیع بلاد و امصار اعتبار و
اشتهار یابد که آن موجب اشتهار و بقای نام
سعادت‌فرجام این بادشاه عالیشان تا ابد الآباد
شود و مستلزم آن است که تاریخ مبارک
آن حضرت همیشه در تمام عالم معمول و
مشهور باشد

aknūn bar jamīᶜ-i dawlat-ḫwāhān u band-agān-i ān ḥażrat vājib u lāzim ast ki īn kitāb rā ravāj dahand u mukarrar navīsānda dar aṭrāf u aknāf-i ᶜālam mašhūr gardānand ba nawᶜī ki dar andak maddat dar jamīᶜ-i bilād u amṣār iᶜtibār u ištihār yābad ki ān mūjib-i ištihār u baqā-yi nām-i saᶜādat-farjām-i īn bādšāh-i ᶜālī-šān tā abad al-ābād šavad u mustalzam ān ast ki tārīḫ-i mubārak-i ān ḥażrat hamīša dar ᶜālam maᶜmūl u mašhūr bāšad

अधुना सर्वे महाप्रभुशुभवाञ्छका अवश्यमेवास्य ग्रन्थस्य प्रसिद्धिं कारयन्तु बहुशो ऽस्य पुस्तकानि लिखापयित्वा दिक्षु विदिक्षु प्रेषयन्तु यथास्य ग्रन्थस्य प्रसिद्धिर्भवति यथा स्वल्पैर्दिनैः सकलदेशनगरेषु प्रसिद्धमिदं भवति पुनरस्य महाप्रभोर्नामशुभायति संसारे स्थिरं चिरं वसति प्रयोजनमिदं महाप्रभोः शाकः सदैवास्मिञ्जगति सर्वत्र प्रवृत्त्या प्रसिद्धो भवति ।

adhunā sarve mahāprabhuśubhavāñchakā avaśyam evāsya granthasya prasiddhiṃ kārayantu bahuśo 'sya pustakāni likhāpa-yitvā dikṣu vidikṣu preṣayantu yathāsya granthasya prasiddhir bhavati yathā svalpair dinaiḥ sakaladeśanagareṣu prasiddham idaṃ bhavati punar asya mahāprabhor nāmaśubhāyati saṃsāre sthiraṃ ciraṃ vasati prayojanam idaṃ mahāprabhoḥ śākaḥ sadaivāsmiñ jagati sarvatra pravṛttyā prasiddho bhavati |

Now, it behoves every well-wisher and servant of His Majesty to circulate this book and, by repeated copy, make it famous in every corner of the world, in a manner that, in a short time, it will gain credit and fame in all countries, by which the auspicious name of this High Emperor will be famed and endure for all eternity. From this, it will necessarily ensue that the blessed era of His Majesty will be forever established and famous in the world.

Now, certainly, may all the well-wishers of the King bring about the renown of this text. After having made [manuscript-]copies of this repeatedly, may they diffuse [these copies] in every part of the world so that the renown of this book grows in a manner that within the littlest of days in all the countries and cities this [text] becomes famous, [and] moreover, the name of this King becomes a blessing [and] maintains [its] steadfast and long-lasting purpose in the world. [Thus,] the era of the King will always be celebrated in this world everywhere by [its] use.

Remarks   Contains, inter alia,

1. statements on the conditions for writing an observational *zīj* and the reason why the author chose to compose a computational *zīj*:

مخفی نماند که چون زیج رصدی
بکمتر از سی سال که دور سبعه سیاره
دران تمام میشود و غیر از معاونان
بسیار و آلات صحیحه و نصب آن
کما ینبغی و جاه و مال و فراغ بال
نتوان ساخت و اگر بیشتر از سی سال
باین کار پردازند بهتر و صحیحتر بود
چنانچه علامه طوسی در زیج خود
آورده بنا بران فرصت را غنیمت شمرده
اختیار زیج حسابی نمود

maḫfī namānad ki čūn zīj-i raṣadī
ba kamtar az sī sāl ki dawr-i sabᶜa
sayyāra dar ān tamām mīšavad u
ġayr az muᶜāvinān-i bisyār u ālāt-i
ṣaḥīḥa u naṣb-i ān kamā yanbaġī u
jāh u māl u firāġ-i bāl natavān sāḫt u

Remarks   Contains, inter alia,

1. statements on the inability to update in time a three-hundred year old *zīj* (i.e., the *Zīj-i Uluġ Bīg*) observationally, bearing upon al-Ṭūsī's statement:

किंवा त्रिंशद्वर्षेभ्यो ऽप्यधिककालेन यदा रसदं सध्यते तदातीव शुद्धा ग्रहा भवन्तीति ऽलामततूसीनाम्नाचार्येण स्वजीचे प्रोक्तं तस्मादिममेव बहुसमयं मत्वा हिसाबीजीच- स्याङ्गीकारो मया कृतः ।

kiṃvā triṃśadvarṣebhyo 'py adhi-
kakālena yadā rasadaṃ sadhyate
tadātīva śuddhā grahā bhavantīti
'lāmatatūsīnāmnācāryeṇa svajīce
proktaṃ tasmād imam eva

agar bīštar az sī sāl ba īn kār pardāz-and bihtar u ṣaḥīḥtar buvad čunānči ʿallāma ṭūsī dar zīj-i ḫwud āvarda binā bar ān furṣat rā ġanīmat šumurda iḫtiyār-i zīj-i ḥisābī namūd

It is known that it is impossible to make an observational *zīj* in less than thirty years, in which the revolution of the seven planets is completed, and also without many assistants, exact instruments and their installation as is required, a high rank, fortune and leisure. If more than thirty years are spent on this work it will be better and more perfect, just as the learned [Naṣīr al-Dīn] Ṭūsī related in his own *zīj*. On this ground, having seized the opportunity, [this author] chose to [write] a computational *zīj*;

2. statements proselytising the divine era of Šāh Jahān in relation to writing astronomical tables derived from the *Zīj-i Gūrgānī* (an alias of *Zīj-i Uluġ Bīg*).

bahusamayaṃ matvā hisābījīca-syāṅgīkāro mayā kṛtaḥ |

Otherwise, if observation (*rasada*) is made over time in excess of three-hundred years, then extremely precise [positions of the] planets can be determined—this is said by the preceptor ʿAllāma al-Ṭūsī (*alamata-tūsī*) in his own *zīj*. Therefore, having thought about this [for a] long time, the promise of [composing] a computational *zīj* (*hisābī-jīca*) is made by me;

2. statements on the superiority of the numbers contained in the *Zīj-i Uluġ Bīg*; and

3. list of certain modifications made in the tables, especially the correspondence between values found in some tables and the abjad values of names of Šāh Jahān; and the addition of dates given in the divine era of Šāh Jahān.

ZŠJ

ff. 3v–4v D
ff. 4rv H
ff. 4v–5r L
ff. 7r–8r O
f. – Q
p. – R
ff. 4rv S

[§ ID.3]

قسم سیوم (*qism-i sīvum*):
Third part

Begins with:

در بیان موافقت و مناسبت اعدادی که درین
زیج سعید معمول و مذکور است

*dar bayān-i muvāfaqāt u munāsabāt-i
aʿdādī ki dar īn zīj-i saʿīd maʿmūl u maḏkūr
ast*

On the conformity and convenience of
numerology (*aʿdād*, lit. numbers) cal-
culated and mentioned in these fortu-
nate tables.

Remark   Contains a detailed exposi-
tion on the correspondences between
the abjad values of several names given
to Šāh Jahān and various astronomical
parameters; for example, the number
of solar days in a year (365) and the ab-
jad value of 'Šāh Jahān' (365). Includes
tables.[8]

[§ ID.3]

तृतीयप्रकार (*tṛtīyaprakāra*, lit. the third
kind): Third part

Begins with:

अथ तृतीयप्रकारो नविवर्णितो ऽप्रयोजकत्वात् ।

*atha tṛtīyaprakāro navivarṇito 'prayoja-
katvāt |*

Now, on account of irrelevancy (*apra-
yojakatva*), the third part is not con-
sidered.[7]

SS

f. 7v Al
f. 9v Kh
f. 8v Pg

ZŠJ

ff. 4v–5r D
ff. 4v–6v H
ff. 5r–6r L
ff. 8r–9r O
f. – Q
p. 7 R
ff. 4v–5v S

[§ ID.4]

قسم چهارم (*qism-i čahārum*):
Fourth part

Begins with:

در ذکر آنچه دران زیج بعمل آورده شد از
تصحیحات و اختراعات و الحاقات زیاده از
زیج الغ بیگی نور الله مرقد راصده

[§ ID.4]

चतुर्थप्रकार (*caturthaprakāra*, lit. the fourth
kind): Fourth part

Begins with:

अथ चतुर्थप्रकारे परमेश्वरप्रसादात्प्राप्तस्वर्गस्य
मिरज्याउलग्बेगस्य जीचतो नवनव-
वस्तूत्पादनैर्ग्रन्थशोधनैर्ग्रन्थान्तरादानीय
लिखनैर्येदधिकं तदनुक्रमणं द्विविधं प्रोक्तं ।

SS

ff. 7v–9r Al
ff. 9v–11r Kh
ff. 8v–10r Pg

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7 An alternative understanding of the word
aprayojakatva as the 'state of being without
the means to cause or effect', i.e., being in-
effective, lends a second translation of this
opening statement: 'Now, due to ineffect-
iveness, the third part is not considered.'

8 A more extensive discussion on numer-
ology in the *Zīj-i Šāh Jahānī* is to appear
in Matthew Melvin-Koushki's forthcoming
publication (personal communication, July
2023).

dar ḏikr-i ānči dar īn zīj ba ʿamal āvarda šud az taṣḥīḥāt u iḫtirāʿāt u ilḫāqāt ziyāda az zīj-i uluġ bīgī nawwara llāh marqad rāṣidihi

atha caturthaprakāre parameśvaraprasādāt prāptasvargasya mirajyāūlagabegasya jīcato navanavavastūtpādanair grantha-śodhanair granthāntarād ānīya likhanair yadadhikaṃ tadanukramaṇaṃ dvividhaṃ proktaṃ |

On what was introduced to the calculations in these tables in terms of corrections, inventions, additions [that are made to the] *Zīj-i Uluġ Bīg*—May Allah enlighten the tomb of His observer.

Now, in the fourth part, compared to the *zīj* of Mirzā Uluġ Bīg (*mirajyā-ulaga-bega*) who obtained heaven by the mercy of God, what is superior by writing, having brought [it] from the interior of the book [i.e., from inside the *Zīj-i Uluġ Bīg*] by correcting the book [and] by producing things that are completely new, proceeding methodically, that is described in two ways.

In two verbal recollections (*ḏikr*s), the first beginning with:

In two parts (*dvividha*), the first part beginning with:

درانچه قبل ازین علامه العالم مولانا الأعظم ناصب رایات الفضل والحكم افتخار العلما فى العالم المغفور بعنایة الله الملك الصمد مولانا محمد و سالک مسالک التحقیق ناهج مناهج التدقیق زبدة المهندسین قدوة المدققین المرحوم برحمة الملک المنان مولانا روزبهان علیهم الرحمة والغفران بعمل آورده بودند

तत्र पूर्वं विश्वैकपण्डितस्य युक्तिपाण्डित्यध्वज-स्थापकस्य संसारे बुधजनयशसः परमेश्वरमोचिता-पराधस्य मौलानामहम्मदस्य पुनः प्रामाणिक-सूक्ष्मज्ञानां पथिपथिकस्य कलाविदां सारस्य परमेश्वरमोचितापराधस्य मौलानारोजविहाख्य या या कृतिस्तस्यास्तस्या अनुक्रमः ।

dar ānči qabl az īn ʿallāma al-ʿālim al-aʿẓam nāṣib rāyāt al-faẓl wa-l-ḥukm iftiḫār al-ʿulamā fī l-ʿālam al-maġfūr bi-ʿināyat allāh al-malik al-ṣamad mawlānā muḥammad u sālik masālik al-taḥqīq nāhij manāhij al-tadqīq zubdat al-muhandisīn qidwat al-mudaqqiqīn al-marḥūm bi-raḥmat al-malik al-mannān mawlānā rūzbihān ʿalayhim al-raḥma wa-l-ġufrān ba ʿamal āvarda būdand

tatra pūrvaṃ viśvaikapaṇḍitasya yukti-pāṇḍityadhvajasthāpakasya saṃsāre bud-hajanayaśasaḥ parameśvaramocitāparā-dhasya maulānāmahammadasya punaḥ prāmāṇikasūkṣmajñānāṃ pathipathikasya kalāvidāṃ sārasya parameśvaramocitā-parādhasya maulānārojavihākhya yā yā kṛtis tasyās tasyā anukramaḥ |

On what was brought to calculations before these [tables] by the most learned, holder of the standard of ex-

First then, whatever is in the composition of Mawlānā Muḥammad (*maulānā-mahammada*), the one whose

cellence and authority, glory of the learned in the world, forgiven by the grace of Allah, who is the King, the Sublime, Mawlānā Muḥammad and the traveller of the paths of certainty, the pointer of the roads of scrutiny, the best of the geometers, an exemplar of inspectors, the late and regretted by the mercy of the King, the Bounteous, Mawlānā Rūzbihān—May the mercy and pardon [of Allah] be upon them;

transgressions are forgiven by God, the one venerated among wise men in the world, the establisher of the standard of erudition by [his] rationales, a one [true] scholar in the world; and of the one named Mawlānā Rūzbihān (*maulāna rojavihā*), the one whose transgressions are forgiven by God, the one who is the essence of men learned in the arts, a guide to the path of men possessing subtle probative knowledge—an enumerated list of contents of all of that [is now described];

ZŠJ
ff. 4v–5r D
f. 5r–6r H
ff. 5r-6r L
ff. 8r–9r O
f. – Q
p. 7 R
ff. 4v–5v S

and the second beginning with:

درینچه این کمترین بنده‌های درگاه عمل نموده و از کتب معتبره آورده

dar īnči īn kamtarīn-i bandahā-yi dargāh ʿamal namūda u az kutub-i muʿtabara āvarda

On the calculations made by this lowest of the slaves of the [heavenly] palace [Mullā Farīd] and on what was chosen from reputable books.

and the second part beginning with:

अथ द्वितीयो ऽनुक्रमो मुल्लाफरीदेनोक्तः ।

atha dvitīyo 'nukramo mullāpharī-denoktaḥ |

Now, the second enumerated list of contents stated by Mullā Farīd (*mullā-pharīda*).

SS
ff. 8r–9r Al
ff. 9v–11r Kh
ff. 9r–10r Pg

End with:

در زیج گورگانی و شرح هر یک در محل خود گفته شود انشاء الله تعالی با چندین جزئیات دیگر که اینجا تذکار نیافته

dar zīj-i gūrgānī u šarḥ har yak dar maḥall-i ḫwud gufta šavad inšāʾ llāh taʿālà bā čandīn juzʾīyāt-i dīgar ki īnjā taḏkār nayāfta

In the *Zīj-i Gūrgānī* and in its commentary, every [topic] is discussed in its own place, if God—May He be exalted—wills, with some more details which are not here mentioned.

End with:

स्वस्वविषये सर्वं विवर्ण्यते ।

svasvaviṣaye sarvaṃ vivarṇyate |

In their own respective topics, everything is described.

Remark Contains, in two separate enumerated lists, the 11 additions/improvements to the *Zīj-i Uluġ Bīg* made by Mawlānā Muḥammad and Mawlānā Rūzbihān and the 101 additions/improvements to the *Zīj-i Uluġ Bīg* made by Mullā Farīd.

Remark Mirroring the Persian, the Sanskrit text also contains an enumerated list of Mavlānā Muḥammad's and Mavlānā Rūzbihān's 11 additions/improvements to the *Zīj-i Uluġ Bīg*, as well as an enumerated list of Mullā Farīd's 101 additions/improvements to the *Zīj-i Uluġ Bīg*.

ZŠJ
ff. 5rv D
ff. 6rv H
ff. 6rv L
ff. 9rv O
f. – Q
pp. 7–8 R
ff. 5v–6r S

[**§ ID.5**]

قسم پنجم (*qism-i panjum*):
Fifth part

Begins with:

در معرفت تاریخ و سال و ماه و روز و اجزای آن

dar maʿrifat-i tārīḫ u sāl u māh u rūz u ajzā-yi ān

On the knowledge of the eras, years, months, days and parts of the day.[9]

Ends in:

اول سالی که دران سال حادثه عظیم واقع شده باشد چون ظهور ملتی یا دولتی[10] آنرا مبدء سازند تا چون ضبط اوقات حوادث دیگر خواهند که کنند بآن مبدء نسبت کنند و آنرا تاریخ خوانند و آن بحسب اصطلاح هر قوم چیزی دیگر باشد و آنچه مشهور است تاریخ هجری است و تاریخ جدید سعید الهی شاهجهانی و تاریخ فرس و تاریخ روم و تاریخ ملکی و تاریخ هندی و تاریخ خطا و ایغور و هر یک در محل خود تذکار یابد انشاء الله تعالی

[**§ ID.5**]

पञ्चमप्रकार (*pañcamaprakāra*, lit. the fifth kind): Fifth part

Begins with:

अथ पञ्चमप्रकारे परिभाषाज्ञानम् ।

atha pañcamaprakāre paribhāṣājñānam |

Now, in the fifth part, the knowledge of the definitions [of calendrical terms].

Ends in:

यस्मिन्वर्षे स्यान्महाभूमिकंपः
किंवोत्पातो ऽन्यो ऽथवा राज्यलक्ष्मीः ॥
उत्कृष्टा स्याद्रूपतेः कस्यचिद्वा
शाकारंभो जायते तत्र वर्षे ॥ २२ ॥
नानाविधाः शका भवन्ति ।

अथ प्रसिद्धतरा आरबीयशाहजहानीयरौमीय-
फरसीयमलकीयहिन्दुकीयखितायीयतुरकीयशाका
ये वर्तन्ते तेषां विवरणं स्वस्वाधिकारे करिष्यामि
प्रकरणे ।

(शालिनी)

SS
ff. 9r–10r Al
ff. 11r–12r Kh
ff. 10rv Pg

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9 This section corresponds to the introduction (*muqaddama*) in the first discourse (*maqāla-yi avvalīn*) of the *Zīj-i Uluġ Bīg*.
10 Sédillot's edition of the *Zīj-i Uluġ Bīg* adds the following additional occurrences, which the Sanskrit translation appears to

echo; see ZUB, p. 295:

یا طوفانی یا زلزله یا امثال اینها

yā ṭūfānī yā zalzala yā amṯāl-i īnhā

a flood or an earthquake, or such things

avval-i sālī ki dar ān sāl ḥādiṯa-yi ᶜaẓīm vāqiᶜ šuda bāšad čūn ẓuhūr-i millatī yā dawlatī ¹⁰ ān rā mabdaʔ sāzand tā čūn żabṭ-i awqāt-i ḥavādiṯ-i dīgar ḫwāhand ki kunand ba ān mabdaʔ nisbat kunand u ān rā tārīḫ ḫwānand u ān ba ḥasb-i iṣṭilāḥ-i har qawm čīzī dīgar bāšad u ānči mašhūr ast tārīḫ-i hijrī ast u tārīḫ-i jadīd-i saᶜīd-i ilāhī-yi šāh-jahānī u tārīḫ-i furs u tārīḫ-i rūm u tārīḫ-i malikī u tārīḫ-i hindī u tārīḫ-i ḫaṭā u uyġūr u har yak dar maḥall-i ḫwud taḏkār yābad inšāʔ llāh taᶜālà

yasminvarṣe syān mahābhūmikaṃpaḥ kiṃvotpāto ʼnyo ʼthavā rājyalakṣmīḥ ǁ utkṛṣṭā syād bhūpateḥ kasyacid vā śākāraṃbho jāyate tatra varṣe ǁ 22 ǁ   (*śālinī*)

nānāvidhāḥ śakā bhavanti ǀ

atha prasiddhatarā ārabīyaśāhajahānīya-raumīyapharasīyamalakīyahindukīyakhitā-yīyaturakīyaśākā ye vartante teṣāṃ vivaraṇaṃ svasvādhikāre kariṣyāmi prakaraṇe ǀ

The beginning of the year in which an important event has taken place, such as the birth of a religion or a state,[10] is made as a starting point, so that when one wants to keep the times of other events, they are connected to this starting point and it is called an era. According the usage of each community, it will be a different thing. Those that are famous are the era of the Hegira, the new and fortunate divine era of Šāh Jahān, the Persian era, the Greek era, the Malikī era, the Indian era and the era of the Chinese and the Uyghur. Each of them will be discussed in its own place, God willing.

The year in which a great earthquake or any other calamity occurs, or rather [when] the glory of the kingdom of some sovereign gets exalted perhaps, the beginning of a calendrical era commences in that year. 22

The calendrical eras are of various forms.

Now, I shall describe in individual topics, in chapters, what exists in the more well-known eras of the Arabic [Hijri] (*ārabīya*), Šāh Jahān (*śāhajahānīya*), Rūmī (*raumīya*), Persian [Yazdgirdī] (*phārasīya*), Malakī (*malakīya*), Hindū (*hindukīya*), Chinese [and Uyghur] (*khitāyīya*), and Turkic (*turakīya*) calendars.

Remark See Appendix § F for a fuller description of the contents of this section.

Remark See Appendix § F for a fuller description of the contents of this section.

<table>
<tr><td>

ZŠJ
ff. 5v–16r D
ff. 6v–14r H
ff. 6v–13r L
ff. 9v–18v O
f. – Q
pp. 8–25 R
ff. 6r–13r S

</td><td>

[§ I]

مقاله اولین (*maqāla-yi avvalīn*):
First discourse

Begins with

در معرفت تواریخ و آن مشتمل است بر نه
باب

dar maᶜrifat-i tavārīḫ u ān muštamil ast bar nuh bāb

On the knowledge of the eras. In nine chapters.

</td><td>

[§ I]

प्रथमकाण्ड (*prathamakāṇḍa*):
First part

Begins with

अथ प्रथमकाण्डे सप्तभिरध्यायैः समस्तशाक-विवरणम् । शकस्य नाम तारीखेति कथयन्ति ।

atha prathamakāṇḍe saptabhir adhyāyaiḥ samastaśākavivaraṇam | śakasya nāma tārīkheti kathayanti |

Now, in the first part, with seven chapters, the descriptions of all the calendrical eras. The name of an era is called *tārīkha* (PER: *tārīḫ*).

</td><td>

SS
ff. 10r–15r Al
ff. 12r–16v Kh
ff. 10v–15v Pg

</td></tr>

<tr><td>

ZŠJ
f. 6r D
ff. 6v–7r H
f. 6v L
ff. 9v–10r O
f. – Q
pp. 8–9 R
ff. 6rv S

</td><td>

[§ I.1]

باب اول (*bāb-i avval*):
First chapter

Begins with

در معرفت تاریخ الهی شاهجهانی
dar maᶜrifat-i tārīḫ-i ilāhī-yi šāh-jahānī

On the knowledge of the divine era of Šāh Jahān (*tārīḫ-i ilāhī-yi šāh-jahānī*).

Remark See Appendix § G for the text and translation of this chapter.

</td><td>

[§ I.1]

प्रथमाध्याय (*prathamādhyāya*):
First chapter

Begins with

तत्र प्रथमाध्याये शाहजहानीयशकविवर्णम् ।
tatra prathamādhyāye śāhajahānīyaśaka-vivarṇam |

Then, in the first chapter, the description of the era of Šāh Jahān (*śāhajahānīya-śaka*).

Remark See Appendix § G for the text and translation of this chapter.

</td><td>

SS
ff. 10rv Al
ff. 12rv Kh
ff. 11r Pg

</td></tr>

<tr><td>

ZŠJ
ff. 6rv D
ff. 7rv H
ff. 6v–7r L
ff. 10rv O
f. – Q
pp. 9–10 R
f. 6v S

</td><td>

[§ I.2]

باب دوم (*bāb-i duvum*):
Second chapter

Begins with

در معرفت تاریخ هجری ابتداء آن از اول
محرم آن سال بوده است که پیغمبر ما محمد
مصطفی صلی الله علیه بمدینه از مکه تشریف
فرموده اند

</td><td>

[§ I.2]

द्वितीयाध्याय (*dvitīyādhyāya*):
Second chapter

Begins with

अथ द्वितीयाध्याये हिजरीशकज्ञानं । पर्यायेण तस्य नामारबीति । अस्य शकारम्भे पूर्वं मुहरम-मासारम्भो बभूव ।

</td><td>

SS
ff. 10v–11v Al
ff. 12v–13r Kh
ff. 11r–12r Pg

</td></tr>
</table>

dar maʿrifat-i tārīḫ-i hijrī ibtidāʾ-i ān az avval-i muḥarram-i ān sāl būda ast ki payġambar-i mā muḥammad muṣṭafà ṣallà llāh ʿalayhi az makka ba madīna tašrīf farmūda and

On the knowledge of the Hijri era (*tārīḫ-i hijrī*). The beginning of this [era] was on the first day of Muharram of the year in which our messenger Muḥammad the Chosen—May God's prayers be upon him—[left] Mecca and honoured Medina [with his visit].

atha dvitīyādhyāye hijarīśakajñānaṃ | paryāyeṇa tasya nāmārabīti | asya śakārambhe pūrvaṃ muharamamāsārambho babhūva |

Now, in the second chapter, the knowledge of the Hijri era (*hijarī-śaka*). Alternatively, [it is called the] Arabic (*ārabi*) [era] by name. Formerly, the beginning of the month of Muḥarram (*muharama*) was at the beginning of this era.

[§ I.3]

باب سيوم (*bāb-i sīvum*):

Third chapter

Begins with

در معرفت تاریخ رومی مبدء این تاریخ روز
دوشنبه بوده بعد از وفات اسکندر بن فلیقوس
رومی بدوازده سال شمسی

dar maʿrifat-i tārīḫ-i rūmī mabdaʾ-i īn tārīḫ dū-šanba būda ast baʿd az vafāt-i iskandar bin falīqūs rūmī ba davāzdah sāl-i šamsī

On the knowledge of the Rūmī era (*tārīḫ-i rūmī*), i.e., the Greek [Seleucid] era. This era starts on a Monday, twelve solar years after the death of Alexander (*iskandar*) [the Great], son of Philip [II] of Macedon (*falīqūs rūmī*).

[§ I.3]

तृतीयाध्याय (*tṛtīyādhyāya*):

Third chapter

Begins with

अथ तृतीयाध्याये रूमीशकज्ञानं । अस्य शक-
स्यारम्भे सोमवारो बभूव । फैलकूसरूमीतिनाम्नो यः
पुत्रः सिकन्दरस्तस्य निधनानन्तरं द्वादशसौरवर्षैरयं
शकः प्रवृत्तो ऽभूत् ।

atha tṛtīyādhyāye rūmīśakajñānaṃ | asya śakasyārambhe somavāro babhūva | phailakūsarūmītināmno yaḥ putraḥ sikandaras tasya nidhanānantaraṃ dvādaśasauravarṣair ayaṃ śakaḥ pravṛtto ʾbhūt |

Now, in the third chapter, the knowledge of the Rūmī era (*rūmī-śaka*). Monday was at the beginning of this era. Twelve years following the demise of Alexander (*sikandara*) [the Great], the son of the one named Philip [II] of Macedon (*phailakūsa-rūmī*), this era came into circulation.

ZŠJ

ff. 7rv D

f. 8r H

f. 7v L

f. 11r O

f. – Q

p. 11 R

ff. 7rv S

[§ I.4]

باب چهارم (*bāb-i čahārum*):

Fourth chapter

Begins with

در معرفت تاریخ فرس مبدء این تاریخ روز سهشنبه بوده اول سال جلوس یزدجرد بن شهریار که آخر ملوک عجم است

dar maʿrifat-i tārīḫ-i furs mabdaʾ-i īn tārīḫ rūz-i sih-šanba būda avval-i sāl-i julūs-i yazdajird bin šahryār ki āḫir-i mulūk-i ʿa-jam ast

On the knowledge of the Persian era (*tārīḫ-i furs*), i.e., the Yazdgirdī era. This era starts on a Tuesday, in the first year of the coronation of Yazdgird (*yazdajird*) son of Šahryār, the last king of Iran.

[§ I.4]

चतुर्थाध्याय (*caturthādhyāya*):

Fourth chapter

Begins with

अथ चतुर्थाध्याये तारीखफुरसज्ञानं । अस्य शकस्यारम्भे भौमवारो बभूव । शहरयारस्य पुत्रो यो यज्दजिरदनामा महाप्रभुस्तस्य राज्यसमयादस्य शकस्य प्रवृत्तिरासीत् ।

atha caturthādhyāye tārīkhaphura-sajñānaṃ | asya śakasyārambhe bhauma-vāro babhūva | śaharayārasya putro yo yajdajiradanāmā mahāprabhus tasya rājyasamayād asya śakasya pravṛttir āsīt |

Now, in the fourth chapter, the knowledge of the Persian era (*tārīkha-phu-rasa*). Tuesday was at the beginning of this era. The circulation of this era commenced from the time of the reign of the [Sasanian] king named Yazdgird [III] (*yajdajirada*), son of Shahryār (*śaharayāra*).

SS

f. 12r Al

ff. 13v–14r Kh

f. 12v Pg

ZŠJ

f. 7v D

f. 8r H

f. 7v L

ff. 11rv O

f. – Q

p. 12 R

f. 7v S

[§ I.5]

باب پنجم (*bāb-i panjum*):

Fifth chapter

Begins with

در معرفت تاریخ ملکی این تاریخ منسوب است بسلطان جلال الدین ملکشاه بن الب ارسلان سلجوقی

dar maʿrifat-i tārīḫ-i malikī īn tārīḫ mansūb ast ba sulṭān jalāl al-dīn malik-šāh bin alb arslān saljūqī

On the knowledge of the Malikī era (*tārīḫ-i malikī*). This era is related to the Seljuk Sultan Jalāl al-Dīn Malik Šāh, son of Alp Arslān of the Seljuk [Em-

[§ I.5]

पञ्चमाध्याय (*pañcamādhyāya*):

Fifth chapter

Begins with

अथ पञ्चमाध्याये तारीखमलकीज्ञानं । अलब-अरसलानसलजूकीतिनम्नो यः पुत्रः सुलतानजला-लद्दीनमलकशाहेति नामा महाभूपस्तस्य सम्बन्धेन शको ऽयं जातः ।

atha pañcamādhyāye tārīkhamalakī-jñānaṃ | alabaarasalānasalajūkītinamno yaḥ putraḥ sulatānajalāladdīnamalakaśā-heti nāmā mahābhūpas tasya sambandhena śako 'yaṃ jātaḥ |

Now, in the fifth chapter, the knowl-edge of the Malakī era (*tārīkha-malakī*) era. This era was produced in rela-tion to the [Seljuk] King named Sulṭān

SS

f. 12r Al

f. 14r Kh

ff. 12v–13r Pg

pire] (*alb arslān saljūqī*).

Jalāl al-Dīn Malik Šāh [I] (*sulatāna-jalāladdīna-malaka-śāha*), the son of the one called Alp Arslān of the Seljuk [Empire] (*alaba-arasalāna-salajūkī*).

ZŠJ
ff. 7v–10r D
ff. 8r–9v H
ff. 7v–9r L
ff. 11v–13r O
f. – Q
pp. 12–15 R
ff. 7v–8v S

[**§ I.6**]

باب ششم (*bāb-i šišum*):
Sixth chapter

Begins with

در دانستن این پنج از یکدیگر بطریق عمل و بطریق جدول

dar dānistan-i īn panj az yak-dīgar ba ṭarīq-i ʿamal u ba ṭarīq-i jadval

On determining these five [eras] from one another via calculation and via tables.

[**§ I.6**]

षष्ठाध्याय (*saṣṭhādhyāya*):
Sixth chapter

Begins with

अथ षष्ठाध्याये पञ्चतारीखाणां परस्परज्ञानं गणितेन कोष्ठैर्वा ।

atha ṣaṣṭhādhyāye pañcatārīkhāṇāṃ parasparajñānaṃ gaṇitena koṣṭhair vā ।

Now, in the sixth chapter, the mutual knowledge of the five eras (*pañcatārīkha*) [from one another] with computation and with tables.

SS
ff. 12r–14r Al
ff. 14r–16r Kh
ff. 13r–14v Pg

ZŠJ
ff. 10rv D
ff. 9v–10r H
f. 9r L
f. 13r O
f. – Q
pp. 15–16 R
ff. 8v–9r S

[**§ I.7**]

باب هفتم (*bāb-i haftum*):
Seventh chapter

Begins with

در بیان تاریخ هندی

dar bayān-i tārīḫ-i hindī

On the explanation of the Hindī era (*tārīḫ-i hindī*).

Remark   See Appendix § H for the text and translation of this chapter.

[–]
A corresponding chapter is absent.

ZŠJ
f. 10v D
f. 10r H
ff. 9rv L
ff. 13r–14r O
f. – Q
pp. 16–17 R
ff. 9rv S

[**§ I.8**]

باب هشتم (*bāb-i haštum*):
Eighth chapter

Begins with

در استخراج تاریخ هندی از تاریخ عربی و عکس آن

[**§ I.7**]

सप्तमाध्याय (*saptamādhyāya*):
Seventh chapter

Begins with

अथ सप्तमाध्याये विक्रमार्केशकतो हिजरीशकज्ञानं हिजरीतो विक्रमार्केशकज्ञानं च ।

SS
ff. 14r–15r Al
ff. 16rv– Kh
ff. 14v–15r Pg

dar istiḫrāj-i tārīḫ-i hindī az tārīḫ-i ʿarabī u ʿaks-i ān

On the derivation of the Hindī era (*tārīḫ-i hindī*) from the Arabic era (*tārīḫ-i ʿarabī*) and vice versa.

atha saptamādhyāye vikramārkaśakato hijarīśakajñānaṃ hijarīto vikramārka-śakajñānaṃ ca |

Now, in the seventh chapter, the knowledge of the Hijri era (*hijarī-śaka*) from the Vikram Saṃvat era (*vikramārka-śaka*) and the knowledge of the Vikram Saṃvat era from the Hijri [era].

ZŠJ	[**§ I.9**]
ff. 10v–15v D	باب نهم (*bāb-i nuhum*):
ff. 10v–13v H	Ninth chapter
ff. 9v–12v L	
ff. 14r–18v O	Begins with
f. – Q	
pp. 17–24 R	
ff. 9v–13r S	

در معرفت تاریخ خطا و ایغور و آن مشتمل
بر ده فصل است

dar maʿrifat-i tārīḫ-i ḫaṭā u uyġūr u ān muštamil bar dah faṣl ast

On the knowledge of the Chinese (*tārīḫ-i ḫaṭā*) and Uyghur (*tārīḫ-i uyġūr*) eras. In ten chapters.

[–]

A corresponding chapter is absent.

ZŠJ	[**§ I.10**]
ff. 15v–16r D	باب دهم (*bāb-i dahum*):
f. 14r H	Tenth chapter
f. 13r L	
f. 18r O	Begins with
f. – Q	
p. 25 R	
f. 13v S	

در معرفت ایام مشهوره از تاریخ

dar maʿrifat-i ayyām-i mašhūra az tārīḫ

On the knowledge of the public days in these eras.

Remark Contains, inter alia, a Muslim calendar with a number of festivals and commemorations related to the family of the Prophet and Shia imams, and a Hindu calendar with seven festivals; see Appendix § I.

[–]

A corresponding chapter is absent.

[−]

A corresponding colophon is absent.

[§ I.col]

[Colophon]

यः श्री शाहिजहाँनृपालमुकुटालङ्कारचूडामणि-
स्तस्याज्ञामवलम्ब्य दुस्तरममुं सिद्धान्तसिन्धुं
तरन् । नित्यानन्द इति द्विजोत्तमकृपः
श्रीदेवदत्तात्मजस्तारीखाख्यविनिर्णयेन सहितं
काण्डं ह्यगादादिमम् ।

yaḥ śrī śāhijahāṁnṛpālamukuṭālaṅkāra-
cūḍāmaṇis tasyājñām avalambya dustaram
amuṃ siddhāntasindhuṃ taran | nityā-
nanda iti dvijottamakṛpaḥ śrīdeva-
dattātmajas tārīkhākhyavinirṇayena
sahitaṃ kāṇḍaṃ hy agād ādimam |

Having obeyed the command of the one who is the jewel in the crown of King Šāh Jahān (*śāhijahāṁ*, lit. the Emperor of the World), i.e., Āṣaf H̲ān [and] accomplishing that formidable [task of composing the] *Siddhānta-sindhu* [lit. an ocean of doctrinal truths], Nityānanda, [the one worthy of] the mercy of the best Brahmins, the son of Śri Devadatta, has indeed finished the first part associated with established entities called eras (SAN: *tārīkha*, PER: *tārīh̲*).

SS

f. 15r Al

f. 16v Kh

ff. 15rv Pg

ZŠJ
ff. 16r–23v D
ff. 15r–22v H
ff. 13v–20v L
ff. 18v–27v O
f. – Q
pp. 26–41 R
ff. 13r–21v S

SS
ff. 15r–29r Al
ff. 17r–28v Kh
ff. 15v–28r Pg†

† ff. 18v–27r
  desunt

[§ II]

مقاله دوم (*maqāla-yi duvum*):
Second discourse

Begins with

در معرفت اوقات و طالع هر وقت و آنچه
تعلق بدان دارد مشتمل بر بیست و دو
باب[11]

*dar maʿrifat-i awqāt u ṭāliʿ-i har vaqt u ānči
taʿalluq badān dārad muštamil bar bīst u
dū bāb* [11]

On the knowledge of [finding] the
times (*awqāt*) and the ascendant (*ṭāliʿ*)
at each time, and whatever belongs to
it [i.e., all things related to this topic],
including twenty-two chapters.[11]

[§ II]

द्वितीयकाण्ड (*dvitīyakāṇḍa*):
Second part

Begins with

नित्यानन्दस्वरूपाय सच्चिद्द्वयमुर्तये ।
अद्वितीयाय विभवे ऽनन्ताय ब्रह्मणे नमः ॥

अथ द्वितीयकाण्डे द्वाविंशत्यध्यायैरभिमतसमय-
स्तात्कालिकलग्नं च तदुपयोगीन्यपि ज्ञायन्ते ।

*nityānandasvarūpāya saccidvayamurtaye |
advitīyāya vibhave ʼnantāya brahmaṇe
namaḥ ||*

*atha dvitīyakāṇḍe dvāviṃśatyadhyāyair
abhimatasamayas   tātkālikalagnaṃ   ca
tadupayogīny api jñāyante |*

Obeisance to Brahman who is the em-
bodiment of eternal bliss, the One who
has the form of both existence and
thought, the One who is without a
second, the omnipresent One, the One
who is infinite.

Now, in the second part, the de-
sired time (*samaya*) and the ascend-
ant (*lagna*) at that time, as well as
[things] using that, are understood
with twenty-two chapters.

(अनुष्टुभ्)

(*anuṣṭubh*)

ZŠJ
ff. 16r–17r D
ff. 15rv H
ff. 13v–14r L
ff. 18v–19r O
f. – Q
pp. 26–27 R
ff. 13r–14r S

SS
ff. 15r–16r Al
ff. 17r–18r Kh
ff. 15v–16v Pg

[§ II.1]

باب اول (*bāb-i avval*):
First chapter

Begins with:

در بیان معرفت جنس هر یک از حاصل
ضرب و خارج قسمت و جذر یعنی دانستن
آنکه حاصل ضرب یا خارج قسمت یا جذر

[§ II.1]

प्रथमाध्याय (*prathamādhyāya*):
First chapter

Begins with:

तत्र प्रथमाध्याये गुणनभजनफले मूलं च
परिवर्तादिस्थानैः कलादिस्थानैर्वा किं जातीयं
स्यादिति ज्ञायते । तत्र गणितसौकर्यार्थं
यवनप्रसिद्धप्रकारेणाङ्कस्थानानां संस्कृतशब्दैः
संज्ञा कल्प्यते ।

---

11 MS O reads: (...بيست و سه باب ...*bīst u sih
bāb*) "...[including] twenty-three chapters."

از کدام مرتبه است از مراتب مرفوعات و
درج و اجزاء درج مثل دقایق و ثوانی و غیر
آن

*dar bayān-i maᶜrifat-i jins-i har yak az
ḥāṣil-i żarb u ḫārij-i qismat u jaḏr yaᶜnī
dānistan-i ānki ḥāṣil-i żarb yā ḫārij-i qis-
mat yā jaḏr az kudām martaba ast az
marātib-i marfūᶜāt u daraj u ajzāʾ-i daraj
miṯl-i daqāyiq u ṯavānī u ġayr-i ān*

On the expression of the knowledge of
each genus (*jins*) [of digits] from the
result of multiplication, and the quo-
tient of division, and the square root.
In other words, to know what is the
position of [the digits in] the result of
multiplication, or the quotient of di-
vision, or the square root, from the
positions (*marātib*) of elevated [ranks]
(*marfūᶜāt*) [sc. integer number of re-
volutions], and the degree, and the
fractional parts of a degree like minutes
and seconds and so on.

*tatra prathamādhyāye guṇanabhajana-
phale mūlaṃ ca parivartādisthānaiḥ
kalādisthānair vā kiṃ jātīyaṃ syād iti
jñāyate | tatra gaṇitasaukaryārthaṃ
yavanaprasiddhaprakāreṇāṅkasthānānāṃ
saṃskṛtaśabdaiḥ saṃjñā kalpyate |*

Then, in the first chapter, what [digits]
should belong to a particular genus
(*jātīya*) in the result of multiplication
and division, and the square root, that
is understood by [inspecting] the po-
sitions of revolution etc. (*parivartādi-
sthāna*) or by the positions of minute
etc. (*kalādi-sthāna*). There, for the pur-
pose of facilitating ease in computa-
tions with the method famous amongst
the Muslims, the name of the positions
of the digits (*aṅka-sthāna*) is declared
with Sanskrit words.

[**§ II.2**]

باب دوم (*bāb-i duvum*):
Second chapter

Begins with:

در عمل تعدیل ما بین السطرین که بناء آن
بر اربعه اعداد متناسبه است

*dar ᶜamal-i taᶜdīl-i mā bayna l-saṭrayn ki
bināʾ-i ān bar arbᶜa aᶜdād-i mutanāsiba ast*

On the method of interpolation
(*ᶜamal-i taᶜdīl*) between two lines [of
a table], which is constructed via
the four correlated numbers (*aᶜdād-i
mutanāsiba*) [i.e., the rule of three].

[**§ II.2**]

द्वितीयाध्याय (*dvitīyādhyāya*):
Second chapter

Begins with:

अथ द्वितीयाध्याये द्विकोष्ठान्तरोत्थफलसाधनम् ।
तस्य मूलं त्रैराशिकम् । अत्र यवनाः परस्पर-
सम्बन्धिचतूराशीन्गणयन्ति । तल्लक्षणं च ।

*atha dvitīyādhyāye dvikoṣṭhāntarottha-
phalasādhanam | tasya mūlaṃ trairāśikam |
atra yavanāḥ parasparasambandhicatū
rāśīn gaṇayanti | tallakṣaṇaṃ ca |*

Now, in the second chapter,
the demonstration of the res-
ult derived from the difference
between two cells. The basis of
this is the rule of three quantities

(*trai-rāśika*). Here, the Muslims take into account four correlated digits (*paraspara-sambandhi-rāśi*), and their definitions.

ZŠJ
ff. 17v–18r D
ff. 16rv H
ff. 14v–15r L
ff. 20rv O
f. – Q
pp. 28–29 R
ff. 15rv S

[§ II.3]
باب سیوم (*bāb-i sīvum*):
Third chapter

Begins with:

در معرفت جیب و سهم
dar maʿrifat-i jayb u sahm

On the knowledge of the Sine (*jayb*) and the Sagitta (*sahm*) [i.e., the versed Sine].

[§ II.3]
तृतीयाध्याय (*tṛtīyādhyāya*):
Third chapter

Begins with:

अथ तृतीयाध्याये ज्याशरज्ञानम् ।
atha tṛtīyādhyāye jyāśarajñānam |

Now, in the third chapter, the knowledge of the Sine (*jyā*) and the versed Sine (*śara*).

SS
ff. 16v–17v Al
ff. 18r–19r Kh
ff. 17rv Pg

ZŠJ
ff. 18rv D
ff. 16v–17r H
ff. 15rv L
ff. 20v–21r O
f. – Q
pp. 29–30 R
ff. 15v–16r S

[§ II.4]
باب چهارم (*bāb-i čahārum*):
Fourth chapter

Begins with:

در معرفت ظل مقیاس
dar maʿrifat-i ẓill-i miqyās

On the knowledge of the shadow (*ẓill*) of a gnomon.

[§ II.4]
चतुर्थाध्याय (*caturthādhyāya*):
Fourth chapter

Begins with:

अथ चतुर्थाध्याये छायाज्ञानम् ।
atha caturthādhyāye chāyājñānam |

Now, in the fourth chapter, the knowledge of the shadow (*chāyā*) [of a gnomon].

SS
ff. 17v–18v Al
ff. 19rv Kh
ff. 17v–18r Pg
(incomp.)

ZŠJ
ff. 18v–19r D
ff. 17rv H
f. 15v L
ff. 21rv O
f. – Q
pp. 30–31 R
f. 16r S

[§ II.5]
باب پنجم (*bāb-i panjum*):
Fifth chapter

Begins with:

در معرفت میل اجزاء فلك البروج از معدل
النهار
dar maʿrifat-i mayl-i ajzāʾ-i falak al-burūj az muʿaddil al-nahār

On the knowledge of the declination (*mayl*) of parts of the ecliptic (*falak al-burūj*) from the celestial equator (*muʿaddil al-nahār*).

[§ II.5]
पञ्चमाध्याय (*pañcamādhyāya*):
Fifth chapter

Begins with:

अथ पञ्चमाध्याये क्रान्तिज्ञानम् । तत्र तावत्क्रान्ति-
सूत्रादिसंज्ञोच्यते ।
atha pañcamādhyāye krāntijñānam | tatra tāvat krāntisūtrādisaṃjñocyate |

Now, in the fifth chapter, the knowledge of the declination (*krānti*). There, firstly, the [technical] terms like circle of declination (*krānti-sūtra*) etc. are stated.

SS
ff. 18v–19r Al
ff. 19v–20r Kh
f. – Pg

ZŠJ
f. 19r D
f. 17v H
ff. 15v–16r L
ff. 21v–22r O
f. – Q
p. 31 R
f. 16r S

[§ II.6]

باب ششم (*bāb-i šišum*):
Sixth chapter

Begins with:

در معرفت بعد کواکب از معدل النهار

dar maᶜrifat-i buᶜd-i kavākib az muᶜaddil al-nahār

On the knowledge of the distance (*buᶜd*) of a celestial object from the celestial equator.

[§ II.6]

षष्ठाध्याय (*ṣaṣṭhādhyāya*):
Sixth chapter

Begins with:

अथ षष्ठाध्याये स्पष्टक्रान्तिज्ञानम् ।

atha ṣaṣṭhādhyāye spaṣṭakrāntijñānam |

Now, in the sixth chapter, the knowledge of the true declination (*spaṣṭa-krānti*).

SS
ff. 19rv Al
ff. 20rv Kh
f. – Pg

ZŠJ
f. 19r D
f. 17v H
f. 16r L
f. 22r O
f. – Q
pp. 31–32 R
ff. 16rv S

[§ II.7]

باب هفتم (*bāb-i haftum*):
Seventh chapter

Begins with:

در معرفت غایت ارتفاع و انخفاض کواکب

dar maᶜrifat-i ġāyat-i irtifāᶜ u inḫifāż-i kavākib

On the knowledge of the maximum elevation (*ġāyat-i irtifāᶜ*) and depression (*inḫifāż*) of celestial objects.

[§ II.7]

सप्तमाध्याय (*saptamādhyāya*):
Seventh chapter

Begins with:

अथ सप्तमाध्याये ग्रहस्य परमोन्नतांशानामधः-स्थपरमभागानां च ज्ञानम् ।

atha saptamādhyāye grahasya paramonnatāṃśānām adhaḥsthaparamabhāgānāṃ ca jñānam |

Now, in the seventh chapter, the knowledge of the degrees of the maximum elevation (*parama-unnata-aṃśa*) and the degrees of the maximum depression (*adhaḥstha-parama-bhāga*) of a planet.

SS
f. 19v Al
f. 20v Kh
f. – Pg

ZŠJ
ff. 19rv D
ff. 17v–18r H
f. 16r L
f. 22r O
f. – Q
p. 32 R
f. 16v S

[§ II.8]

باب هشتم (*bāb-i haštum*):
Eighth chapter

Begins with:

در معرفت مطالع خط استوا و آنرا مطالع فلك مستقیم نیز گویند

dar maᶜrifat-i maṭāliᶜ-i ḫaṭṭ-i istivā u ān rā maṭāliᶜ-i falak-i mustaqīm nīz gūyand

On the knowledge of the ascensions (*maṭāliᶜ*) [of the ecliptic] at the line

[§ II.8]

अष्टमाध्याय (*aṣṭamādhyāya*):
Eighth chapter

Begins with:

अथ अष्टमाध्याये व्यक्षोयांशज्ञानम् । तेषां लङ्को-दयांशसंज्ञाप्युच्यते । तल्लक्षणमाह ।

atha aṣṭamādhyāye vyakṣoyāṃśajñānam | teṣāṃ laṅkodayāṃśasaṃjñāpy ucyate | tallakṣaṇam āha |

Now, in the eighth chapter, the knowledge of the rising [of zodiacal signs]

SS
ff. 19v–20r Al
ff. 20v–21r Kh
f. – Pg

of the terrestrial equator (*ḫaṭṭ-i istivā*) [i.e., the right ascensions of the zodiacal signs]. And that is also called the ascensions [of the ecliptic] in the right sphere (*falak-i mustaqīm*).

at the terrestrial equator in degrees (*vyakṣa-udaya-aṃśa*) [i.e., the right ascensions of the degrees of the ecliptic]. All of them are also called the rising [of the zodiacal signs] at Laṅkā in degrees (*laṅkā-udaya-aṃśa*) by name. Their definitions are stated [as follows].

ZŠJ
ff. 19v–20r D
ff. 18rv H
ff. 16rv L
ff. 22r–23r O
f. – Q
pp. 32–33 R
ff. 16v–17v S

[§ II.9]
باب نهم (*bāb-i nuhum*):
Ninth chapter

Begins with:

در معرفت تعديل النهار و قوس النهار و قوس الليل و ساعات النهار و ساعات الليل

dar maʿrifat-i taʿdīl al-nahār u qaws al-nahār u qaws al-layl u sāʿāt al-nahār u sāʿāt al-layl

On the knowledge of the equation of daylight (*taʿdīl al-nahār*); and the arc of daylight (*qaws al-nahār*) and the arc of night (*qaws al-layl*); and the hours of daylight (*sāʿāt al-nahār*) and the hours of night (*sāʿāt al-layl*).

[§ II.9]
नवमाध्याय (*navamādhyāya*):
Ninth chapter

Begins with:

अथ नवमाध्याये चरदिनरात्रिवामानां दिनरात्रि-होरादीनां च ज्ञानम् । तत्र तावत्तेषां लक्षणम् ।

atha navamādhyāye caradinarātrivāmānāṃ dinarātrihorādīnāṃ ca jñānam | tatra tāvat teṣāṃ lakṣaṇam |

Now, in the ninth chapter, the knowledge of the ascensional difference (*cara*) of the oblique diurnal circle (*dina-rātri-vāma-[vṛtta]*) and of the hours of day and night (*dina-rātri-horā*) etc. There, firstly, all of their definitions [are stated].

SS
ff. 20rv Al
ff. 21rv Kh
f. – Pg

ZŠJ
f. 20r D
f. 18v H
ff. 16v–17r L
f. 23r O
f. – Q
p. 33 R
f. 17v S

[§ II.10]
باب دهم (*bāb-i dahum*):
Tenth chapter

Begins with:

در معرفت مطالع بلد

dar maʿrifat-i maṭāliʿ-i balad

On the knowledge of the ascensions (*maṭāliʿ*) [of the ecliptic] of a locality (*balad*) [i.e., the oblique ascensions of the zodiacal signs].

[§ II.10]
दशमाध्याय (*daśamādhyāya*):
Tenth chapter

Begins with:

अथ दशमाध्याये निजोदयांशज्ञानम् । तल्लक्षणं च ।

atha daśamādhyāye nijodayāṃśajñānam | tallakṣaṇaṃ ca |

Now, in the tenth chapter, the knowledge of the rising [of the zodiacal signs] in one's own location (*nija-udaya-aṃśa*) [i.e., the oblique ascensions of the degrees of the ecliptic], and their definitions.

SS
ff. 20v–21r Al
ff. 21v–22r Kh
f. – Pg

ZŠJ
ff. 20rv D
ff. 18v–19r H
f. 17r L
ff. 23rv O
f. – Q
pp. 33–34 R
ff. 17v–18r S

[§ II.11]

باب يازدهم (*bāb-i yāzdahum*):
Eleventh chapter

Begins with:

در عمل عكس مطالع يعنى معرفت طوالع از مطالع بعمل

dar ᶜamal-i ᶜaks-i maṭāliᶜ yaᶜnī maᶜrifat-i ṭavāliᶜ az maṭāliᶜ ba ᶜamal

On the inverse method (*ᶜamal-i ᶜaks*) [of] ascensions (*maṭāliᶜ*); in other words, the knowledge of the [ecliptic degrees of the] ascendants (*ṭavāliᶜ*) from the [local] ascensions [i.e., from the oblique ascensions of the ascendants] by direct calculation.

[§ II.11]

एकादशाध्याय (*ekādaśādhyāya*):
Eleventh chapter

Begins with:

अथैकादशाध्याये स्वोदयांशेभ्यो विनैव कोष्ठकै-
र्विलोमक्रियातो विलग्नांशकज्ञानम् । विलोमक्रिया-
लक्षणम् ।

athaikādaśādhyāye svodayāṃśebhyo vinaiva koṣṭhakair vilomakriyāto vilagnāṃśakajñānam | vilomakriyā-lakṣaṇam |

Now, in the eleventh chapter, the knowledge of the [ecliptic] degrees of the ascendants (*vilagna-aṃśaka*) from the rising [of the zodiacal signs] in one's own location (*sva-udaya-aṃśa*) [i.e. from the oblique ascensions of the ascendants] without [using] the tables [and] by using the inverse procedure (*viloma-kriyā*). The definition of the inverse procedure [is first stated].

SS
ff. 21rv Al
ff. 22rv Kh
f. – Pg

ZŠJ
f. 20v D
f. 19r H
ff. 17rv L
f. 23v O
f. – Q
p. 34 R
f. 18r S

[§ II.12]

باب دوازدهم (*bāb-i davāzdahum*):
Twelfth chapter

Begins with:

در معرفت مطالع ممر و درجه ممر كوكب

dar maᶜrifat-i maṭāliᶜ-i mamarr u daraja-yi mamarr-i kawkab

On the knowledge of the ascensions (*maṭāliᶜ*) of [the degrees of the meridian] transit (*mamarr*)—[i.e., the right ascension of the zodiacal sign culminating with a celestial object]—and the [ecliptic] degree of the [meridian]

[§ II.12]

द्वादशाध्याय (*dvādaśādhyāya*):
Twelfth chapter

Begins with:

अथ द्वादशाध्याये नक्षत्रस्य लङ्कायामुदये जाते
सति भोदयलग्नव्यक्षोदयांशभोदयलग्नांशयोर्ज्ञानम् ।
तल्लक्षणम् ।

atha dvādaśādhyāye nakṣatrasya laṅkāyām udaye jāte sati bhodayalagnavyakṣo-dayāṃśabhodayalagnāṃśayor jñānam | tallakṣaṇam |

Now, in the twelfth chapter, when a celestial object rises at Laṅkā [i.e., at the terrestrial equator], the knowledge of the degrees of equatorial ascension (*vyakṣa-udaya-aṃśa*) of the [meridian] ecliptic point (*lagna*) at the [time of]

SS
ff. 21v–22r Al
ff. 22v–23r Kh
f. – Pg

transit [at the time of rising] of a celestial object—[i.e., the ecliptic longitude of the zodiacal sign culminating with a celestial object].

rising of a celestial object—[i.e., the right ascension of the zodiacal sign culminating with the celestial object]—and the degrees of the [meridian] ecliptic point at the [time of] rising of a celestial object—[i.e., the ecliptic longitude of the zodiacal sign culminating with the celestial object]. Their definitions [are first stated].

ZŠJ
f. 20v D
ff. 19rv H
f. 17v L
ff. 23v–24r O
f. – Q
pp. 34–35 R
f. 18r S

[§ II.13]
باب سیزدهم (*bāb-i sīzdahum*):
Thirteenth chapter

Begins with:

در مطالع طالع و غروب کواکب

dar maṭāliᶜ-i ṭulūᶜ u ġurūb-i kavākib

On the [right] ascensions (*maṭāliᶜ*) of the rising (*ṭulūᶜ*) and setting (*ġurūb*) of celestial objects.

[§ II.13]
त्रयोदशाध्याय (*trayodaśādhyāya*):
Thirteenth chapter

Begins with:

अथ त्रयोदशाध्याये नक्षत्रस्योदयसमये ऽस्तसमये च निजोदयांशकज्ञानम् । तल्लक्षणं पूर्वार्धमध्ये प्रोक्तमेव ।

atha trayodaśādhyāye nakṣatrasyodaya-samaye 'stasamaye ca nijodayāṃśaka-jñānam | tallakṣaṇaṃ pūrvārdhamadhye proktameva |

Now, in the thirteenth chapter, at the time of rising (*udaya-samaya*) and time of setting (*asta-samaya*) of a celestial object, the knowledge of the rising [of the zodiacal signs] in one's own location in degrees (*nija-udaya-aṃśaka*)—[i.e., the oblique ascensions of the degrees of the ecliptic]. The definition of that has already been declared in the first half [of § II].

SS
ff. 22rv Al
f. 23r Kh
f. – Pg

ZŠJ
ff. 20v–21r D
f. 19v H
ff. 17v–18r L
ff. 24rv O
f. – Q
p. 35 R
ff. 18rv S

[§ II.14]
باب چهاردهم (*bāb-i čahārdahum*):
Fourteenth chapter

Begins with:

در معرفت سمت از ارتفاع یا انخفاض

[§ II.14]
चतुर्दशाध्याय (*caturdaśādhyāya*):
Fourteenth chapter

Begins with:

अथ चतुर्दशाध्याये ऽभीप्सितोन्नतांशाधरांशोभ्यः स्वदिगंशज्ञानम् ।

SS
f. 22v–23r Al
ff. 23rv Kh
f. – Pg

dar maʿrifat-i samt az irtifāʿ yā inḥifāż

On the knowledge of the azimuth (*samt*) from the elevation (*irtifāʿ*) or the depression (*inḥifāż*) [of a celestial object].

atha caturdaśādhyāye ʾbhīpsitonnatāṃśā-dharāṃśebhyaḥ svadigaṃśajñānam |

Now, in the fourteenth chapter, the knowledge of the degrees of the azimuth in one's own location (*sva-diś-aṃśa*) from the desired degrees of elevation (*unnata-aṃśa*) and the degrees of depression (*adharā-aṃśa*) [of a celestial object].

ZŠJ
f. 21r D
ff. 19v–2or H
f. 18r L
f. 24v O
f. – Q
pp. 35–36 R
f. 18v S

[§ II.15]
باب پانزدهم (*bāb-i pānzdahum*):
Fifteenth chapter

Begins with:

در معرفت ارتفاع از سمت

dar maʿrifat-i irtifāʿ az samt

On the knowledge of the elevation (*irtifāʿ*) [of a celestial object] from [its] azimuth (*samt*).

[§ II.15]
पञ्चदशाध्याय (*pañcadaśādhyāya*):
Fifteenth chapter

Begins with:

अथ पञ्चदशाध्याये दिगंशेभ्यो ऽभीष्टोन्नतांशा-धरांशज्ञानम् । तत्रानन्यत्वप्रकारोपपत्तिः ।

atha pañcadaśādhyāye digaṃśebhyo ʾbhīṣṭonnatāṃśādharāṃśajñānam | tatrā-nanyatvaprakāropapattiḥ |

Now, in the fifteenth chapter, the knowledge of the desired degrees of elevation (*unnata-aṃśa*) and the degrees of depression (*adharā-aṃśa*) [of a celestial object] from the degrees of the azimuth in one's own location (*sva-diś-aṃśa*). There, a demonstration (*upapatti*) by the method of identity (*ananyatva-prakāra*) [is stated].

SS
f. 23rv Al
ff. 23v–24r Kh
f. – Pg

ZŠJ
ff. 21rv D
f. 2or H
f. 18r L
f. 24v O
f. – Q
p. 36 R
ff. 18v–19r S

[§ II.16]
باب شانزدهم (*bāb-i šānzdahum*):
Sixteenth chapter

Begins with:

در معرفت خط نصف النهار

dar maʿrifat-i ḫaṭṭ-i niṣf al-nahār

[§ II.16]
षोडशाध्याय (*ṣoḍaśādhyāya*):
Sixteenth chapter

Begins with:

अथ षोडशाध्याये याम्योतररेखाज्ञानम् । तस्य एव नाम मध्याह्नरेखेति । तदायनप्रकारा बहवो भवन्ति तेषां सुगमतरो ऽयम् ।

atha ṣoḍaśādhyāye yāmyotararekhā-jñānam | tasya eva nāma madhyāhna-

SS
ff. 23v–24r Al
ff. 24rv Kh
f. – Pg

rekheti | tadāyanaprakārā bahavo bhavanti
teṣāṃ sugamataro 'yam |

On the knowledge of the line of mid-day (*ḫaṭṭ-i niṣf al-nahār*) [i.e., the local meridian line].

Now, in the sixteenth chapter, the knowledge of the line of the meridian (*yāmya-uttara-rekhā*). It is even called the line of midday (*madhyāhna-rekhā*). There are many methods of computing this, of which, this is among the easier [one].

ZŠJ
ff. 21v D
ff. 20rv H
ff. 18rv L
ff. 24v–25r O
f. – Q
pp. 36–37 R
ff. 19rv S

[§ II.17]
باب هفدهم (*bāb-i hifdahum*):
Seventeenth chapter

Begins with:

در معرفت طول و عرض بلد

dar maʿrifat-i ṭūl u ʿarż-i balad

On the knowledge of the [terrestrial] longitude (*ṭūl*) and latitude (*ʿarż*) of a locality (*balad*).

[§ II.17]
सप्तदशाध्याय (*saptadaśādhyāya*):
Seventeenth chapter

Begins with:

अथ सप्तदशाध्याये देशान्तराक्षांशज्ञानम् । तल्लक्षणं
च ।

atha saptadaśādhyāye deśāntarākṣāṃśa-
jñānam | tallakṣaṇaṃ ca |

Now, in the seventeenth chapter, the knowledge of the degrees of [terrestrial] longitude (*deśāntara*) and latitude (*akṣa*) [in one's own location], and their definitions.

SS
ff. 24rv Al
ff. 24v–25r Kh
f. – Pg

ZŠJ
ff. 21v–22r D
f. 20v H
f. 18v L
ff. 25rv O
f. – Q
p. 37 R
f. 19v S

[§ II.18]
باب هژدهم (*bāb-i hiždahum*):
Eighteenth chapter

Begins with:

در معرفت عرض اقليم رؤيت

dar maʿrifat-i ʿarż-i iqlīm-i ruʾyat

On the knowledge of the latitude (*ʿarż*) of the visible climate (*iqlīm*) [i.e., the zenith distance of the nonagesimal point].

[§ II.18]
अष्टादशाध्याय (*aṣṭādaśādhyāya*):
Eighteenth chapter

Begins with:

अथाष्टादशाध्याये दृक्क्षेपदृग्गतिज्ञानम् । तल्लक्षणं
च ।

athāṣṭādaśādhyāye dṛkkṣepadṛggatijñānam |
tallakṣaṇaṃ ca |

Now, in the eighteenth chapter, the knowledge of the zenith distance of the nonagesimal point (*dṛkkṣepa*) and the zenith distance of the ecliptic pole (*dṛggati*), and their definitions.

SS
ff. 24v–25r Al
ff. 25rv Kh
f. – Pg

ZŠJ

f. 22r D

ff. 20v–21r H

ff. 18v–19r L

f. 25v O

f. – Q

pp. 37–38 R

ff. 19v–20r S

[§ II.19]

باب نوزدهم (*bāb-i nūzdahum*):
Nineteenth chapter

Begins with:

در استخراج بعد میان دو کوکب

dar istiḥrāj-i buᶜd miyān-i dū kawkab

On the determination of the distance (*buᶜd*) between two celestial object.

[§ II.19]

एकोनविंशाध्याय (*ekonaviṃśādhyāya*):
Nineteenth chapter

Begins with:

अथैकोनविंशाध्याये द्विनक्षत्रान्तरांशकज्ञानम् ।
तल्लक्षणम् ।

athaikonaviṃśādhyāye dvinakṣatrāntarāṃ-śakajñānam | tallakṣaṇam |

Now, in the nineteenth chapter, the knowledge of the interior degrees (*antara-aṃśa*) [of separation] between two celestial objects. Its definition [is first stated].

SS

ff. 25r–26v Al

ff. 25v–26v Kh

f. – Pg

ZŠJ

ff. 22r–23r D

ff. 21rv H

ff. 19rv L

ff. 25v–26v O

f. – Q

pp. 38–40 R

ff. 20rv S

[§ II.20]

باب بیستم (*bāb-i bīstum*):
Twentieth chapter

Begins with:

در معرفت سمت قبله و انحراف او

dar maᶜrifat-i samt-i qibla u inḥirāf-i ū

On the knowledge of the azimuth (*samt*) of Qibla [i.e., the direction of Mecca] and its inclination (*inḥirāf*).

[§ II.20]

विंशाध्याय (*viṃśādhyāya*):
Twentieth chapter

Begins with:

अथ विंशाध्याये स्वपुरे सौम्ययाम्यदिग्भ्यां दिगंशैः
काशी कास्तीति ज्ञायते ।

atha viṃśādhyāye svapure saumyayāmya-digbhyāṃ digaṃśaiḥ kāśī kvāstīti jñāyate |

Now, in the twentieth chapter, [the direction of] Kāśī is understood with the degrees of azimuth (*diś-aṃśa*) [measured] from both the northern and southern directions (*saumya-yāmya-diś*) in one's own city.

SS

ff. 26v–27v Al

ff. 26v–27r Kh

f. – Pg

ZŠJ

ff. 23rv D

ff. 21v–22r H

ff. 19v–20r L

ff. 26v–27r O

f. – Q

p. 40 R

ff. 20v–21r S

[§ II.21]

باب بیست و یکم (*bāb-i bīst u yakum*):
Twenty-first chapter

Begins with:

در معرفت طالع از ارتفاع

dar maᶜrifat-i ṭāliᶜ az irtifāᶜ

[§ II.21]

एकविंशतितमाध्याय (*ekaviṃśatitamādhyāya*):
Twenty-first chapter

Begins with:

अथ एकविंशतिमे ऽध्याये ऽभीष्टोन्नतांशेभ्यो
लग्नज्ञानम् । उन्नतज्यायाः पर्यायः शङ्कुरपि
प्रथमतस्तु नतकलांशाः शोध्याः । तल्लक्षणम् ।

atha ekaviṃśatime 'dhyāye 'bhīṣṭonnatāṃ-śebhyo lagnajñānam | unnatajyāyāḥ

SS

ff. 27v–28v Al

ff. 27r–28r Kh

f. 27v Pg
(incomp.)

paryāyaḥ śaṅkurapi prathamatas tu natakālāṃśāḥ śodhyāḥ | tallakṣaṇam |

On the knowledge of the ascendant (*ṭāliᶜ*) from the elevation (*irtifāᶜ*).

Now, in the twenty-first chapter, the knowledge of the ascendant (*lagna*) from the desired degrees of elevation (*unnata-aṃśa*). But firstly, the method of [determining the height of] the gnomon (*śaṅku*) [corresponding to the altitude of the celestial object] from the Sine of [the degrees of] the elevation (*unnata-jyā*) [and then] the corrected degrees of hour angle (*natakāla-aṃśa*). Their definitions [are first stated].

ZŠJ
f. 23v D
ff. 22rv H
ff. 20rv L
ff. 27rv O
f. – Q
pp. 40–41 R
ff. 21rv S

[**§ II.22**]

باب بیست و دوم *bāb-i bīst u duvum*): Twenty-second chapter

Begins with:

در معرفت ارتفاع یا انخفاض کواکب از مطالع/طالع

dar maᶜrifat-i irtifāᶜ yā inḥifāż-i kavākib az maṭāliᶜ/ṭāliᶜ

On the knowledge of the elevation (*irtifāᶜ*) or depression (*inḥifāż*) of celestial objects from the ascendant(s) (*maṭāliᶜ/ṭāliᶜ*).

[**§ II.22**]

द्वाविंशतितमाध्याय (*dvāviṃśatitamādhyāya*): Twenty-second chapter

Begins with:

अथ द्वाविंशतिमे ऽध्याये खगस्य स्वोदयांशेभ्यो ऽभीष्टोन्नतांशानामधरांशकानां च ज्ञानम् । एतल्लक्षणं पूर्वमेषोक्तम् ।

atha dvāviṃśatime 'dhyāye khagasya svodayāṃśebhyo 'bhīṣṭonnatāṃśānāma- dharāṃśakānāṃ ca jñānam | etallakṣaṇaṃ pūrvameṣoktam |

Now, in the twenty-second chapter, the knowledge of the desired degrees of elevation (*unnata-aṃśa*) and of the degrees of depression (*adhara-aṃśaka*) from the rising [of the zodiacal signs] in one's own location in degrees (*sva-udaya-aṃśa*) of a celestial object. The definition of this has already been declared in the first half [of § II].

SS
ff. 28v–29r Al
ff. 28rv Kh
ff. 27v–28r Pg

[−]

A corresponding colophon is absent.

[§ II.col]

[Colophon]

यः श्री शाहजहाँनृपालमुकुटालङ्कारचूडामणि-
स्तस्याज्ञामवलम्ब्य दुस्तरममुं सिद्धान्त-
सिन्धुं तरन् । नित्यानन्द इति द्विजोत्तमकृपः
श्रीदेवदत्तात्मजस्त्रिप्रश्नप्रचुरोक्तियुक्तिसहितं काण्डं
द्वितीयं ह्यगात् ।

*yaḥ śrī śāhajahām̐nṛpālamukuṭālaṅkāra-
cūḍāmaṇis tasyājñām avalambya dustaram
amuṃ siddhāntasindhuṃ taran | nityā-
nanda iti dvijottamakṛpaḥ śrīdeva-
dattātmajas tripraśnapracuroktiyukti-
sahitaṃ kāṇḍaṃ dvitīyaṃ hy agāt |*

Having obeyed the command of the
one who is the jewel in the crown
of King Šāh Jahān (*śāhijahām̐*, lit. the
Emperor of the World), i.e., Āṣaf Ḫān
[and] accomplishing that formidable
[task of composing the] *Siddhānta-
sindhu* [lit. an ocean of doctrinal
truths], Nityānanda, [the one worthy
of] the mercy of the best Brahmins,
the son of Śri Devadatta, has indeed
finished the second part accompanied
by many statements and rationales on
the *tripraśna*—[i.e., on topics related to
the 'three questions' on determining
the direction (*diś*), location (*deśa*), and
time (*kāla*)].

ZŠJ			SS
ff. 78r–87v D			f. – Al
ff. 72r–8ov H			ff. 98v–
ff. 9or–97v L			111v Kh
ff. 78r–87v O			f. – Pg
ff. 75r–83r Q			
pp. 53–72 R			
ff. 27v–36r S			

[§ III]

مقاله سیوم (*maqāla-yi sīvum*):
Third discourse

Begins with

در معرفت روش ستارگان و مواضع ایشان
در طول و عرض و توابع آن

*dar maʿrifat-i raviš-i sitāragān u mavāżiʿ-i
īšān dar ṭūl u ʿarż u tavābiʿ-i ān*

On the knowledge of the movement of the starts, their positions in longitude (*ṭūl*) and latitude (*ʿarż*) and other things pertaining to this matter.

[§ III]

तृतीयकाण्ड (*tṛtīyakāṇḍa*):
Third part

Begins with

श्री गणपतये नमः ।

वन्दे तं परमानन्दं यो ऽव्यक्तो व्यक्तकारणम् ।
परमो निर्गुणः शान्तो नितान्तं योगिवल्लभः ॥ (अनुष्टुभ्)

अथ तृतीयकाण्डे पञ्चदशभिरध्यायैर्ग्रहाणां षड्विध-
वारेण स्फुटत्वं तदुपयोगि च तत्संगत्यान्यदपि
ज्ञायते ।

śrī gaṇapataye namaḥ |

*vande taṃ paramānandaṃ
yo 'vyakto vyaktakāraṇam |
paramo nirguṇaḥ śānto
nitāntaṃ yogivallabhaḥ ||* (*anuṣṭubh*)

*atha tṛtīyakāṇḍe pañcadaśabhir adhyāyair
grahāṇāṃ ṣaḍvidhavāreṇa sphuṭatvaṃ
tadupayogi ca tatsaṃgatyānyad api
jñāyate |*

Obeisance to Gaṇapati.

Salutations to the One who is the greatest bliss, the One who is unmanifested [despite being] the cause of all things manifest, the Supreme Being, the One without attributes, the One who is free of passion, the One dearly beloved by ascetics.

Now, in the third part, with fifteen chapters, the true position (*sphuṭatva*) [i.e., the longitude] of the planets with six methods repeatedly and its application, even though different by chance, is understood.

ZŠJ

f. 78r D
f. 72r H
f. 90r L
f. 78r O
f. 75r Q
f. 53 R
f. 27v S

[§ III.1]

باب اول (*bāb-i avval*):

First chapter

Begins with:

در معرفت تعدیل ایام

dar maꜥrifat-i taꜥdīl-i ayyām

On the knowledge of the equation of time (*taꜥdīl-i ayyām*).

[§ III.1]

प्रथमाध्याय (*prathamādhyāya*):

First chapter

Begins with:

तत्र प्रथमे ऽध्याये दिनफलज्ञानम् । तल्लक्षणम् ।

tatra prathame 'dhyāye dinaphalajñānam | tallakṣaṇam |

Then, in the first chapter, the knowledge of the equation of time (*dinaphala*). Its definition [is first stated].

SS

f. – Al
ff. 98v–99r Kh
f. – Pg

ZŠJ

ff. 78rv D
ff. 72rv H
ff. 90rv L
ff. 78rv O
ff. 75rv Q
pp. 53–54 R
ff. 27v–28r S

[§ III.2]

باب دوم (*bāb-i duvum*):
Second chapter

Begins with:

در استخراج اوساط کواکب

dar istiḫrāj-i awsāṭ-i kavākib

On the determination of mean longitudes (*awsāṭ*) of celestial objects.

[§ III.2]

द्वितीयाध्याय (*dvitīyādhyāya*):

Second chapter

Begins with:

अथ द्वितीये ऽध्याये मध्यमग्रहानयनम् ।

atha dvitīye 'dhyāye madhyamagrahā-nayanam |

Now, in the second chapter, calculating the mean (*madhyama*) [longitudes of] planets.

SS

f. – Al
ff. 99rv Kh
f. – Pg

ZŠJ

ff. 78v–8or D
ff. 72v–73v H
ff. 90v–91v L
ff. 78v–79v O
ff. 75v–76v Q
pp. 54–56 R
ff. 28r–29r S

[§ III.3]

باب سیوم (*bāb-i sīvum*):
Third chapter

Begins with:

در بیان استخراج تقاویم سبعه سیاره و راس میزان آن

dar bayān-i istiḫrāj-i taqāvīm-i sabꜥa sayyāra u rās-i mīzān-i ān

On the expression of the determination of the true longitudes (*taqāvīm*) of the seven planets and the head of Libra (*rās-i mīzān*) [*fortasse*, autumnal equinox or 0° Libra?].

[§ III.3]

तृतीयाध्याय (*tṛtīyādhyāya*):

Third chapter

Begins with:

अथ तृतीये ऽध्याये स्फुटग्रहानयनम् । तत्र सूर्यस्य द्विविधं स्फुटीकरणं । एकं तुङ्गफलदानेन द्वितीयं च सारण्या तत्र फलदानेनाह ।

atha tṛtīye 'dhyāye sphuṭagrahānayanam | tatra sūryasya dvividhaṃ sphuṭīkaraṇaṃ | ekaṃ tuṅgaphaladānena dvitīyaṃ ca sāraṇyā tatra phaladānenāha |

Now, in the second chapter, calculating the true (*sphuṭa*) [longitudes of] planets. There, the determination of true longitude of the Sun is of two kinds: first, by means of the equation of apo-

SS

f. – Al
ff. 99v–
   100v Kh
f. – Pg

gee (*tuṅga-phala*) and then secondly, by means of the equation (*phala*) said to be obtained with tables.

[§ III.4]

ZŠJ
f. 80r D
f. 73v H
f. 91v L
ff. 79v–80r O
f. 76v Q
pp. 56–57 R
ff. 29rv S

باب چهارم (*bāb-i čahārum*):
Fourth chapter

Begins with:

در دانستن عروض کواکب متحیره و قمر

dar dānistan-i ᶜurūż-i kavākib-i mutaḥayyira u qamar

On knowing the latitudes (*ᶜurūż*) of celestial objects and the Moon.

[§ III.4]

चतुर्थाध्याय (*caturthādhyāya*):
Fourth chapter

Begins with:

अथ चतुर्थाध्याये विना सूर्यं ग्रहशरज्ञानम् ।

atha caturthādhyāye vinā sūryaṃ grahaśarajñānam |

Now, in the fourth chapter, the knowledge of the latitude (*śara*) of the planets excluding the Sun.

SS
f. – Al
f. 100v Kh
f. – Pg

[§ III.5]

ZŠJ
ff. 80rv D
ff. 73v–74r H
f. 91v L
f. 80r O
f. 76v Q
p. 57 R
f. 29v S

باب پنجم (*bāb-i panjum*):
Fifth chapter

Begins with:

در دانستن ابعاد نیران از مرکز عالم

dar dānistan-i abᶜād-i nayyirān az markaz-i ᶜālam

On knowing the distances of the [two] luminaries from the centre of the world (*markaz-i ᶜālam*).

[§ III.5]

पञ्चमाध्याय (*pañcamādhyāya*):
Fifth chapter

Begins with:

अथ पञ्चमाध्याये सूर्येन्द्वोर्भूगर्भादिव पर्यन्तकर्णानयनम् ।

atha pañcamādhyāye sūryendvor bhūgarbhād iva paryantakarṇānayanam |

Now, in the fifth chapter, calculating the radius of the circumference [of the orbit] of the Sun and the Moon precisely from the centre of the Earth (*bhūgarbha*).

SS
f. – Al
ff. 100v–101r Kh
f. – Pg

[§ III.6]

ZŠJ
f. 80v D
f. 74r H
ff. 91v–92r L
ff. 80rv O
ff. 76v–77r Q
pp. 57–58 R
f. 29v S

باب ششم (*bāb-i šišum*):
Sixth chapter

Begins with:

در دانستن نطاقات و مقامات کواکب

dar dānistan-i niṭāqāt u maqāmāt-i kavākib

[§ III.6]

षष्ठाध्याय (*ṣaṣṭhādhyāya*):
Sixth chapter

Begins with:

अथ षष्ठाध्याये ग्रहाणां केन्द्रपदचतुष्टयारम्भवक्रमार्गस्थानानयनम् ।

atha ṣaṣṭhādhyāye grahāṇāṃ kendrapadacatuṣṭayārambhavakramārgasthānānayanam |

SS
f. – Al
ff. 101rv Kh
f. – Pg

On knowing the zones (*niṭāqāt*) and the stations (*maqāmāt*) of celestial objects [during retrograde motion].

Now, in the sixth chapter, calculating the stations (*sthāna*) during the retrograde motion (*vakra-mārga*) [and] the beginnings of the four quarters [of the eccentric] with respect to the anomaly (*kendra*) of the planets.

ZŠJ
ff. 80v–81v D
ff. 74rv H
ff. 92rv L
ff. 80v–81r O
ff. 77rv Q
pp. 58–59 R
ff. 29v–30r S

[§ III.7]

باب هفتم (*bāb-i haftum*):
Seventh chapter

Begins with:

در قسمت تقویم کواکب و عروض آنها

dar qismat-i taqvīm-i kavākib u ʿurūż-i ānhā

On the division of the true longitudes (*taqvīm*) of celestial objects and their latitudes (*ʿurūż*).

[§ III.7]

सप्तमाध्याय (*saptamādhyāya*):
Seventh chapter

Begins with:

अथ सप्तमाध्याये ग्रहाणां प्रत्यहस्फुटत्वं शरभुक्त्या च शरः साध्यते ।

atha saptamādhyāye grahāṇāṃ pratyaha-sphuṭatvaṃ śarabhuktyā ca śaraḥ sādhyate |

Now, in the seventh chapter, the daily true [longitude] (*sphuṭatva*) divided by the latitude (*śara*), and the latitude of planets is calculated.

SS
f. – Al
ff. 101v–102r Kh
f. – Pg

ZŠJ
ff. 81v–82v D
ff. 74v–75v H
ff. 92v–93v L
ff. 81r–82r O
ff. 77v–78r Q
pp. 59–61 R
ff. 30r–31r S

[§ III.8]

باب هشتم (*bāb-i haštum*):
Eighth chapter

Begins with:

در دانستن اوقات اتصالات کواکب با یکدیگر و تحویلات

dar dānistan-i awqāt-i ittiṣālāt-i kavākib bā yak-dīgar u taḥvīlāt

On knowing the times of conjunction (*awqāt-i ittiṣālāt*) of the celestial objects with one another and their return.

[§ III.8]

अष्टमाध्याय (*aṣṭamādhyāya*):
Eighth chapter

Begins with:

अथ अष्टमाध्याये परस्परग्रहयोगसंक्रान्तिसमया-नयनम् ।

atha aṣṭamādhyāye parasparagrahayoga-saṃkrāntisamayānayanam |

Now, in the eighth chapter, calculating the times of zodiacal ingress (*saṃkrānti*) and conjunction (*yoga*) of planets with one another.

SS
f. – Al
ff. 102r–103v Kh
f. – Pg

ZŠJ

f. 82v D
ff. 75v–76r H
f. 93v L
ff. 82rv O
f. 78v Q
pp. 61–62 R
ff. 31rv S

[§ III.9]

باب نهم (*bāb-i nuhum*):
Ninth chapter

Begins with:

در بیان ساعات بست و بهدره

dar bayān-i sāʿāt-i bust u bhadra

On the hours (*sāʿāt*) of *bust* and *bhadra* (SAN: *bhadrā*).

[§ III.9]

नवमाध्याय (*navamādhyāya*):
Ninth chapter

Begins with:

अथ नवमाध्याये बुस्तभद्रयोर्होरानयनम् । अथ यवनमते बुस्तचक्रं भद्रासादृश्येन प्रायो ऽङ्गीकृतं तस्य सप्तविभागैः परिभ्रमणं भवति प्रत्येकभागस्य द्वादशविषमहोरा गण्यते ।

atha navamādhyāye bustabhadrayor horānayanam | atha yavanamate busta-cakraṃ bhadrāsādṛśyena prāyo 'ṅgīkṛtaṃ tasya saptavibhāgaiḥ paribhramaṇaṃ bhavati pratyekabhāgasya dvādaśaviṣama-horā gaṇyate |

Now, in the ninth chapter, calculating the hours (*horā*) of *busta* (PER: *bust*) and *bhadrā*. Now, according to the opinion of the Muslims, the cycle including the *busta* is commonly agreed to resemble the [Indian] *bhadrā*. Its revolution occurs with seven parts, [where] twelve unequal hours should be regarded as each of its part.

SS

f. – Al
f. 103v Kh
f. – Pg

ZŠJ

ff. 82v–83v D
ff. 76r–77r H
ff. 93v–94v L
ff. 82v–83v O
ff. 78v–79v Q
pp. 62–64 R
ff. 31v–32v S

[§ III.10]

باب دهم (*bāb-i dahum*):
Tenth chapter

Begins with:

در معرفت خسوف

dar maʿrifat-i ḫusūf

On the knowledge of lunar eclipses (*ḫusūf*).

[§ III.10]

दशमाध्याय (*daśamādhyāya*):
Tenth chapter

Begins with:

अथ दशमाध्याये चन्द्रग्रहणानयनम् ।
atha daśamādhyāye candragrahaṇā-nayanam |

Now, in the tenth chapter, calculating the lunar eclipses (*candra-grahaṇa*).

SS

f. – Al
ff. 103v–105v Kh
f. – Pg

ZŠJ
ff. 83v–85v D
ff. 77r–79r H
ff. 94v–96v L
ff. 83v–86r O
ff. 79v–81v Q
pp. 64–69 R
ff. 32v–34v S

[§ III.11]
باب یازدهم (*bāb-i yāzdahum*):
Eleventh chapter

Begins with:

در معرفت کسوف
dar maʿrifat-i kusūf
On the knowledge of solar eclipses (*kusūf*).

[§ III.11]
एकादशाध्याय (*ekādaśādhyāya*):
Eleventh chapter

Begins with:

अथ एकादशाध्याये सूर्यग्रहणानयनम् ।
atha ekādaśādhyāye sūryagrahaṇānayanam |
Now, in the eleventh chapter, calculating solar eclipse (*sūrya-grahaṇa*).

SS
f. – Al
ff. 105v–109v Kh
f. – Pg

ZŠJ
ff. 85v–86v D
ff. 79r–80r H
ff. 96v–97v L
ff. 86r–87r O
ff. 81v–82r Q
pp. 69–70 R
ff. 34v–35v S

[§ III.12]
باب دوازدهم (*bāb-i davāzdahum*):
Twelfth chapter

Begins with:

در معرفت وقت رؤیه هلال و ظهور و خفای کواکب
dar maʿrifat-i vaqt-i ruʾya-yi hilāl u ẓuhūr u ḫafā-yi kavākib

On the knowledge of the time of sighting (*vaqt-i ruʾya*) of the crescent of the new Moon (*hilāl*), and the appearance (*ẓuhūr*) and disappearance (*ḫafā*) of celestial objects.

[§ III.12]
द्वादशाध्याय (*dvādaśādhyāya*):
Twelfth chapter

Begins with:

अथ द्वादशाध्याये नवचन्द्रोदयानयनम् । पुनरत्रैव ग्रहाणामुदयास्तानयनम् ।
atha dvādaśādhyāye navacandrodayānayanam | punar atra iva grahāṇāmudayāstānayanam |

Now, in the twelfth chapter, calculating the rising of the new Moon (*nava-candra-udaya*). And also in this [chapter], calculating the rising (*udaya*) and setting (*asta*) of planets.

SS
f. – Al
ff. 109v–110v Kh
f. – Pg

ZŠJ
ff. 86v–87r D
ff. 80rv H
f. 97v L
ff. 87rv O
ff. 82rv Q
pp. 70–71 R
ff. 35v–36r S

[§ III.13]
باب سیزدهم (*bāb-i sīzdahum*):
Thirteenth chapter

Begins with:

در معرفت طالع از ساعات و تسویة البیوت
dar maʿrifat-i ṭāliʿ az sāʿāt u tasvīyat al-buyūt
On the knowledge of the ascendant (*ṭāliʿ*) from the hours (*sāʿāt*) and the equalisation of the houses (*tasvīyat al-buyūt*).

[§ III.13]
त्रयोदशाध्याय (*trayodaśādhyāya*):
Thirteenth chapter

Begins with:

अथ त्रयोदशाध्याये त्रिविधभाचक्रानयनम् ।
atha trayodaśādhyāye trividhabhācakrānayanam |

Now, in the thirteenth chapter, calculating [the division of the] ecliptic (*bhā-cakra*) in three ways.

SS
f. – Al
ff. 110v–111r Kh
f. – Pg

ZŠJ

[§ III.14]

ff. 87rv D

f. 80v H

f. 97v L

f. 87v O

ff. 82v–83r Q

pp. 71–72 R

f. 36r S

باب چهاردهم (*bāb-i čahārdahum*):

Fourteenth chapter

Begins with:

در معرفت مواضع ثوابت در طول و عرض

dar maᶜrifat-i mavāżiᶜ-i t̲avābit dar t̤ūl u ᶜarż

On the knowledge of the positions of the fixed stars (*t̲avābit*) in longitude (*t̤ūl*) and latitude (*ᶜarż*).

[§ III.14]

[चतुर्दशाध्याय (*caturdaśādhyāya*):

Fourteenth chapter]

A corresponding chapter title is absent.

SS

f. – Al

ff. 111rv Kh

f. – Pg

ZŠJ

[§ III.15]

f. 87v D

f. 80v H

f. 97v L

f. 87v O†

f. 83r Q

p. 72 R

f. 36r S

† The text of the chapter is highly corrupted.

باب پانزدهم (*bāb-i pānzdahum*):

Fifteenth chapter

Begins with:

در بیان تقویم کید

dar bayān-i taqvīm-i kayd

On the expression of the true longitude (*taqvīm*) of Kayd.

[§ III.15]

पञ्चदशाध्याय (*pañcadaśādhyāya*):

Fifteenth chapter

Begins with:

अथ पञ्चदशाध्याये कैदानयनम् ।

atha pañcadaśādhyāye kaidānayanam |

Now, in the fifteenth chapter, calculating the [true longitude of] *Kayd* (SAN: *kaida*, PER: *kayd*, an inauspicious fictional star).

SS

f. – Al

f. 111v Kh

f. – Pg

[–]

A corresponding colophon is absent.

[§ III.col]

[Colophon]

[यः श्री शा]हजहाँनृपालमुकुटालङ्कारचूडामणि-
स्तस्याज्ञामवलम्ब्य दुस्तरममुं सिद्धान्तसिन्धुं
तरन् । नित्यानन्द इति द्विजोत्तमकृपः
श्रीदेवदत्तात्मजो मध्यस्पष्टशरोपरागसहितं
काण्डं तृतीयं त्वगात् । शुभमस्तु ।

[*yaḥ śrī śā*]*hajahām̐nṛpālamukuṭālaṅkāra-
cūḍāmaṇis tasyājñām avalambya
dustaram amuṃ siddhāntasindhuṃ
taran | nityānanda iti dvijottama-
kṛpaḥ śrīdevadattātmajo madhya-
spaṣṭaśaroparāgasahitaṃ kāṇḍaṃ tṛtīyaṃ
tv agāt | śubhamastu |*

SS

f. – Al

f. 111v Kh

f. – Pg

Having obeyed the command of the one who is the jewel in the crown of King Šāh Jahān (*śāhijahām̐*, lit. the Emperor of the World), i.e., Āṣaf Ḫān [and] accomplishing that formidable [task of composing the] *Siddhānta-sindhu* [lit. an ocean of doctrinal truths], Nityānanda, [the one worthy of] the mercy of the best Brahmins, the son of Śri Devadatta, has indeed finished the third part accompanied [by discussions on] eclipses (*uparāga*), planetary latitudes (*śara*), true planetary longitudes (*spaṣṭa*), and mean planetary longitudes (*madhya*). May all things be auspicious.

ZŠJ	[§ IV]	[–]
ff. 385r– 390v D	مقاله چهارم (*maqāla-yi čahārum*): **Fourth discourse**	**A corresponding fourth part is absent (as witnessed in MS Kh)**
ff. 404r– 410r H	Begins with	
ff. 418r– 419r L	در باقی اعمال نجومی و این مشتمل بر دو	
f. – O	باب است	
ff. 402r– 409v Q	*dar bāqī-yi aʿmāl-i nujūmī u īn muštamil bar dū bāb ast*	
pp. 675– 687 R	On the remaining astronomical calcu- lations. In two chapters.	
ff. 408r– 416r S		

ZŠJ	[§ IV.1]	[–]
ff. 385r– 388v D	باب اول (*bāb-i avval*): First chapter	A corresponding chapter is absent
ff. 404r– 407v H	Begins with	
f. – L	درانچه تعلق بطالع موالید دارد و آن پنج	
f. – O	فصل است	
ff. 402r– 405r Q	*dar ānči taʿalluq ba ṭāliʿ-i mavālīd dārad u ān panj faṣl ast*	
pp. 675– 682 R	On things related to the ascendant (*ṭāliʿ*) at the nativity (*mavālīd*). In five sections.	
ff. 408r– 411v S		

ZŠJ	[§ IV.1.i]	[–]
ff. 385r– 386r D	فصل اول (*faṣl-i avval*): First section	A corresponding section is absent
ff. 404r– 405r H	Begins with	
f. – L	در نمودارات	
f. – O	*dar namūdārāt*	
ff. 402r– 403r Q	On indicators (*namūdārāt*) [i.e, a tech- nique to determine a person's nativity].	
pp. 675– 677 R		
ff. 408r– 409r S		

ZŠJ

f. 386r D
f. 405r H
f. – L
f. – O
f. 403r Q
pp. 677–
678 R
ff. 409rv S

[**§ IV.1.ii**]

فصل دوم (*faṣl-i duvum*):
Second section

Begins with

در معرفت عرض افق حادث هر کوکبی
بحسب موضع او در صورت طالع

dar maʿrifat-i ʿarż-i ufuq-i ḥādiṯ-i har kawkabī ba ḥasb-i mawżiʿ-i ū dar ṣūrat-i ṭāliʿ

On the knowledge of the latitude (*ʿarż*) of the horizon of event (*ufuq-i ḥādiṯ*) of each celestial object according to its place in the figure of the ascendant (*ṣūrat-i ṭāliʿ*).

[–]

A corresponding section is absent

ZŠJ

ff. 386rv D
ff. 405rv H
f. – L
f. – O
ff. 403rv Q
p. 678 R
f. 409v S

[**§ IV.1.iii**]

فصل سیوم (*faṣl-i sīvum*):
Third section

Begins with

در معرفت درجه مصحح و مطالع مصحح
کواکب

dar maʿrifat-i daraja-yi muṣaḥḥaḥ u maṭāliʿ-i muṣaḥḥaḥ-i kavākib

On the knowledge of the corrected degree (*daraja-yi muṣaḥḥaḥ*) and the corrected ascensions (*maṭāliʿ-i muṣaḥḥaḥ*) of celestial objects.

[–]

A corresponding section is absent

ZŠJ

ff. 386v–
387r D
ff. 405v–
406r H
f. – L
f. – O
ff. 403v–
404r Q
pp. 678–
679 R
ff. 409v–
410r S

[**§ IV.1.iv**]

فصل چهارم (*faṣl-i čahārum*):
Fourth section

Begins with

در اعمال مطارح شعاعات و انوار کواکب
و غیر آن

dar aʿmāl-i maṭāriḥ-i šuʿāʿāt u anvār-i kavākib u ġayr-i ān

[–]

A corresponding section is absent

On the calculations of the places of pro-
jection of the beams (*šuʿāʿāt*) and lights
(*anvār*) of celestial objects, etc.

ZŠJ	**[§ IV.1.v]**	[–]
ff. 387r–388r D	فصل پنجم (*faṣl-i panjum*): Fifth section	A corresponding section is absent
ff. 406r–407r H	Begins with	
ff. 418rv L		
ff. 372rv O	در تسییرات	
ff. 404r–405r Q	*dar tasyīrāt* On prorogations (*tasyīrāt*).	
pp. 679–682 R		
ff. 410r–411r S		

ZŠJ	**[§ VI.1.vi]**	[–]
ff. 388rv D	فصل ششم (*faṣl-i šišum*):	A corresponding section is absent
f. 407r H	Sixth section	
ff. 418v–419r L	Begins with	
ff. 372v–373r O	در انتهاآت موالید	
f. 405r Q	*dar intihāʾāt-i mavālīd*	
p. 682 R	On the final term of nativities (*intihāʾāt-i mavālīd*).	
ff. 411rv S		

ZŠJ	**[§ IV.1.vii]**	[–]
f. 388v D	فصل هفتم (*faṣl-i haftum*):	A corresponding section is absent
ff. 407rv H	Seventh section	
f. 419r L	Begins with	
f. 373r O		
f. 405r Q	در فردارات موالید و سالهای ترتیب	
p. 682 R	*dar firdārāt-i mavālīd u sālhā-yi tartīb*	
f. 411v S	On the fixed planetary periods of nativities (*firdārāt-i mavālīd*) and the [planets governing] the years of disposition (*sālhā-yi tartīb*) [from birth].	

ZŠJ

f. 390v D†

ff. 409v–
  410r H

f. – L

ff. 375r–
  376v O

ff. 409rv Q

pp. 686–
  687 R

ff. 415v–
  416r S

†The end of
the chapter
is missing in
MS D.

[§ **IV.2**]

باب دوم (*bāb-i duvum*):
Second chapter

Begins with

در لیالی که تعلق بطالع عالم دارد
dar layālī ki taʿalluq ba ṭāliʿ-i ʿālam dārad

On the nights which are related to the
ascendant of the world (*ṭāliʿ-i ʿālam*).

[–]
A corresponding section is absent

ACKNOWLEDGEMENTS

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RAMPUR	*Fihrist-i nusḫahā-yi ḫaṭṭī-yi kitāb-ḫāna-yi riżā, rāmpūr* (1996) (Rampur: Rampur Raza Library).
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CESS	Pingree, David (1970–94), *Census of the Exact Sciences in Sanskrit* (Series A; Philadelphia: American Philosophical Society).
MJM	Bahura, Gopal Narain (1971), *Catalogue of Manuscripts in the Maharaja Of Jaipur Museum* (Maharaja Sawai Mansingh Memorial Series No. 1; Jaipur: City Palace Library).

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MMSM	Pingree, David (2003), *A Descriptive Catalogue of the Sanskrit Astronomical Manuscripts Preserved at the Maharaja Man Singh II Museum in Jaipur, India* (Philadelphia: American Philosophical Society), ISBN: 9780871692504.
RORI	Menaria, O. L., et al. (1985) (eds.), *Catalogue of Sanskrit and Prakrit Manuscripts (Alwar-Collection)* (Rajasthan Puratan Granthmala No. 151; Jodhpur: Rajasthan Oriental Research Institute).

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Abbreviation	Text
AṢ	*ʿAmal-i Ṣāliḥ* Yazdānī, Ġulām (1923–27) (ed.), *ʿAmal-i Ṣāliḥ al-mawsūm ba Šahjahān-nāma of Muḥammad Ṣāliḥ Kambū* (Calcutta: The Asiatic Society of Bengal).
ĀA	*Āʾīn-i Akbarī* Blochmann, Heinrich (1872–77) (ed.), *Āʾīn-i Akbarī of Abū l-Fażl* (Calcutta: Baptist Mission Press).
MR	*Maʾāṯir-i Raḥīmī* Ḥusayn, Hidāyat (1910–31) (ed.), *Maʾāṯir-i Raḥīmī of ʿAbd al-Bāqī Nahāvandī* (Calcutta: The Asiatic Society).
MŠJn	*Mulaḫḫaṣ-i Šāhjahān-nāma* al-Raḥmān, Jamīl (2009) (ed.), *Mulaḫḫaṣ-i Šāhjahān-nāma of Mīrzā Muḥammad Ṭāhir Ḫān Āšnā "ʿInāyat Ḫān"* (New Delhi: Markaz-i Taḥqīqāt-i Fārsī, Rāyzanī-yi Farhangī-yi Sifārat-i Jumhūrī-yi Islāmī-yi Īrān (Centre for Persian Research, Office of the Cultural Counsellor, Embassy of Islamic Republic of Iran)).
Nḫ	*Nuzhat al-ḫawāṭir* al-Iʿlām biman fī tārīḫ al-hind min al-aʿlām al-musammà bi-Nuzhat al-ḫawāṭir wa-bahjat al-masāmiʿ wa-l-nawāẓir of ʿAbd al-Ḥayy b. Faḫr al-Dīn al-Ḥasanī (1999) (1 ed., Beirut: Dār ibn Ḥazm li-l-Ṭibāʿa wa-l-Našr wa-l-Tawzīʿ).

(*continued*)

(*continued*)

TM	*Tārīḫ-i Muḥammadī* b. Rustam b. Qubād, Muḥammad (n.d.), *Tārīḫ-i Muḥammadī*, MS Or. 1824 (London: The British Library).
TŠJ	*Ṭabaqāt-i Šāh Jahānī* Ḫān, Muḥammad Aslam (1990) (ed.), *Ṭabaqāt-i Šāh Jahānī: ṭabaqa-yi avval of Muḥammad Kašmīrī Hamadānī* (Delhi: Dānišgāh-i Dihlī).
ZUB	*Zīj-i Uluġ Bīg* Sédillot, Louis-Amélie (1847a) (ed.), *Prolégomènes des tables astro-nomiques d'Oloug-Beg: Publiés avec notes et variantes et précédés d'une introduction par M. L. P. E. A. Sédillot* (Paris: l'Institut de France).

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APPENDICES

A   DISTRIBUTION OF THE CHAPTERS OF THE CANONS

Table A1: Distribution of the chapters of the canon in Mullā Farīd's *Zīj-i Šāh Jahānī* (ZŠJ) vis-à-vis Nityānanda's *Siddhāntasindhu* (SS). This distribution is based on the (near-)complete manuscripts of ZŠJ and the SS made available to us for this study; see § 2.

ZŠJ	SS	ZŠJ	SS	ZŠJ	SS
[§ P]	[§ P]	[§ II]	[§ II]	[§ III]	[§ III]
[–]	[§ P.1]	[§ II.1]	[§ II.1]	[§ III.1]	[§ III.1]
[§ P.1]	[§ P.2]	[§ II.2]	[§ II.2]	[§ III.2]	[§ III.2]
[§ P.2]	[§ P.3]	[§ II.3]	[§ II.3]	[§ III.3]	[§ III.3]
[§ P.4]	[§ P.5]	[§ II.4]	[§ II.4]	[§ III.4]	[§ III.4]
[§ ID]	[§ ID]	[§ II.5]	[§ II.5]	[§ III.5]	[§ III.5]
[§ ID.1]	[§ ID.1]	[§ II.6]	[§ II.6]	[§ III.6]	[§ III.6]
[§ ID.2]	[§ ID.2]	[§ II.7]	[§ II.7]	[§ III.7]	[§ III.7]
[§ ID.3]	[§ ID.3]	[§ II.8]	[§ II.8]	[§ III.8]	[§ III.8]
[§ ID.4]	[§ ID.4]	[§ II.9]	[§ II.9]	[§ III.9]	[§ III.9]
[§ ID.5]	[§ ID.5]	[§ II.10]	[§ II.10]	[§ III.10]	[§ III.10]
[§ I]	[§ I]	[§ II.11]	[§ II.11]	[§ III.11]	[§ III.11]
[§ I.1]	[§ I.1]	[§ II.12]	[§ II.12]	[§ III.12]	[§ III.12]
[§ I.2]	[§ I.2]	[§ II.13]	[§ II.13]	[§ III.13]	[§ III.13]
[§ I.3]	[§ I.3]	[§ II.14]	[§ II.14]	[§ III.14]	[§ III.14]
[§ I.4]	[§ I.4]	[§ II.15]	[§ II.15]	[§ III.15]	[§ III.14]
[§ I.5]	[§ I.5]	[§ II.16]	[§ II.16]	[–]	[§ III.col]
[§ I.6]	[§ I.6]	[§ II.17]	[§ II.17]	[§ IV]	[–]
[§ I.7]	[–]	[§ II.18]	[§ II.18]	[§ IV.1]	[–]
[§ I.8]	[§ I.7]	[§ II.19]	[§ II.19]	with	
[§ I.9]	[–]	[§ II.20]	[§ II.20]	[§ IV.1.i]–	[–]-[–]
[§ I.10]	[–]	[§ II.21]	[§ II.21]	[§ IV.1.vii]	
[–]	[§ I.col]	[§ II.22]	[§ II.22]	[§ IV.2]	[–]
		[–]	[§ II.col]		

B   LIST OF EARLIER *ZĪJES*

In the First part of the Introduction of the *Zīj-i Šāh Jahānī* (i.e., the *qism-i avval* [**§ ID.1**] from the *muqaddama*), and correspondingly in the First part of the Introduction of the *Siddhāntasindhu* (i.e., the *prathamaprakāra* [**§ ID.1**] from the *grantha-mukha*), we find a list of Islamicate *zīj*es from earlier times. These are described below, and whenever possible, apposite modern references are appended in footnotes. It is worth noting that Nityānanda expressly states in Sanskrit that the basis of both the *Zīj-i sanjarī* (*Jīca-saṃjarī*) and *Zīj-i ʿalāʾī* (*Jīca-ālāyī*) is the *Zīj-i šīrvān-šāhī* (*Jīca-śeravāṁśāhī*), whereas, Mullā Farīd's Persian suggests that only the *Zīj-i ʿalāʾī* is based on the *Zīj-i šīrvān-šāhī*.

ZŠJ	Ten *zīj*es based (*mabnī*) on the observations (*raṣadhā*) of [al-]Battānī	Ten *jīca*s derived (*jāta*) from the observations (*rasada*) of Battānī	SS
f. 3r D	*Zīj-i jāmiʿ*[1] and *Zīj-i bāliġ*[2] of Kūšyār	*Jīca-jāme* and *Jīca-bāligaṁ* of Gośiyāra	f. 6v Al
ff. 3rv H	*Zīj-i mufrad*[3] of Muḥammad Ayyūb Ṭabarī	*Jīca-mapharada* of Mahammada Ayuba Tabarī	ff. 7v–8r Kh
f. 4r L	*Zīj-i kāmil*[4] of Abū Rašīd Dānišī	*Jīca-kāmīla* of Abū Rasīda Dānaśī	ff. 7rv Pg
f. 6v O	*Zīj-i sālār*[5] of Ḥusām Sālār	*Jīca-salāra* of Hisāma Salāra	
f. – Q	*Zīj-i muġnī*,[6] *Zīj-i muḥkam*,[7] *Zīj-i mustavī*,[8] and *Zīj-i zāhidī*[9] of ʿAlī b. ʿAbd al-Karīm Širvānī Bakūhī	*Jīca-mugaṁnī*, *Jīca-muhakama*, *Jīca-mastauphī* and *Jīca-jāhadī* of Alī, son of Abdala Karīma Śeravānī Bākohī	
p. 6 R			
f. 3r S	*Zīj-i fāḫir*[10] of ʿAlī Mustawfī	*Jīca-phākhaja* of Alī Mauśtauphī	

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1 See Kennedy (1956: no. 9 on p. 125) and `https://ismi.mpiwg-berlin.mpg.de/text/147173`.
2 See Kennedy (1956: no. 7 on p. 125).
3 See Kennedy (1956: no. 65 on p. 134) and `https://ismi.mpiwg-berlin.mpg.de/text/481724`.
4 See Kennedy (1956: no. 49 on p. 132).
5 Also known as *Zīj-i šāhī*; see Kennedy (1956: no. 32 on p. 130) and `https://ismi.mpiwg-berlin.mpg.de/text/137424`.
6 See Kennedy (1956: no. 64 on p. 134) and `https://ismi.mpiwg-berlin.mpg.de/text/99703`.

7 See Kennedy (1956: no. 53 on p. 132) and `https://ismi.mpiwg-berlin.mpg.de/text/66489`.
8 See Kennedy (1956: no. 58 on p. 133) and `https://ismi.mpiwg-berlin.mpg.de/text/73738`.
9 Also known as *al-Zīj al-zāhir* of Farīd al-Dīn Abū l-Ḥasan ʿAlī b. ʿAbd al-Karīm al-Širwānī al-Fahhād; see Kennedy (1956: no. 23 on p. 128) and `https://ismi.mpiwg-berlin.mpg.de/text/59095`.
10 Most probably, the *al-Zīj al-Fāḫir* of Abū l-Ḥasan ʿAlī b. Aḥmad al-Nasawī; see Kennedy (1956: no. 44 on p. 131) and `https://ismi.mpiwg-berlin.mpg.de/text/122261`.

One *zīj* of unspecified basis

Zīj-i sanjarī[11] of ʿAbd al-Raḥmān Ḫāzinī

One *zij* based (*mabnī*) on the *Zīj-i šīrvān-šāhī*[12]

Zīj-i ʿalāʾī[13]
[of unnamed authorship]

Other *zij*es

Zīj-i ʿumda-yi īlḫānī[14]

Zīj-i ḫāqānī takmīl-i zīj-i īlḫānī[15] of Mawlānā Jamšīd Kāšī

Zīj-i sulṭānī[16] of Imām Muḥammad b. Ḫwāja ʿAlī Vābkanavī

Zīj of Abū l-Vafā Būzjānī[17]

Zīj of Abū Ḥāmid Anṣārī

Zīj of Abū l-Faraj Šīrāzī

Zīj of Abū l-Ḥasan Ṭūsī[18]

Two *jīca*s derived (*jāta*) from the *Jīca-śeravāṁśāhī*

Jīca-saṃjarī of Amāma Abdala Rahamā Khājanī

Jīca-ālāyī
[of unnamed authorship]

Other *jīca*s

Jīca of Ali-śāha Khvārajamī, resembling the great treatise famously called *Jīca-yīlakhānī* [of Naṣīr al-Dīn al-Ṭūsī]

Jīca-khākānī-takamīla-jīca-yīlakhānī of Maulānā Jamaśeda Kāśī

Jīca-sulatānī of Amāma Mahammada, son of Khvāja Alī Yaknavī

Jīca-abala-vaphā-būjajānī

Jīca-abū-hāmida-aṃsārī

Jīca-abū-khala-pharaja-śīrājī

Jīca-abūla-hasan-tūsī

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11 See Kennedy (1956: no. 27 on p. 129) and https://ismi.mpiwg-berlin.mpg.de/text/150288.

12 See Kennedy (1956: no. 30 on p9. 129–30).

13 Most probably, the *Zīj-i ʿAlāʾī* of al-Ḥasan b. Muḥammad b. al-Ḥusayn Niẓām al-Dīn al-Aʿraj al-Nīsābūrī; see Kennedy (1956: no. 42 on p. 131) and https://ismi.mpiwg-berlin.mpg.de/text/152130.

14 See Kennedy (1956: no. 32 on p. 130), and also see http://isamveri.org/pdfdkm/02/DKM021059.pdf (last accessed: 20th December 2023) for collated biblio-

graphic references on the works of Alī-šāh Ḫwārazmī [al-Buḫārī].

15 See Kennedy (1956: no. 20 on pp. 127–28) and https://ismi.mpiwg-berlin.mpg.de/text/74283.

16 Also known as *al-Zīj al-muḥaqqaq al-sulṭānī ʿalá uṣūl al-raṣad al-Īlḫānī*; see Kennedy (1956: no. 35 on p. 130) and https://ismi.mpiwg-berlin.mpg.de/text/153227.

17 See Kennedy (1956: no. 73 on p. 134).

18 Most probably, the *Zīj-i Īlḫānī* of Abū Jaʿfar Naṣīr al-Dīn Muḥammad b. Muḥammad b. al-Ḥasan al-Ṭūsī; see Kennedy (1956: no. 6 on p. 125) and https://ismi.mpiwg-berlin.mpg.de/index.php/text/154844.

Zīj-i kāfī[19]
[of unnamed authorship]

Jīca-kāphī
[of unnamed authorship]

Zīj-i sikandarī[20]
[of unnamed authorship]

Jīca-sikandarī
[of unnamed authorship]

Zīj-i advār akvār[21]
[of unnamed authorship]

Jīca-adavāra-akavāra
[of unnamed authorship]

Zīj-i ašrafī[22]
[of unnamed authorship]

Jīca-aśaraphī
[of unnamed authorship]

Zīj-i raḥīmī[23]
[of unnamed authorship]

Jīca-rahīmī
[of unnamed authorship]

Zīj-i maẓharī[24]
[of unnamed authorship]

Jīca-mujaharī
[of unnamed authorship]

Zīj-i kāšifī[25]
[of unnamed authorship]

Jīca-kāśaphī
[of unnamed authorship]

Zīj-i šāṭirī[26]
[of unnamed authorship]

Jīca-śātarī
[of unnamed authorship]

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19 Most probably, the *al-Zīj al-kāfī* of ʿUṭārid b. Muḥammad al-Ḥāsib; see Kennedy (1956: no. 103 on p. 136) and https://ismi.mpiwg-berlin.mpg.de/index.php/text/130305.

20 Speculatively, the *Lubāb-i Iskandarī* (alias: *Muḫtaṣar dar ʿilm-i hayʾat*) of Ġiyāṯ al-Dīn Jamšīd b. Masʿūd b. Maḥmūd al-Kāšī; see https://ismi.mpiwg-berlin.mpg.de/node/2672949.

21 Most probably, the *Adwār al-anwār madá l-duhūr wa-l-akwār* of Muḥyī al-Milla wa-l-Dīn Yaḥyá b. Abī l-Šukr al-Maġribī al-Andalusī; see Kennedy (1956: no. 108 on p. 137) and https://ismi.mpiwg-berlin.mpg.de/text/41182.

22 Most probably, the *Zīj-i Ašrafī* of Muḥammad b. Abī ʿAbd Allāh Sanjar al-Kāmilī; see Kennedy (1956: no. 4 on p. 124) and https://ismi.mpiwg-berlin.mpg.de/text/79219.

23 Most probably, the *Zīj-i Raḥīmī* of Mullā Farīd al-Dīn Masʿūd Ḥāfīẓ Ibrāhīm Dihlavī; see § 1.2.1.

24 Most probably, the *Zīj-i Maẓharī* of Maẓhar al-Dīn Muḥammad Qārī b. Bahāʾ al-Dīn ʿAlī; see Ansari (2015: no. 3.8 on p. 591–93) for a brief description of the *Zīj-i maẓharī*.

25 Speculatively, the *Kašf-i ḥaqāʾiq-i Zīj-i Īlḫānī* (alias: *Kašf al-ḥaqāʾiq Zīj-i Īlḫānī*) of al-Ḥasan b. Muḥammad b. al-Ḥusayn Niẓām al-Dīn al-Aʿraj al-Nīsābūrī; see https://ismi.mpiwg-berlin.mpg.de/text/101627.

26 Most probably, the *al-Zīj al-jadīd* of ʿAlāʾ al-Dīn Abū l-Ḥasan ʿAlī b. Ibrāhīm al-Anṣārī (commonly known as Ibn al-Šāṭir); see, Kennedy (1956: no. 11 on p. 125) and https://ismi.mpiwg-berlin.mpg.de/index.php/text/118322.

Zīj-i quṭbī[27]
[of unnamed authorship]

Jīca-kutabī
[of unnamed authorship]

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27 Most probably, the *Zīj-i sulṭānī* of Quṭb al-Dīn Maḥmūd b. Masʿūd b. Muṣliḥ al-Šīrāzī; see Kennedy (1956: no. 25 on p. 129) and https://ismi.mpiwg-berlin.mpg.de/text/141286.

C   LIST OF EARLIER FACILITATORY TABLES
(PER: *TASHĪL*, SAN: *SĀRAṆĪ*)

In the First part of the Introduction of the *Zīj-i Šāh Jahānī* (i.e., the *qism-i avval* [§ ID.1] from the *muqaddama*), and correspondingly in the First part of the Introduction of the *Siddhāntasindhu* (i.e., the *prathamaprakāra* [§ ID.1] from the *granthamukha*), we find the following five Islamicate simplification tables (PER: *tashīl*, SAN: *sāraṇī*) from earlier times. These are described below, and when possible, apposite modern references are appended in footnotes. We note that both the Persian original and its Sanskrit translation state that there are several other such tables based on ancient and recent observations (PER: *raṣad*, SAN: *rasada*) at the end of this short list.

ZŠJ			SS
f. 3r D	*Tashīl* of the Moon and Mercury by Mullā ʿImād,[1] based (*mabnī*) on the *Zīj-i Gūrgānī* [i.e., the *Zīj-i Uluġ Bīg*]	*Sāraṇī* of the Moon and Mercury by Mullā Imāda, in agreement (*anumata*) with the *Jīca-koragānī*	ff. 6v–7r Al
f. 3v H			ff. 8rv Kh
f. 4r L			f. 7v Pg
f. 6v O	*Tashīl* of the five planets by ʿUmar Ḫayyām[2]	Five *sāraṇī*s of the five planets beginning with Mars by Umara Khayāma	
f. – Q			
f. 6 R	Two *tashīl*s of the Moon known as *Ḥasanča* [of unnamed authorship]	Two *sāraṇī*s of the Moon called *Hasaṃcaya* [of unnamed authorship]	
f. 3v S			
	Tashīl of the seven planets by Ḥusayn b. Mūsà Hurmuzī[3]	*Sāraṇī* of the seven planets by Husaina, son of Mūse Huramajī	
	Tashīl of the Sun [of anonymous authorship]	*Sāraṇī* of the Sun [of anonymous authorship]	

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1 Identified as the *Kitāb Jadwal tashīl al-qamar wa-jadwal tashīl ʿuṭārid* of ʿImād al-Dīn al-Buḫārī (fl. fifteenth century); see Şen and Fleischer (2019: no. [23] on p. 784).
2 Most probably, part of the *al-Zīj Malik-šāhī* of Ġiyāṯ al-Dīn Abū l-Fatḥ ʿUmar b. Ibrāhīm al-Ḫayyāmī al-Nīšāpūrī ʿUmar Ḫayyām; see Kennedy (1956: no. 22 on

p. 128) and https://ismi.mpiwg-berlin.mpg.de/text/97813.
3 Most probably, part of the *Zīj-i Šastgah* of Ḥusayn b. Mūsá al-Hurmuzdī al-Ḥāsib; see Kennedy (1956: no. 33 on p. 130) and https://ismi.mpiwg-berlin.mpg.de/text/70224.

D   ON THE ETYMOLOGY OF THE WORD *ZĪJ*

In the First part of the Introduction of Mullā Farīd's *Zīj-i Šāh Jahānī* (i.e., the *qism-i avval* [**§ ID.1**] from the *muqaddama*), and correspondingly in the First part of the Introduction of Nityānanda's *Siddhāntasindhu* (i.e., the *prathamaprakāra* [**§ ID.1**] from the *granthamukha*), we find their discussion on the etymology of the word *zīj*.[1] These are presented below with the original text and corresponding English translations in parallel columns.

ZŠJ	In the words of Mullā Farīd	In the words of Nityānanda	SS

ZŠJ

f. 3r D
f. 3v H
f. 4r L
f. 6v O
f. – Q
f. – R
ff. 3rv S

In the words of Mullā Farīd

زیج معرب زیگ است بکاف فارسی پس
بجیم عربی باشد و آنکه او را با بجیم فارسی
میخوانند غلط عامه است و زیگ بپارسی نام
آن ریسمانها است که نقشبندان بآنها پارچهها
نقش میبندند و آن قانون است جامهباف را
در معرفت بافتن پارچههای منقش همچنانکه
زیج قانونی است منجم را در شناختن نقوش
و اوضاع فلکی و خطوط جداول زیج در
طول و عرض در هم کشیده که کیفیت
نقوش ثیاب ازان پیدا شود و راصد درین
صنعت بمنزله نقشبند است

zīj muᶜarrab-i zīg ast ba kāf-i fārsī pas zīj ba jīm-i ᶜarabī bāšad u ānki ū rā ba jīm-i fārsī mīḫwānand ġalaṭ-i ᶜāmma ast u zīg ba pārsī nām-i ān rīsmānhā ast ki naqš-bandān ba ānhā bar pārčahā naqš mībandand u ān qānūn ast jāma-bāf rā dar maᶜrifat-i bāftan-i pārčahā-yi munaqqaš hamčunānki zīj qānūnī ast munajjim rā dar šināḫtan-i nuqūš u awżāᶜ-i falakī u ḫuṭūṭ-i jadāvil-i zīj dar ṭūl u ᶜarż dar ham kašīda ki kayfīyat-i nuqūš-i t̲iyāb az ān paydā šavad

In the words of Nityānanda

SS

f. 6v Al
f. 8r Kh
f. 7v Pg

प्रथमं फारसीजीगशब्दः प्रसिद्धः आरबदेशे तस्यापभ्रंशेन जीज इति आरबदेशे गकारस्याभावात् । गकारस्थानजकारमेव तद्देशवासिनः पठन्ति । तस्मादेतस्य नाम जीज इति यवनलिपौ जकारचकारयोरभेदाज्जीचशब्दो रूढितः । प्रसिद्धो जातो वास्तवेनाशुद्धशुद्धं तु जीज इति फारसीदेशे तन्तुवायानां वस्त्रविशेषचित्ररचनायां जीग इति नाम्नो रजवो भवन्ति । ताभिस्तन्तुवायाश्चित्रकाश्चित्राणि रचयन्ति । तन्तुवायचित्रकानां वस्त्रचिन्तनारम्मे चित्रज्ञानार्थं ता रजव उपकरणानि भवन्ति । यथा ज्योतिर्विदां चित्ररूपगोलसंस्थाज्ञानार्थं जीच इति । पुनर्येभ्यः कोष्ठकेभ्यो ग्रहभुक्तिपरिमाणं प्रकटं भवति तद्दैर्घ्यायामरेखा एतादृशा भवन्ति यथा जीगाख्यरजव आयामविस्तारगता भवन्ति । अत्र रसदकर्ता चैतादृशो याद्रग्वस्त्रचित्रकः ।

prathamaṃ phārasījīgaśabdaḥ prasiddhaḥ ārabadeśe tasyāpabhraṃśena jīja iti ārabadeśe gakārasyābhāvāt | gakārasthāna-jakāram eva taddeśavāsinaḥ paṭhanti | tasmād etasya nāma jīja iti yavana-lipau jakāracakārayor abhedāj jīca-śabdo rūḍhitaḥ | prasiddho jāto vāstavenāśuddhaṃ śuddhaṃ tu jīja iti phārasīdeśe tantuvāyānāṃ vastra-viśeṣacitraracanāyāṃ jīga iti nāmnyo rajjavo bhavanti | tābhis tantuvāyāś

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1 Originally, the etymology of the word *zīj* derives from the *Zīj-i muḥaqqaq-i sulṭānī* of Muḥammad ibn ᶜAlī al-Munajjim al-Wāb-kanawī (more commonly, Šams al-Munaj-jim) written in Persian, c. 1320.

u rāṣid dar īn ṣanᶜat ba manzila-yi naqš-band ast

citrakāś citrāṇi racayanti | tantuvāya-citrakānāṃ vastracintanārambhe citra-jñānārthaṃ tā rajjava upakaraṇāni bhavanti | yathā jyotirvidāṃ citrarūpagola-saṃsthājñānārthaṃ jīca iti | punar yebhyaḥ koṣṭhakebhyo grahabhukti-parimāṇaṃ prakaṭaṃ bhavati tad dairghyāyāmarekhā etādṛśā bhavanti yathā jīgākhyarajjava āyāmavistāragatā bhavanti | atra rasadakartā ca itādṛśo yādṛg vastracitrakaḥ |

Zīj is the Arabicization of *zīg*, written with a Persian *kāf*. It becomes *zīj* with an Arabic *jīm*. It is a common mistake to pronounce it with a Persian *jīm*. In Persian *zīg* is the name given to the strings (*rīsmān*) with which embroiderers sew pictures on clothes. This is for the weaver the basic principle in the knowledge of weaving embroidered clothes in exactly the same manner as the *zīj* is for the astronomer the basic principle in his knowledge of the celestial pictures and positions. Having drawn together both in length and breadth the lines of the tables in the *zīj* from which are produced the details of the pictures on the clothes. In this craft, the observer is in the position of the embroiderer.

Firstly, the Persian word *jīga* (PER: *zīg*) that is famous in the Arab world, by its corruption, becomes *jīja* (ARA: *zīj*) due to the absence of the letter *ga* (i.e., PER: *gāf*) in the Arab world. Indeed, the residents of those countries [i.e., Arab native speakers] read the letter *ja* (i.e., ARA: *jīm*) in place of the letter *ga*. [And] from that, the name *jīja* of this [word *zīj*] becomes the word *jīca* in common usage due to absence of distinction between the letter *ja* and the letter *ca* in the Muslim [Arabic] script (*yavana-lipi*). The famous [word] that, although genuinely inaccurate, was [though as] correct [and] called *jīja*; in the Persian world, the string (*rajju*) in the creation of special figures on cloth by the weavers are [called] *jīga* by name. With those [strings], weavers [like] painters create figures. When beginning to think about [the design on] the cloth, these strings become instruments of the weavers and painters for the sake of understanding the figure just as *jīca* [becomes the instrument] of the astronomers for the sake of understanding the arrangement of [the movement of] the celestial sphere in the form of figures. Moreover,

all those tables from which the measure of the daily motion of the planets becomes evident, the lines constituting their length and breadth are thus formed, just as the strings called *jiga* outline the length and breadth [of the woven figures]. And here, the observers (*rasada-kartṛ*, lit. makers of *rasada* 'observations') are in a way similar to the painters of cloth.

E   ON THE UTILITY OF ALMANACS (*TAQVĪM*) AND *ZĪJES*, AND OF OBSERVATIONS (*RAṢAD*)

In the First part of the Introduction of Mullā Farīd's *Zīj-i Šāh Jahānī* (i.e., the *qism-i avval* [§ **ID.1**] from the *muqaddama*), and correspondingly in the First part of the Introduction of Nityānanda's *Siddhāntasindhu* (i.e., the *prathamaprakāra* [§ **ID.1**] from the *granthamukha*), we find their statements on the utility (PER: *fāyida* 'advantage', SAN: *prayojana* 'use') of almanacs (PER: *taqvīm*, SAN: *takavīma*) and *zījes* (SAN: *jīca*), and of observations (PER: *raṣad*, SAN: *rasada*). These are presented below with the original text and corresponding English translations in parallel columns.

ZŠJ
f. 3v D
f. 3v H
f. 4r L
ff. 6v–7r O
f. – Q
f. – R
f. 3v S

On the advantage of an almanac (*taqvīm*)

و فایده تقویم آن است که اختیارات جزوی روزهای سال و احوال گردش روزگار و صلح بادشاهان با یکدیگر و حرب و ایمنی و تندرستی و رنجوری مردمان و ارزانی و گرانی نرخها و بارندگی و خشکی سال معلوم گردد

u fāyida-yi taqvīm ān ast ki iḫtiyārāt-i juzvī-yi rūzhā-yi sāl u aḥvāl-i gardiš-i rūzgār u ṣulḥ-i bādšāhān bā yak-dīgar u ḥarb u īmnà u tan-durustī u ranjvarī-yi mardumān u arzānī u garānī-yi nirḫā u bārandagī u ḫuškī-yi sāl maʿlūm gardad

An almanac (*taqvīm*) is useful in knowing how to choose the parts of the day in the year [on which to perform successful actions], and to know the details of the motions of fortune, peace between emperors, war, security, the health and infirmity of men, the cheapness and expensiveness of commodities, [and] the rain and drought periods in the year.

On the use of an almanac (*takavīma*) SS

f. 7r Al
f. 8v Kh
f. 8r Pg

प्रतिदिनमुहूर्तादिविचारः समयविचारो यथाराज्ञा-मस्मिन्वर्षे परस्परं संधियुद्धं वा सशङ्कत्वं निःशङ्कत्वं वा सातुज्यं नैतुज्यं वा लोकानां च काण्डस्य समर्घत्वं महार्घत्वं वा वर्षणमवर्षणं वेत्यादि तकवीमस्य प्रयोजनम् ।

pratidinamuhūrtādivicāraḥ samayavicāro yathārājñām asmin varṣe parasparaṃ saṃdhir yuddhaṃ vā saśaṅkatvaṃ niḥśaṅkatvaṃ vā sātujyaṃ naitujyaṃ vā lokānāṃ ca kāṇḍasya samarghatvaṃ mahārghatvaṃ vā varṣaṇam avarṣaṇaṃ vetyādi takavīmasya prayojanam |

The use of an almanac (*takavīma*) is, among other things, for investigating daily [time divisions of] *muhūrta* etc. [and] for investigating opportune times, just as [the moments] in this year [when there could be] a mutual peace treaty between kings or war, a state of doubt or certainty, vitality or languor among men, the cheapness or expensiveness of a commodity, and [the chance of] rain or drought.

On the advantage of a *zīj*

و از جمله فواید زیج آنکه هر فرزندی که در
وجود آید طالع مولود و تحویل وی ازانجا
استخراج کنند تا احوال او از درازی عمر
و کوتاهی و نیکبختی و بدبختی و تندرستی
و بیماری و توانگری و درویشی و رنج و
راحت او و دانسته شود

*u az jumla-yi favāyid-i zīj ānki har farzandī
ki dar vujūd āyad ṭāliᶜ-i mawlūd u taḥvīl-i
vay az ānjā istiḫrāj kunand tā aḥvāl-i ū az
darāzī-yi ᶜumr u kūtāhī u nīk-baḫtī u bad-
baḫtī u tan-durustī u bīmārī u tavāngarī u
darvīšī u ranj u rāḥat-i ū dānista šavad*

Amongst the advantages in *zīj*es, is
the derivation from it of the Ascend-
ant at birth and of annual revolution
for every child who is born so that his
circumstances may be known, such as
length and shortness of life, good or
bad fortune, health and illness, wealth,
poverty, suffering, tranquillity.

On the use of a *zīj* (*jīca*)

अथ यस्य बालस्य जन्मसमयो ज्ञायते तस्य
जन्मलग्नं यतो गण्यते वर्षलग्नादिकमायुर्दायादिकं
शुभाशुभफलं ज्ञायत इत्यादि जीचस्य प्रयोजनम् ।

*atha yasya bālasya janmasamayo
jñāyate tasya janmalagnaṃ yato gaṇyate
varṣalagnādikam āyurdāyādikam śubhā-
śubhaphalaṃ jñāyata ityādi jīcasya
prayojanam |*

Now, the use of a *zīj* (*jīca*) is, among
other things, to calculate for a child
whose time of birth is known, the natal
Ascendant, the Ascendant of annual
revolution etc. to predict the length of
[their] life from the aspect of the stars
etc. [and] to determine the auspicious
and inauspicious [astrological] effects.

On the advantage of observations (*raṣad*)

فایده رصد آنکه اگر در مواضع کواکب بمرور
ایام خللی ظاهر شود آنرا صاحب رصد راست
کند تا درین احکام که گفته شد خطا کمتر
واقع شود چه اگر یکدرجه در تقویم کوکبی
خطا باشد یکسال در احکام تسییرات تفاوت
افتد و اگر یکدقیقه خطا باشد شش روز این
است

*fāyida-yi raṣad ānki agar dar mavāżiᶜ-i
kavākib ba murūr-i ayyām ḫalalī ẓāhir
šavad ān rā ṣāḥib-i raṣad rāst kunad tā dar
īn aḥkām ki gufta šud ḫaṭā kamtar vāqiᶜ
šavad či agar yak-daraja dar taqvīm-i kawk-
abī ḫaṭā bāšad yak-sāl dar aḥkām-i tasyīrāt*

On the use of observations (*rasada*)

अथ कियाद्भिर्दिनैर्गतैर्ग्रहेषु किंचिदन्तरं यदि
पतति तदा रसदकर्ता सम्यक्तदन्तरं जानाति
साधयति च ततः सर्वाण्युक्तानि फलानि मिलन्ति ।
यदन्तरमंशप्रमाणं ग्रहे चलति तदा तसीरातसंज्ञे
वर्षमेकं चलति यदि कलैका चलति तदा षड्दिनानि
चलन्तीत्यादि रसदस्य प्रयोजनम् ।

*atha kiyādbhir dinair gatair graheṣu kiṃ-
cid antaraṃ yadi patati tadā rasadakartā
samyak tadantaraṃ jānāti sādhayati ca
tataḥ sarvāṇy uktāni phalāni milanti | yady
antaram aṃśapramāṇaṃ grahe calati tadā
tasīrātasaṃjñe varṣam ekaṃ calati yadi*

tafāvut uftad u agar yak-daqīqa ḫaṭā bāšad šiš rūz ast

The advantage of observation (*raṣad*) is that if a defect appears in the positions of planets with the passing of days, the observer (*ṣāḥib-i raṣad*) will rectify it so that in making prognostications, less errors will arise. Indeed if one degree is wrong in the table of positions of the planets, there is will be a one-year discrepancy in the astrological judgement (*aḥkām*) of the prorogations (*tasyīrāt*), and if one minute is wrong, it will be a six-day [difference].

kalaikā calati tadā ṣaḍdināni calantītyādi rasadasya prayojanam |

Now, the use of observations (*rasada*) is, among other things, that if there occurs a little difference in the [attested and observed positions of the] planets with some amount of elapsed days, then an observer (*rasadakartṛ*) knows and corrects that difference completely [and] thereupon, all declared results concur. If an amount of [one] degrees of arc difference deviates in the [attested and observed positions of the] planet [in the tables], then one year deviates in [what is called] *tasīrata* (PER: *tasyīrāt* 'prorogations') by name; if [the amount of difference of] one minute of arc deviates, then six days deviate.

F ON VARIOUS CALENDRICAL TERMS IN DIFFERENT TRADITIONS

In the Fifth part of the Introduction of Mullā Farīd's *Zīj-i Šāh Jahānī* (i.e., the *qism-i panjum* [**§ ID.5**] from the *muqaddama*), and correspondingly in the Fifth part of the Introduction of Nityānanda's *Siddhāntasindhu* (i.e., the *pañcama-prakāra* [**§ ID.5**] from the *granthamukha*), we find descriptions of calendrical terms according to the different traditions of Arabic (PER: *arabī*, SAN: *ārabīya*), Byzantine Roman (PER: *rūm*, SAN: *romaka*), Chinese (PER: *ḥaṭā*, SAN: *khitā/khitāya*), Greek (PER: *yūnān*, SAN: *yūnāna*), Hindu (PER: *hind*, SAN: *hindu*), Persian (PER: *fārs*, SAN: *phārasa*), Turkic (PER: *turkī*, SAN: *turakī*), Uyghur (PER: *uyġur*, SAN: *yagūra*), and more generally, Muslim (PER: *ahl-i šarᶜ* 'people of Islamic law', SAN: *yavana*) astronomers. These are presented below as enumerated lists in parallel columns.

In his *Zīj-i Šāh Jahānī*, Mullā Farīd de-scribes:

1. the tropical solar year (*sāl-i āftābī*) with respect to the vernal equinox (0° Aries or *avval-i ḥamal*, lit. 'beginning of Aries');
2. the lunar year (*sāl-i qamarī*) of twelve synodic lunar months (*māh*);
3. the sidereal solar month (*māh-i šamsī*) with respect to the ingress of the Sun into a zodiacal sign (i.e., the beginning of the *sayr-i āftāb dar yak burj* 'course of the Sun in a zodiacal sign');
4. the nychthemeron (*šabāna-rūz*), according to the Persian and Greek astronomers, measured from the preceding midday (*nīm-i rūz*) to the succeeding midday;
5. the nychthemeron, according to the Chinese, Uyghur and Hindu astronomers, measured from the

In his *Siddhāntasindhu*, Nityānanda de-scribes:

1. the tropical solar year (*saura-abda*) with respect to the vernal equinox (0° Aries or *meśa-mukha*, lit. 'beginning of Aries');
2. the lunar year (*cāndra-varṣa*) of twelve synodic lunar months (*candra-māsa*);
3. the sidereal solar month (*saura-māsa*) with respect to the in-gress of the Sun into a zodiacal sign (i.e., the beginning of the *saṃkrānti* 'zodiacal transit of the Sun');
4. the nychthemeron (*ahorātra*), ac-cording to the astronomers born in the Persian lands who were influenced by [the astronomers in] the Greek lands, measured from the preceding midday (*dyu-madhyāhna*) to the succeeding midday;
5. the nychthemeron (*dyuniśa*), ac-cording to the astronomers of the Chinese and Hindu main-lands, measured from the pre-

preceding midnight (*nīm-i šab*) to the succeeding midnight;

6. the nychthemeron, according to the Arabs and to the people of the Law [astronomers], measured from the preceding evening (*avval-i šab*) to the succeeding evening;

7. the nychthemeron, according to other peoples, measured from the preceding sunrise (*avval-i rūz*) to the succeeding sunrise;

8. the mean nychthemeron (*šabāna-rūz-i vasaṭī*), equal to one revolution of the highest celestial sphere (*falak-i aᶜẓam*) with the mean motion of the Sun, which, according to the observations made in Samarqand, is equal to 0°59′8″19‴37⁗48‴‴‴;

9. the length of day (*rūz*) for the Persian and Byzantine Roman astronomers, from the rising of the centre of [the disc of] the Sun (*ṭulūᶜ-i markaz-i šams*) till its setting (*ġurūb*);

10. the length of day (*rūz*) for people who follow Islamic law as measured from the rising of the true dawn (*ṭulūᶜ-i ṣubḥ-i ṣādiq*) until the setting of the entire body of the Sun (*ġurūb-i tamām-i jirm-i šams*); [with] the length of a night (*šab*) as the opposite of both preceding items;

ceding midnight (*dyu-rātrārdha*) to the succeeding midnight (*dyu-rātrimadhya*);

6. the nychthemeron (*dyurātra*), according to the Arabic [astronomers] who are famous among the Muslims, measured from the preceding evening (*sāya*) to the succeeding evening, always according to the teachings of their own religion;

7. the nychthemeron, according to those born in other Hindu regions, measured from the preceding sunrise (*arka-udaya*) to the succeeding sunrise;

8. the mean nychthemeron (*madhya-dyuniśa*), according to the best of the sages and the best of Muslims, as the revolution of time (*kālacakra*) of 4 sidereal seconds (*prāṇa*) [approximately] equal to the arcminutes (*lipta*) of daily mean motion of the Sun;

9. the length of day and night (*dina-rātri*) for the Persian and Byzantine Roman astronomers, and those born in the land of the Hindus, from the rising of the centre of the disc of the Sun (*dineśa-bimbārdha-samudgama*) till its setting (*asta*) reciprocally;

10. the length of day (*vāsara*) for those coming from the Arab lands and those following the religion of the greater Muslim [regions] as measured from dawn (*anūru*) to the time of the setting of the disc of the Sun (*kharāṃśu-bimba-asta-kāla*), with the other part being entirely night (*rātri*);

11. the length of equal hours (*sāʿāt-i mustavīya u muʿtadila*) either mean (*vasaṭī*) or true (*ḥaqīqī*) as the twenty-fourth parts of the mean or exact nychthemeron (*šabānrūz-i vasaṭī u ḥaqīqī*);

12. the twelve unequal hours (*sāʿāt-i muʿvajja u zamānī*) dividing equally either the day or the night;

13. the twelve divisions of the whole nychthemeron, known as *čāġ*, according Chinese and Uyghur astronomers;[1]

14. the period of an eighth part of a *čāġ* called *kih* and the definition of its smaller unit *fank* (CHIN: *fēn*), and the names of the different *čāġ* following their Chinese and Uyghur nomenclature; and

15. on the commencement of the nychthemeron from the first *kih* of the first *čāġ*.

11. the length of equal hours (*tulya-horā*) for those born in Persia and Byzantine Rome as the twenty-fourth part of some precise or imprecise nychthemeron (*sphuṭa-asphuṭa-dyuniśa*);

12. the twelve unequal hours (*atulya-horā*) of the measures of the day and the night (*vāsara-rātri-miti*) according to the best of the Muslims;

13. the twelve equal divisions of two hours (*horikā*) each of the length of the nychthemeron, famously known as *cāga* (TUR: *čāġ*), according to wise men from the Sino-Uyghur [region];

14. the period of an eighth part of a *cāga* called *kiha* (TUR: *kih*) and the definition of its smaller unit *phaṃga* (CHIN: *fēn*), and the names of the different *cāga* following their Chinese and Turkic nomenclature; and

15. on the commencement of the nychthemeron from the middle of the first *cāga*.

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1 See (Kennedy 1964) for discussions on the Chinese-Uyghur calendars in Islamicate *zīj*es; in particular, for definitions of *čāġ* (a Turkic word synonymous with the Chinese word *shí*) consisting of right *kih* (CHIN: *kè*).

G ON THE DESCRIPTION OF THE ERA OF ŠĀH JAHĀN

In the First chapter of the First discourse of Mullā Farīd's *Zīj-i Šāh Jahānī* (i.e., the *bāb-i avval* [§ I.1] from the *maqāla-yi avvalīn*), and correspondingly in the First chapter of the First part of Nityānanda's *Siddhāntasindhu* (i.e., the *prathamādhyāya* [§ I.1] from the *prathamakāṇḍa*), we find their descriptions of the era (PER: *tārīḫ-i ilāhī* 'divine era', SAN: *śaka*) of Šāh Jahān.[1] These are presented below with the original text and corresponding English translations in parallel columns.

ZŠJ	**In the words of Mullā Farīd**	**In the words of Nityānanda**	SS
f. 6r D	باب اول در معرفت تاریخ الهی شاهجهانی	तत्र प्रथमाध्याये शाहजहानीयशकविवर्णम् ।	ff. 10rv Al
ff. 6v–7r H	*bāb-i avval dar maʿrifat-i tārīḫ-i ilāhī-yi šāh-jahānī*	*tatra prathamādhyāye śāhajahānīyaśaka-vivarṇam |*	ff. 12rv Kh
f. 6v L			ff. 11r Pg
ff. 9v–10r O	First chapter, on the divine era of Šāh Jahān.	Then, in the first chapter, the description of the era of Šāh Jahān.	
f. – Q			
ff. 3v–5r R			
ff. 6rv S			

In the words of Mullā Farīd:

ابتداء آن از اول سال جلوس همایون روز دوشنبه اول فروردین ماه الهی موافق پانزدهم ماه رجب المرجب بحسب امر اوسط و سیزدهم آن بحسب رؤیه سنه ۱۰۳۷ هجری است بعد از چهار ساعت و هفت دقیقه از اول روز مذکور بطول دار الخلافه اگره

In the words of Nityānanda:

सप्तत्रिखेन्दु १०३७ प्रमितारबीय-
शाके प्रवृत्ते खलु चान्द्रवर्षैः ॥
मासे तथा रजबसञ्ज्ञिके ऽस्मिन्
मध्याह्वये पञ्चदशे दिने च ॥ १ ॥   (इन्द्रवज्रा)

त्रयोदशे ऽत्यन्तपरिस्फुटाख्ये
विधोर्दिने खेन्दु १० घटीषु तद्वत् ॥
पलेषु मेघप्रमितेषु १७ भूयो
दिनस्य यातेषु दलान्वितेषु ॥ २ ॥   (उपेन्द्रवज्रा)

शाकोद्भवः शाहजहानृपस्या-
सीदाद्यमासप्रथममाहसञ्ज्ञे ॥
पुरे ऽर्गलाख्ये नृपराजधान्यां
श्रीसूरसेनाभिधदेशसंस्थे ॥ ३ ॥   ⎛ उपजाति ⎞
                                                     ⎝ बाला ⎠

ibtidāʾ-i ān az avval-i sāl-i julūs-i humāyūn rūz-i dū-šanba avval-i farvardīn māh-i ilāhī muvāfiq-i pānzdahum-i māh-i rajab al-murajjab ba ḥasb-i amr-i awsaṭ u sīzdahum-i ān ba ḥasb-i ruʾya sana 1037 hijrī ast baʿd az čahār sāʿat u haft daqīqa az

saptatrikhendu 1037 pramitārabīya-śāke pravṛtte khalu cāndravarṣaiḥ \|\|
māse tathā rajjabasajñike ʾsmin madhyāhvaye pañcadaśe dine ca \|\| 1 \|\| (*indravajrā*)

trayodaśe ʾtyantaparisphuṭākhye vidhor dine khendu 10 ghaṭīṣu tadvat \|\|

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[1] The era of Šāh Jahān began on AH 1037, Rajab 15 (20 March 1628), on the day of the vernal equinox (*naw-rūz*), and imitated the old Persian (Yazdgirdī/Qadīmī) era (epoch 16 June 632) and the Jalālī era of Saljūq King Malik Shāh I (epoch 15 March 1079) in its naming of the months (beginning with Far-

vardīn). The epoch of Šāh Jahān's era corresponded to the 996th year in the Yazdgirdī era and the 550th in Jalālī era. A fuller discussion on Šāh Jahān's regnal era vis-à-vis the older eras is to appear in Misra (forthcoming).

avval-i rūz-i maḏkūr ba ṭūl-i dār al-ḫilāfa agra

paleṣu meghapramiteṣu 17 bhūyo
dinasya yāteṣu dalānviteṣu || 2 || (*upendravajrā*)

śākodbhavaḥ śāhajahānṛpasyā-
sīd ādyamāsaprathamāhasaṃjñe ||
pure 'rgalākhye nṛparājadhānyāṃ
śrīsūrasenābhidhadeśasaṃsthe || 3 || $\left(\begin{array}{c}upajāti\\ bālā\end{array}\right)$

This era begins from the start of the year of the fortunate enthronement, that is on the Monday, first of the divine month of Farvardin, which corresponds to the 15th of the month of Rajab according to the mean position (*amr-i awsaṭ*) and to the 13th of this month according to the sighting (*ruʾya*), on the year of Hegira 1037, after 4 hours and 7 minutes from the beginning of the above-mentioned day on the longitude of the imperial capital Agra.

Indeed, in [the year] 1037 of the Arabic era with lunar years that has commenced, and in the month called *rajjaba* (PER: Rajab) in this [year], on the 15th day [following what is] called the mean (*madhya*) [position] and... 1

...on the 13th [day following what is] known as exceedingly manifest (*atyanta-parisphuṭa*), on Monday, and likewise at 10 *ghaṭi*s and 17 *pala*s in the elapsed half of the day,... 2

...the birth of the era of King Šāh Jahān occurred in the first month known as the first *māha* (PER: *māh*) in the regnal capital city called Agra situated in the region known as Śrī Sūrasena [i.e., the Braj region of modern-day Uttar Pradesh]. 3[2]

و سال و ماه این تاریخ شمسی حقیقی
است چه سال مدت سیر آفتاب است از
نقطه اول حمل تا باز رسیدن بهمان نقطه
و اول فروردین ماه الهی که نوروز و سر
سال است روزی بود که پیش از نیمروز آن
روز آفتاب در اول حمل تحویل نماید و اگر
بعد از نیمروز تحویل کند نوروز روز دومش
باشد و همچنین تحویل آفتاب در هر برجی
مدخل ماه شمارند و ماه مدت بودن آفتاب
است در یک برج و آن از بیست و نه روز

एतस्य वर्षाणि तथैव मासाः
सौराः स्फुटाख्याः परिचिन्तनीयाः ॥
यदा स्फुटार्कः खलु सायनांशो
मेषं व्रजेन्मध्यदिनात्पुरस्तात् ॥ ४ ॥ $\left(\begin{array}{c}उपजाति\\ शाला\end{array}\right)$

तदैव तस्मिन्दिवसे प्रकल्प्यं
सौराब्दवेशस्य दिनं सदाद्यम् ॥
दिनार्धतश्चेद्रविसंक्रमो ऽयं
पश्चत्तदा स्यात्परवासरं हि ॥ ५ ॥ $\left(\begin{array}{c}विपरीता-\\ ख्यानिकी\end{array}\right)$

सर्वेषु मासेष्वपि तन्नविज्ञै-
रेवं विधानं परिकल्पनीयम् ॥

2 In the Islamic (Hijri) calendar, the day begins at sunset, and hence $4^h 7^m$ past sunset (at 18:53) on 15 Rajab AH 1037 (20 March 1628) at Agra corresponds to a time of 23:00. Following Nityānanda's description using

Indian time units, a time of 10 *ghaṭi*s and 17 *pala*s (i.e., 246.8 minutes or $10^h 17^m$) in the elapsed half of that day at Agra (i.e., at 12:48 in the afternoon) corresponds to a time of 23:05.

كمتر و از سى و دو روز بيشتر نباشد و
منجمان براى آسانى راندن اوساط كواكب در
دستور العمل ماهها را سى سى روز گيرند

u sāl u māh-i īn tārīḫ šamsī ast či sāl mad-
dat-i sayr-i āftāb ast az nuqta-yi avval-i
ḥamal tā bāz rasīdan ba hamān nuqta
u avval-i farvardīn māh-i ilāhī ki naw-
rūz u sar-i sāl ast rūzī buvad ki pīš
az nīm-rūz-i ān rūz āftāb dar avval-i
ḥamal taḥvīl namāyad u agar baᶜd az nīm-
rūz taḥvīl kunad naw-rūz rūz-i duvvu-
maš bāšad u hamčunīn taḥvīl-i āftāb dar
har burjī maḏḫal-i māh šumārand u māh
maddat-i būdan-i āftāb ast dar yak burj
u ān az bīst u nuh rūz kamtar u az sī
u dū rūz bīštar nabāšad u munajjimān
barā-yi āsānī-yi rāndan-i awsāṭ-i kavākib
dar dastūr al-ᶜamal māhhā rā sī sī rūz
gīrand

ज्योतिर्विदः सद्गणितप्रसिद्ध्यै
त्रिंशद्दिनं मासमुशन्ति सर्वम् ॥ ६ ॥

<div align="right">(उपजाति
वाणी)</div>

etasya varṣāṇi tathaiva māsāḥ
saurāḥ sphuṭākhyāḥ paricintanīyāḥ ||
yadā sphuṭārkaḥ khalu sāyanāṃśo
meṣaṃ vrajen madhyadināt purastāt || 4 ||

<div align="right">(upajāti
śālā)</div>

tadaiva tasmin divase prakalpyaṃ
saurābdaveśasya dinaṃ sadādyam ||
dinārdhataś ced ravisaṃkramo 'yaṃ
paścat tadā syāt paravāsaraṃ hi || 5 ||

<div align="right">(viparītā-
khyānikī)</div>

sarveṣu māseṣvapi tantravijñair
evaṃ vidhānaṃ parikalpanīyam ||
jyotirvidaḥ sadgaṇitaprasiddhyai
triṃśaddinaṃ māsam uśanti sarvam || 6 ||

<div align="right">(upajāti
vāṇī)</div>

The year and month of this year are solar, i.e., the year has the duration of the passage of the Sun from the first point of Aries to its return to the same point. The beginning of the divine month of Farvardīn which is the 'new day' (*naw-rūz*) and the extremity of the year should be on the day on which, before midday, the Sun transfers in 0° Aries and if it does so after midday, the 'new day' will be on the second day [of this month]. In the same way, we consider the beginning (*madḫal*) of the month as the transfer of the Sun in every zodiac constellation. One month is the duration of the staying of the Sun in one zodiac constellation and it is minimum 29-day long and maximum 32-day long. Astronomers take 30-day long months to simplify the driving of the mean motions (*awsāṭ*) of planets in [their] practical rules (*dastūr al-ᶜamal*).

The years and similarly the months of this [era] are to be considered as true solar [i.e., tropical or *sāyana* solar year]. Indeed, if the true [position of the] Sun with the degrees of equinoctial precession attains Aries before midday... 4

...then on that very day, the true first day (*sat-ādya-dina*) of the ingress of the solar year should be maintained. And if this passage of the Sun is after midday, then, perhaps, the next day [should be considered]. 5

In this way, [this] rule [for the determining the beginning of a month] should be maintained in all the [solar] months by men learned in the sciences. An astronomer considers a 30-day month entirely for the sake of accomplishing real computations (*sat-gaṇita*). 6

و در آخر سال پنج روز افزایند و آنرا خمسه مسترقه خوانند و گاهی برای اعمال دیگر بترتیب فروردین لا اردیبهشت لا خورداد لب تیر لا امرداد لا شهریور لا مهر ل ابان ل اذر كط دی كط بهمن ل اسفندارمذ ل شمارند

वर्षान्त्यसंस्थं दिनपञ्चकं च
बुधोर्विचिन्त्यं खलु भिन्नमेवम् ॥
किंवा कुरामैः ३१ कुगुणै ३१ रदाख्यै- ३२
भूवह्निभि ३१ भूमिगुणै ३१ दिनैश्च ॥ ७ ॥   (उपजाति)

भूरामसङ्ख्यैः ३१ खगुणैः ३० खरामै- ३०
गोबाहुभि २९ गोनयनै २९ खलोकैः ३० ॥
व्योमाग्नि ३० तुल्यैः क्रमशः प्रकल्प्या
मासा इलाहीति जगत्प्रसिद्धाः ॥ ८ ॥   (इन्द्रवज्रा)

u dar āḫir-i sāl panj rūz afzāyand u ān rā ḫamsa-yi mustariqa ḫwānand u gāhī barā-yi aʿmāl-i dīgar ba tartīb-i far-vardīn 31 ardī-bihišt 31 ḫwurdād 32 tīr 31 amurdād 31 šahrīvar 31 mihr 30 abān 30 aḏar 29 day 29 bahman 30 isfandārmaḏ 30 šumārand

varṣāntyasaṃsthaṃ dinapañcakaṃ ca budhor vicintyaṃ khalu bhinnam evam || kiṃvā kurāmaiḥ 31 kuguṇai 31 radā-khyair 32 bhūvahnibhir 31 bhūmiguṇair 31 dinaiśca || 7 || (upajāti)

bhūrāmasaṅkhyaiḥ 31 khaguṇaiḥ 30 kha-rāmair 30 gobāhubhir 29 gonayanaiḥ 29 khalokaiḥ 30 ||
vyomāgni 30 tulyaiḥ kramaśaḥ prakalpyā māsā ilāhīti jagatprasiddhāḥ || 8 || (indravajrā)

At the end of the year, five days are added and they are called the five supplementary [days]. Sometimes for other calculations, they count [months] in this manner: Farvardīn 31, Ardī-Bihišt 31, Ḫwurdād 32, Tīr 31, Amurdād 31, Šahrīvar 31, Mihr 30, Abān 30, Aḏar 29, Day 29, Bahman 30, [and] Isfandārmaḏ 30.

And five days are situated at the end of the year [that] are indeed regarded by wise men as different. Otherwise, with 31, 31, 32, 31, and 31 days,... 7

...[and] with equivalent numbers 31, 30, 30, 29, 29, 30 [and] 30 sequentially, the months that are world-famous [in the calendar] called *ilāhī* (PER: *ilāhī* 'divine') should be supposed. 8

پس ماهها بر هر دو تقدیر شمسی اصطلاحی باشد و نام ماهها بعینه نام ماههای قدیمی است الا در امرداد ا و خورداد و اضافه نموده و ماهها بالهی مقید سازند و نام روزهای ماه هم همان نامهای قدیمی است الا روز سی و یكم را روز و سی و دوم را شب گویند

यन्नामकाः सन्ति च पारसीका-
स्तन्नामका एव सदेह मासाः ॥
तथैव नामानि च वासराणां
किंत्वत्र रोजं च शबं विशेषः ॥ ९ ॥   (उपजाति शाला)

pas māhhā bar har dū taqdīr-i šamsī iṣṭilāhī bāšad u nām-i māhhā bi-ʿaynihi nām-i māhhā-yi qadīmī ast illā dar amurdād a u ḫurdād v iẓāfa namūda u māhhā ba ilāhī muqayyad sāzand u nām-i rūzhā-yi māh

yannāmakāḥ santi ca pārasīkās tannāmakā eva sadeha māsāḥ ||
tathaiva nāmāni ca vāsarāṇāṃ kiṃtv atra rojaṃ ca śabaṃ viśeṣaḥ || 9 || (upajāti śālā)

ham hamān nāmhā-yi qadīmī ast illā rūz-i
sī u yakum rā rūz u sī u duvum rā šab gū-
yand

Thus, months are used in both solar measures. The names of the months are identical to the old names, except in Amurdād and H̱urdād where an *alif* and a *vāv* are added respectively. The names are called 'divine'. The names of the days of the month are the same of the old names, except the 31st day is called 'day' and the 32nd is called 'night'.

And the names that are Persian, those very names are always [the names of] the months in this case, and similarly, [are also] the names of the years. But here, there is distinction [in the words] *roja* (PER: *ruz* 'day') and *śaba* (PER: *šab* 'night'). 9

و مدت سالش سیصد شصت و پنج روز
بود که موافق عدد اسم مبارک اقدس است
و بعد از چهار سال بجهت کسور زایده ید
لج ز لب رابعه است یک روز کبیسه کنند تا
سیصد و شصت و شش روز شود و چون
هفت بار یا هشت بار کبیسه در چهار سال
شود بعد ازان یکبار در سال پنجم شود

u maddat-i sālaš sīsad u šašt u panj rūz
buvad ki muvāfiq-i ʿadad-i ism-i mubārak-i
aqdas ast u baʿd az čahār sāl ba jihat-i kusūr
zāyida 14 33 7 32 rābiʿa ast yak rūz kabīsa
kunand tā sīsad u šašt u šiš rūz šavad u
čūn haft bār yā hašt bār kabīsa dar čahār sāl
šavad baʿd az ān yak-bār dar sāl-i panjum
šavad

The year is 365 days long, which corresponds to the number [in abjad valuation] of the blessed and sanctified name [of 'Šāh Jahān']. After four years, because of an excess fractional part (*kusūr*) of 14 33 7 32 [up to the] fourth, one intercalary day (*kabīsa*) is added so that there are 366 days. And when there is an intercalary day [added after] every four years [for] seven or eight times, it is [added] once in the fifth year after.[3]

و اگر خواهند که مدخل سال یا ماه تاریخ الهی شاهجهانی بدانند سالهای تامه این تاریخ را درین جدول در آرند و ایام و دقایق که در مقابل سالهای مجموعه مبسوطه یابند بر گیرند و جنس بر جنس افزایند و چون کسور از شصت دقیقه زیاده شود آنرا بیک روز مرفوع کنند آنچه باقی ماند آنرا نیز یک روز اعتبار کنند و از ایام حاصل هفت هفت طرح کنند تا هفت یا کمتر ازان بماند دو بران افزایند حاصل مدخل سال بود

श्रीशाहशाकस्य गताब्दवृन्दा-
देतैः प्रकोष्ठैर्गतवासरौघः ॥
साध्यः पुरावद्द्वियुतो विधेयः
सप्तावशेषो ऽब्दमुखस्य वारः ॥ १० ॥　　　(इन्द्रवज्रा)

u agar ḫwāhand ki madḫal-i sāl yā māh-i tārīḫ-i ilāhī-yi šāh-jahānī badānand sālhā-yi tāmma-yi īn tārīḫ rā dar īn jadval dar ārand u ayyām u daqāyiq ki dar muqābil-i sālhā-yi majmūʿa-yi mabsūṭa yāband bar gīrand u jins bar jins afzāyand u čūn kusūr az šaṣt daqīqa ziyāda šavad ān rā ba yak rūz marfūʿ kunand ānči bāqī mānad ān rā nīz yak rūz iʿtibār kunand u az ayyām-i ḥāṣil haft haft ṭarḥ kunand tā haft yā kamtar az ān bamānad dū bar ān afzāyand ḥāṣil madḫal-i sāl buvad

śrīśāhaśākasya gatābdavṛndād etaiḥ prakoṣṭhair gatavāsaraughaḥ || sādhyaḥ purāvad dviyuto vidheyaḥ saptāvaśeṣo 'bdamukhasya vāraḥ || 10 ||　　　(*indravajrā*)

And if one wants to know the beginning (*madḫal*) of the year or of the month in the divine era of Šāh Jahān, one can take the complete years in this era from the following table, and [then] take the days and minutes found in front of the extended aggregate years and add them unit upon unit.

From the score of elapsed years in the calendrical era of the venerable Šāh [Jahān], the number of elapsed days should be calculated with these tables as before. The weekday at the beginning of the year should be determined as the remainder among seven added to two. 10

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3 As Table G1 (reproduced from what is seen in both the *Zīj-i Šāh Jahānī* and the *Siddhāntasindhu*) shows, the fractional excess of days over 365 in each calendar year is 0;14,33,7,32. Hence, after every four years, the cumulative fractional excess is 0;58,12,30,8, which in turn implies that an intercalary day is added in the day count of the fourth year (when we start counting the intercalation interval from the end of the

first year). This cycle repeats itself up to seven or eight times at which point the offset increases to five years instead of four. For example, in the cumulative count of days beginning from the end of the first year, an intercalary day is added after six intervals of four years (i.e., in years five, nine, thirteen, seventeen, twenty-one, and twenty-five) followed by an interval of five years (i.e., in the thirtieth year).

When the fractional parts exceed sixty minutes, it is carried over as one day. The remainder is to be considered as one day. And from the number of days that are obtained one should repeatedly deduct seven until seven or less remains and add two to this number. The result will be the beginning of the year.[4]

پس دران روز تقویم شمس استخراج کنند
اگر باول حمل باشد فبها و الا یک روز کم
یا زیاده کنند مدخل سال بود

*pas dar ān ruz taqvīm-i šams istiḫrāj kun-
and agar ba avval-i ḥamal bāšad fabihā u
illā yak rūz kam yā ziyāda kunand madḫal-i
sāl buvad*

Afterwards, one can derive the true longitude of the Sun on this day. If it in 0° Aries, this is well and good! If not, one should add or remove one day to obtain the beginning of the year.[5]

तस्मिन्दिने स्पष्टरविर्गतो ऽभू-
न्मेषानने चेत्सतु शुद्ध एव ॥
नो चेत्तदा पूर्वपराख्य वारः
प्रकल्पनीयो गणकप्रमुख्यैः ॥ ११ ॥   (उपजाति बाला)

*tasmin dine spaṣṭaravir gato 'bhūn
meṣānane cet sa tu śuddha eva ||
no cet tadā pūrvaparākhya vāraḥ
prakalpanīyo gaṇakapramukhyaiḥ || 11 ||*   (upajāti bālā)

On that day, if the true [position of the] Sun has gone to the beginning of Aries, then that is just precise; if not, then the weekday before or after should be supposed [as the first day of the year] by the foremost of astronomers. 11

پس بجهت هر ماهی که خواهند ایام آن
ماهها بر مدخل سال افزایند و هفت هفت
طرح کنند باقی مدخل ماه مطلوب بود

*pas ba jihat-i har māhī ki ḫwāhand ayyām-i
ān māhhā bar madḫal-i sāl afzāyand u
haft haft ṭarḥ kunand bāqī madḫal-i māh-i
maṭlūb buvad*

Also, to find the month that one is looking for, one should add the days of these months to the beginning of the year and remove seven repeatedly and the remainder will be the beginning of the desired month.[6]

एवं हि मासोद्भववासराणि
गतानि वर्षाद्यदिनान्वितानि ॥
सप्तावशिष्टानि च मासवेशे
वारो विचिन्त्यः स्फुटतास्य तद्वत् ॥ १२ ॥   (उपजाति)

*evaṃ hi māsodbhavavāsarāṇi
gatāni varṣādyadinānvitāni ||
saptāvaśiṣṭāni ca māsaveśe
vāro vicintyaḥ sphuṭatāsya tadvat || 12 ||*   (upajāti)

In just the same way, the days of months are those that have elapsed since the day at the beginning of the year, and the weekday at the beginning of the month should be regarded from [among their] remainders among seven. Likewise, is its correctness [determined]. 12

و جدول ایام سالهای تامه الهی شاهجهانی این است

अथ तदर्थमेकदशशतसहस्रवर्षाणां यथा पृथक्पृथग्दिनानि लभ्यन्ते कोष्ठका लिख्यन्ते । पूर्वं सहस्रस्थानं वर्षाणां गवेष्यं तदभावे शतस्थनं तदभावे दशस्थानं तदभावैकस्थानं गवेष्यं । यद्यत्स्थानस्य दिवसा लभ्यन्ते तत्तत्स्थानस्य दिनानि घटिकाश्चैकत्रकृत्वा प्राग्वच्चिन्तयेत् ।

u jadval-i ayyām-i sālhā-yi tāmma-yi ilāhī-yi šāh-jahānī īn ast

atha tadartham ekadaśaśatasahasra-varṣāṇāṃ yathā pṛthakpṛthagdināni labhyante koṣṭhakā likhyante | pūrvaṃ sahasrasthānaṃ varṣāṇāṃ gaveṣyaṃ tadabhāve śatasthanaṃ tadabhāve daśa-sthānaṃ tadabhāvaikasthānaṃ gaveṣyaṃ | yadyatsthānasya divasā labhyante-tattatsthānasya dināni ghaṭikāś caikat-rakṛtvā prāgvac cintayet |

4 For example, 1 January 2023 is 394 years, 9 months, and 12 days from the beginning of the calendrical era of Šāh Jahān on Monday, 20 March 1628. Hence, to determine the weekday on which, say, the year 394 in Šāh Jahān's regnal era began, we aggregate the number of days in 394 years from Table G1. This value is 143905;33,31,28,8. The integer-part of this number is 143905, which when added to 1 (rounded up from the remaining fraction part of the number) gives 143906. This number is equivalent to 0 in modulo seven arithmetic (i.e., $0 \equiv 143906 \bmod 7$). Now, in Šāh Jahān's regnal-era calendar, like in the solar Hijri calendar, the week begins with Saturday (PER: *šanba*, day 0) and hence the epoch weekday of Monday corresponds to day 2. To determine any corresponding weekday from this epoch, two is added to the modulo remainder and the resulting number corresponds to the ordinary weekday number (starting from day 0). In the present case, that resulting number is 2; in other words, the day commencing the year 394 in Šāh Jahān's regnal era is a Monday by this calculation. This agree with Gregorian date of Monday, 21 March 2022, the day of the vernal equinox (*naw-rūz*).

5 For example, by the calculation in note 4, the year 394 in the regnal era of Šāh Jahān begins on Monday, 21 March 2022. However, the ingress of the Sun into 0° Aries occurs (for Agra) on Sunday, 20 March 2022, at 21:03. Hence, the beginning of the year 394 could be rectified to Sunday, 20 March 2022; however, a further correction is applicable here as the 'new day' (*naw-rūz*) marking 1 Farvardīn should be on the day when the vernal equinox occurs *before* midday (see page 191). This implies that the true beginning (1 Farvardīn) of the 394th year in the regnal era of Šāh Jahān is, in fact, on Monday, 21 March 2022.

6 For example, as worked out in note 5, the year 394 in the regnal era of Šāh Jahān began on Monday, 21 March 2022. To calculate, say, the weekday at the beginning of the fifth month in this calendar (i.e., 1 Amurdād), we note that the number of days since the beginning of the year are 125 (aggregated by adding the days in the months of Farvardīn, Ardī-Bihišt, Ḫwurdād, and Tīr; see page 192). This is equivalent to 6 in modulo seven arithmetic. In other words, the weekday at the beginning of the month of Amurdād in the year 394 of the regnal era of Šāh Jahān is a Sunday (counting sequentially to day 6 from Monday, day 0). This corresponds with Gregorian date of Sunday, 24 July 2022.

And here is the table of the days of the complete years in the divine era of Šāh Jahān.

Now, towards that end, tables of unit, tens, hundreds, and thousand years are written in order that different successive days be obtained. First, the group of thousands (*sahasra-sthāna*) of years is to be sought; in its absence, the group of hundreds (*śata-sthāna*); in its absence, the group of tens (*daśa-sthāna*); [and] in its absence the group of ones (*eka-sthāna*) is to be sought. The days of whichever group [of years] are obtained, one should regard the days and *ghaṭikā*s of those respective groups, having brought them together, as previously [described].

Table G1: Cumulative number of days in successive scores of years in the calendrical era of Šāh Jahān.

Years	Number of days					Years	Number of days				
	integer	sexagesimal fraction					integer	sexagesimal fraction			
1	365	14	33	7	32	60	21914	33	7	32	0
2	730	29	6	15	4	70	25566	58	38	47	20
3	1095	43	39	22	36	80	29219	24	10	2	40
4	1460	58	12	30	8	90	32871	49	41	18	0
5	1826	12	45	37	40	100	36524	15	12	33	20
6	2191	27	18	45	12	200	73048	30	25	6	40
7	2556	41	51	52	44	300	109572	45	37	40	0
8	2921	56	25	0	16	400	146097	0	50	13	20
9	3287	10	58	7	48	500	182621	16	2	46	40
10	3652	25	31	15	20	600	219145	31	15	20	0
20	7304	51	2	30	40	700	255669	46	27	53	20
30	10957	16	33	46	0	800	292194	1	40	26	40
40	14609	42	5	1	20	900	328718	16	53	0	0
50	18262	7	36	16	40	1000	365242	32	5	33	20

H   MULLĀ FARĪD ON THE INDIAN CALENDAR

In the Seventh chapter of the First discourse of his *Zīj-i Šāh Jahānī* (i.e., the *bāb-i haftum* [§ I.7] from the *maqāla-yi avvalīn*), Mullā Farīd describes the two Indian eras (PER: *tārīḫ-i hindī*) of *bikramājīt* (SAN: *vikramāditya*) and *sālibahān* (SAN: *śāli-vāhana*). The Persian text of this chapter and its English translation is presented below.

باب هفتم بر بیان تاریخ هندی اهل هند را تواریخ در کثرت بحدی است که از حدّ
و عدّ خارج است و آنچه درین زمان بکار دارند تاریخ بکرماجیت است که آنرا سنبت
گویند و تاریخ سکاکال که آنرا سالبهان خوانند و سال ایشان شمسی است و ماه قمری
و روز وضعی و ابتداء سال از روزی گیرند که دران روز اجتماع نزدیک بنقطه اعتدال
ربیعی بحساب آنها شده باشد و ابتداء ماه از اجتماع کنند و بعد هر دوازده درجه میان
ماه و آفتاب را زوزی گیرند و آنرا تته نامند و هر ماهی را سی تته گیرند و آنرا بدو قسم
سازند و هر یک را پاکهه نامند پس پانزده روز را که از اجتماع است تا استقبال پاکهه
سد خوانند و پانزده روز دیگر را که از استقبال است تا اجتماع دیگر پاکهه بد نامند
و تمام سال را سیصد و شصت روز شمارند پس فضل میان این سال و سال شمسی
حقیقی یازده روز وضعی و سی و یک جز از چهارصد و هشتاد جز روز است و چون
سی روز را در ۴۸۰ ضرب کنند و حاصل را در ایام یکسال که ۳۶۰ است ضرب کنند
و بر ۵۳۱۱ پنج هزار و سیصد و یازده قسمت کنند در مدت چهل و سه لک و
بیست هزار سال است قسمت کنند خارج قسمت ۹۷۶ روز و ۴۶۴ جز و از پنج هزار
و سیصد و یازده جزو حاصل آید پس چون این مقدار مدت بگذرد بجهت رفع تفاوت
مذکور میان سال مذکور و سال شمسی حقیقی یکماه کبیسه کنند و آنرا ماه لوند خوانند
و در هر ماهی که کبیسه افتد آن ماه را دو بار شمارند مثلا اگر کبیسه از اول ماه اساره
شروع شود آن ماه را و ماه آینده را نیز اساره خوانند و بعد ازان ماه آینده ساون بود
و چون بر تاریخ سکاکال ۴۲۳۶ افزایند و مبلغ را رفع کنند حرکت اوج بحساب آنها
بیرون آید و چون از وی دو برج و هژده درجه نقصان کنند باقی را این انس گویند و
در تاریخ ذکر سالهای تامه کنند نه ناقصه

bāb-i haftum bar bayān-i tārīḫ-i hindī ahl-i hind rā tavārīḫ dar kaṯrat ba ḥaddī ast ki az ḥadd u ᶜadd ḫārij ast u ānči dar īn zamān ba kār dārand tārīḫ-i bikramājīt ast ki ān rā sanbat gūyand u tārīḫ-i sakākāl ki ān rā sālibahān ḫwānand u sāl-i īšān šamsī ast u māh qamarī u rūz vaẓᶜī u ibtidāᵓ-i sāl az rūzī gīrand ki dar ān rūz ijtimāᶜ-i nazdīk ba nuqṭa-yi iᶜtidāl-i rabīᶜī ba ḥisāb-i ānhā šuda bāšad u ibtidāᵓ-i māh az ijtimāᶜ kunand u buᶜd-i har davāzdah daraja miyān-i māh u āftāb rā rūzī gīrand u ān rā tith nāmand u har māhī rā sī tith gīrand u ān rā ba dū qism sāzand u har yak rā pākha nāmand pas pānzdah rūz rā ki az ijtimāᶜ ast tā istiqbāl pākha-yi sad ḫwānand u pānzdah rūz-i dīgar rā ki az istiqbāl ast tā ijtimāᶜ-i dīgar pākha-yi bad nāmand u tamām-i sāl rā sīṣad u šaṣt rūz šumārand pas faẓl miyān-i īn sāl u sāl-i šamsī-yi ḥaqīqī yāzdah rūz-i vaẓᶜī u sī u yak juz az čahārṣad u

haštād juz-i rūz ast u čūn sī rūz rā dar 480 żarb kunand u ḥāṣil rā dar ayyām-i yak-sāl ki 360 ast żarb kunand u bar 5311 panj hazār u sīṣad u yāzdah ki ᶜadad-i advār-i šams dar maddat-i čihil u sih lak u bīst hazār sāl ast qismat kunand ḥārij-i qismat 976 rūz u 464 juzv az panj hazār u sīṣad u yāzdah juzv ḥāṣil āyad pas čūn īn miqdār-i maddat baguḏarad ba jihat-i rafᶜ-i tafāvut-i maḏkūr-i miyān-i sāl-i maḏkūr u sāl-i šamsī-yi ḥaqīqī yak-māh kabīsa kunand u ān rā māh-i lūnd ḫwānand u dar har māhī ki kabīsa uftad ān māh rā dū bār šumārand maṯalan agar kabīsa az avval-i māh-i asāra šurūᶜ šavad ān māh rā u māh-i āyanda rā nīz asāra ḫwānand u baᶜd az ān māh-i āyanda sāvan buvad u čūn bar tārīḫ-i sakākāl 4236 afzāyand u mablaġ rā rafᶜ kunand ḥarakat-yi awj ba ḥisāb-i ānhā bīrūn āyad u čūn az vay dū burj u hiždah daraja nuqṣān kunand bāqī rā ayan ans gūyand u dar tārīḫ ḏikr-i sālhā-yi tāmma kunand na nāqiṣa

Seventh chapter on the Indian era. The people of India have such a large quantity of eras that they are beyond count. The one that is used nowadays is the era of *bikramājīt* (SAN: *vikramāditya*), also called *sanbat* (SAN: *saṃvat*), and the era of *sakākāl* (SAN: *śakakāla*) also called *sālibahān* (SAN: *śālivāhana*). The year of these [two eras] is solar, their month lunar and their day civil (*vażᶜī* 'position'). They set the beginning of the year from the day on which, according to their calculation, is the close conjunction [of the Sun] with the point of the vernal equinox. [They set] the beginning of the month [starting] from the conjunction [i.e., the new Moon]. They take the distance of every twelve degrees between the Moon and the Sun as a [lunar] day, which they name *tith* (SAN: *tithi*). In every month, they count thirty *tith*s and they divide it in two parts, which are named *pākha* (SAN: *pakṣa*). Thus, the fifteen days from the conjunction to the opposition are named *sad pākha* (SAN: *śuddhapakṣa*). The fifteen other days from the opposition to the conjunction are named *bad pākha* (SAN: *vadyapakṣa*). They count three hundred sixty [*tithi*] days for the whole year. Thus, the remainder between this [lunar] year and the actual solar year is 11 civil days and 31/480 days. Since when you multiply 30 days by 480 and you multiply the result by the days in one year, i.e., 360, and you divide it by 5311, which is the number of revolutions of the Sun over a period of 43,20,000 years. The result of the division is 976 days and 464/5311 parts.[1] Therefore, since this amount of time elapses, they add an intercalary month to remove the above-mentioned difference between this and the actual solar year. They call it the month of *lūnd*. For every month on which the intercalation happens, they count it twice, e.g., if the intercalation starts from the first of the month of *asāra* (SAN: *āṣāḍha*), they call *asāra* this month as well as the following month. After that, the following month will be *sāvan* (SAN: *śrāvaṇa*). Since they add 4236 to the *sakākāl* era and they remove the sum,

1 These calculations for the intercalary months in the Indian system have been previously described by al-Bīrunī in his *al-Qanūn al-Masᶜūdī* (see, e.g., Kennedy et al. 1965).

the movement of the apogee (*awj*) goes outside according to their calculation, and since they remove from it two constellations and 18 degrees, they call the rest *ayan ans* (SAN: *ayanāṃśa*). In dating (*tārīḫ*), they mention [only] full years, not defective ones.

I MULLĀ FARĪD'S LIST OF FESTIVALS

In the Tenth chapter of the First discourse of his *Zīj-i Šāh Jahānī* (i.e., the *bāb-i dahum* [§ I.10] from the *maqāla-yi avvalīn*), Mullā Farīd lists in a table several festivals or 'well-known days' (*ayyām-i mašhūra*) in accordance with different calendars. Many of these occasions are also mentioned in the *Zīj-i Uluġ Bīg*, albeit not in a tabular form (see, e.g., Sédillot 1847*b*: 338–40; Akhmedov 1994: 46–7).

The dates of Christian Greek festivals and Persian festivals are reproduced verbatim from the *Zīj-i Uluġ Bīg*; however, the list of 'Arabic festivals' in Mullā Farīd's table is expanded to include dates related to the Islamic religious calendar, the lives of Muḥammad, prophets (Yūsuf, Yaḥyà), Caliphs (ᶜUṯmān, ᶜUmar), and the family of prophet Muḥammad (Ḫadīja, Fāṭima, ᶜAlī, Ḥasan, Ḥusayn, ᶜAlī Riżā)—all of which are not found in the *Zīj-i Uluġ Bīg*. Moreover, Mullā Farīd adds a list of festivals related to the position of the Sun in the zodiac, containing, inter alia, the dates of new year in the Malikī and Ḫwārazm Šāhī calendars, dates of the solstice and the equinox, dates of the rainy season, date of the Sadeh festival, etc.

The most interesting addition in Mullā Farīd's table of festivities is the inclusion of the following list of Indian religious festivals (following the Hindu lunisolar calendar):

1. Śrāvaṇa bright (SAN: *śuddha*) fortnight, full Moon (SAN: *paurṇamāsī*): Salūno (Raksha Bandhan);
2. Bhādra dark (SAN: *vadya*) fortnight, eighth day: [Krishna] Janmashtami;
3. Āśvina bright fortnight, tenth day: Dussehra;
4. Kārttika dark fortnight, new Moon (SAN: *amāvāsī*): Diwali;
5. Mārga bright fortnight, fifth day: Vasant Panchami;
6. Phālguna dark fortnight, fourteenth day: Shivaratri; and
7. Phālguna bright fortnight, full Moon: Holi.

The names of the Arabic festivals, Sun-related festivals, and Indian festivals in the Tenth chapter of the First discourse of Mullā Farīd's *Zīj-i Šāh Jahānī* are stated in Persian (in Table I1) and its Latin transcription (in Table I2).

Table I1: Names of Arabic festivals, Sun-related festivals, and Indian festivals in Mullā Farīd's *Zīj-i Šāh Jahānī* in Persian.

باب دهم در معرفت ایام مشهوره از هر تاریخ بعضی ازان متعلق است بموضع آفتاب و بعضی متعلق بایام سال و این مجموع درین جدول نهاده شد		
ایام مشهوره از تاریخ عربی		
ماه رجب و شعبان و رمضان ماه عبادت است و رمضان ماه روزه است و محرم و رجب و ذی قعده و ذی الحجه ماههای حرام اند		
سر سال و تا ده روز ایام معلومات است	ا	محرم
عاشورا	ی	
وفات علی بن موسی الرضا	ه	صفر
مرض رسول علیه السلام	یو	
مولد یحی بن زکریا	یح	
دفن نبی صلی الله علیه و سلم در مدینه	ج	ربیع الاول
تزویج خدیجه رضی الله عنها	ی	
مولد النبی صلی الله علیه و سلم	یب	
مقتل یحی بن زکریا	ی	ربیع الآخر
وفات فاطمه زهرا رضی الله عنها	کج	
بیع یوسف علیه السلام	کو	جمادی الاول
مولد فاطمه زهرا رضی الله عنها	ط	جمادی الآخر
وفات حسن رضی الله تعالی عنه	د	رجب
استفتاح	یه	
مبعث و معراج پیغمبر صلی الله علیه و سلم	کز	
مولد حسین رضی الله عنه	ج	شعبان
مولد حسن رضی الله عنه	ه	
شب برات و نقل قبله	یه	
وفات علی رضی الله عنه	کا	رمضان

(continued)

(continued)

	کج	شب قدر
	ا	عید فطر
شوال	د	مباهله
ذی القعده	ج	نزول جبرائیل
	ه	فتح خیبر
	ا	تا ده روز ایام معلومات است
	ح	روز ترویه
	ط	روز عرفه
	ی	عید قربان و آنرا عید اضحی گویند و اول ایام نحر تا سه روز
ذی الحجه	یا	اول ایام تشریق و ایام معدودات تا سه روز
	یه	شهادت عثمان رضی الله تعالی عنه
	یح	روز غدیر خم
	که	وفات عمر رضی الله عنه

سیزدهم و چهاردهم و پانزدهم از هر ماه ایام بیض است

ایام مشهوره که بموضع آفتاب تعلق دارد

٠	٠	نوروز اول سال ملکی و اول بهار
٠	یط	نوروز خوارزم شاهی
ا	ک	آخر ایام مطر
ب	یه	امتزاج فصلین
ج	٠	اول تابستان و آن چهله
ج	ط	آب ریزان و آن سیزدهم تیر ماه
ه	یه	امتزاج فصلین
و	٠	اول خزان
ط	٠	اول زمستان و اول چهله و شب یلدا
ط	یه	امتزاج فصلین
ی	ی	شب سده
یا	یه	امتزاج فصلین

(continued)

(continued)

	ایام مشهوره از تاریخ هندی
پورن ماسی ساون سد	سلونو
بد اشتمی بهادون	جنم اشتمی
سد دسمی اسن	دسهره
بد اماوس کاتک	دیوالی
سد پنچمی ماگه	بسنت پنچمی
بد چودس پهاگن	سیورات
پورن ماسی پهاگن	هولی

Table I2: Names of Arabic festivals, Sun-related festivals, and Indian festivals in Mullā Farīd's *Zīj-i Šāh Jahānī* in transcribed Latin.

bāb-i dahum dar maᶜrifat-i ayyām mašhūra az har tārīḫ baᶜżī az ān mutaᶜalliq ast ba mawżiᶜ-i āftāb u baᶜżī mutaᶜalliq ba ayyām-i sāl u īn majmūᶜ dar īn jadval nihāda šud		
ayyām-i mašhūra az tārīḫ-i ᶜarabī		
māh-i rajab u šaᶜbān u ramażān māh-i ᶜibādat ast u ramażān māh-i rūza ast u muḥar-ram u rajab u ḏī l-qaᶜda u ḏī l-ḥijja māhhā-yi ḥarām and		
muḥarram	1	*sar-i sāl u tā dah rūz ayyām-i maᶜlūmāt ast*
	10	*ᶜāšūrā*
ṣafar	5	*vafāt-i ᶜalī bin mūsà l-riżā*
	16	*maraż-i rasūl ᶜalayhi l-salām*
	18	*mawlid-i yaḥyà bin zakaryā*
rabīᶜ al-avval	3	*dafn-i nabī sallà llāh ᶜalayhi wa-sallama dar madīna*
	10	*tazvīj-i ḫadīja rażiya llāh ᶜanhā*
	12	*mawlid al-nabī sallà llāh ᶜalayhi wa-sallama*
rabīᶜ al-āḫir	10	*maqtal-i yaḥyà bin zakaryā*
	23	*vafāt-i fāṭima-yi zahrā rażiya llāh ᶜanhā*
jumādà al-avval	26	*bayᶜ-i yūsuf ᶜalayhi l-salām*
jumādà al-āḫir	9	*mawlid-i fāṭima-yi zahrā rażiya llāh ᶜanhā*
rajab	4	*vafāt-i ḥasan rażiya llāh taᶜālà ᶜanhu*
	15	*istiftāḥ*
	27	*mabᶜaṯ u miᶜrāj-i payġambar sallà llāh ᶜalayhi wa-sallama*
	3	*mawlid-i ḥusayn rażiya llāh ᶜanhu*
		(continued)

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šaʿbān	5		*mawlid-i ḥasan rażiya llāh ʿanhu*
	15		*šab-i barāt u naql-i qibla*
ramażān	21		*vafāt-i ʿalī rażiya llāh ʿanhu*
	23		*šab-i qadr*
šavvāl	1		*ʿayd-i fiṭr*
	4		*mubāhala*
ḏī l-qaʿda	3		*nuzūl-i jibrāʾīl*
	5		*fatḥ-i ḫaybar*
	1		*tā dah rūz ayyām-i maʿlūmāt ast*
	8		*rūz-i tarvīya*
	9		*rūz-i ʿarafa*
	10		*ʿayd-i qurbān u ān rā ʿayd-i ažḥà gūyand u avval-i ayyām-i naḥr tā sih rūz*
ḏī l-ḥijja	11		*avval-i ayyām-i tašrīq u ayyām-i maʿdūdāt tā sih rūz*
	15		*šahādat-i ʿuṯmān rażiya llāh taʿālà ʿanhu*
	18		*rūz-i ġadīr ḫumm*
	25		*vafāt-i ʿumar rażiya llāh ʿanhu*

sīzdahum u čahārdahum u pānzdahum az har māh ayyām-i bayż ast

ayyām-i mašhūra ki ba mawżiʿ-i āftāb taʿalluq dārad

0	0	*naw-rūz avval-i sāl-i malikī u avval-i bahār*
0	19	*naw-rūz-i ḫwārazm-šāhī*
1	20	*āḫir-i ayyām-i maṭar*
2	15	*imtizāj-i faṣlayn*
3	0	*avval-i tābistān u ān čihila*
3	9	*āb-rīzān u ān sīzdahum-i tīr māh*
5	15	*imtizāj-i faṣlayn*

(continued)

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6	0		*avval-i ḫazān*
9	0		*avval-i zamistān u avval-i čihila u šab-i yaldā*
9	15		*imtizāj-i faṣlayn*
10	10		*šab-i sada*
11	15		*imtizāj-i faṣlayn*

ayyām-i mašhūra az tārīḫ-i hindī

sāvan sad	*pūran māsī*		*salūnū*
bhādūn	*bad aštamī*		*janam aštamī*
asan	*sad dasamī*		*dasahra*
kātika	*bad amāvas*		*dīvālī*
māga	*sad pančamī*		*basant pančamī*
phāgun	*bad čawdas*		*sīvrāt*
phāgun	*pūran māsī*		*hūlī*

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