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THE TOTAL SOLAR ECLIPSE IN THE *BHAGAVATA*: ITS DEPICTION IN WORDS AND IN IMAGES

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Abstract: There is reference to a total solar eclipse over Kurukshetra in an ancient Indian text, the *Srimadbhagvata* (also the *Bhagavata*). The occasion drew not just Lord Krsṇa, his brother Balarama and their clan from Dwarka, but also their parents and the folk from the Braj region, the Pandava family and all the prominent characters of the epic Mahabharata, including many kings from far and wide. The eclipse had been predicted to be a total, like the one that happens at *Kalpakshaye*, i.e., the End of Time. The congregation took a dip in the sacred pond, fasted, and gave away cows and valuables as charity. The same eclipse features in a thirteenth century Marathi commentary on the tenth Canto of the *Bhagavata* by Bahira Jataveda and in an illustration in a late eighteenth century *Bhagavata* manuscript from the Punjab Hills. Lastly, there is a Guler painting from late eighteenth century depicting the religious bath at Kurukshetra during a solar eclipse, which also shows the eclipsed Sun. It probably is a leaf from the book of a Hindi play, *Karuna Bharana Nataka* by Krishna Jiwan Lachchiram, ca. 1780 CE, whose theme is the Bhagavata eclipse.

Extracting history out of mythology is risky since the inferences drawn seldom have independent supporting evidence. However, the emphasis of the authors of the *Bhagavata* on the eclipse having been predicted, a total at that, calls for attention. It seems that the references by the authors were inspired from eclipses that occurred in their own times. In this paper we try to see if these eclipses can be identified. We find that there are three total eclipses of the Sun from different times that can represent the Bhagavata eclipse in the respective texts and the paintings. These were on 2 February 892 CE, visible over Kurukshetra; on 1 March 1253 CE, visible over the Ahmednagar area of Maharashtra; and on 17 October 1762 CE, visible from the Punjab. We believe that during the time-period when the *Bhagavata* was being written or emended (i.e., from 500 CE to ~tenth century), it was impossible to predict total solar eclipses with precision for specific locations. All we can conclude is that a total solar eclipse was visible over Kurukshetra, and it inspired people down the ages to work a beautiful legend around Lord Krsna, in words as well as in images.

Keywords: the *Srimadbhagavata*, Lord Krsna, Guru Nanak, Bahira Jataveda, total solar eclipses, Kurukshetra, Kangra/Modi Bhagavata Purana, Punjab Hills, Pahari paintings, Guler painters

1 INTRODUCTION

The Sun is a giver of life, a protector and the regulator of time. Sun-worship in India goes back to the Neolithic age. Vedic literature, the oldest among the ancient Indian texts, pays tributes to the Sun in glorious words: "By thee were brought together all existing things, possessor of all Godhood, All-effecting God." (*Rgveda*: 10: 170, 4). Down the ages, people were always deeply concerned about eclipses when they saw their gods becoming powerless

> O Sun, when the demon Svarabhānu overspread you with darkness, all the worlds stood as if people not knowing where they were (*Rgveda*: 5.40, 5).

Eclipses have been an integral part of India's cultural and political history. These are special occasions when Hindus throng to the nearest river, engage in ceremonial ablution and oblation in the fond hope for a better after-life. However, in the ancient Indian literature and chronicles, one can hardly find any references to eclipses, or even comets. And if there are any, these are jacketed in mysticism with hardly a word about the phenomenology or the date. That is rather surprising, knowing that a large part of the population in India has always been concerned about the eclipses and their causer, Svarabhānu, and in later texts Rāhu.

Distinct from this are the innumerable records on stone and on metal of the grants and donations made on such occasions, starting from the middle of the first millennium. The history on plates and stones tells stories about how the Hindu kings and chieftains indulged in ritualistic activity during the *parvas* (sacred occasions), particularly the equinoxes, the *Samkrāntis* (Sun's zodiacal transits), the solstices and the eclipses (Shylaja and Ganesh, 2016). They donated villages, land, silver and gold coins to the Brahmins since especially eclipses were considered auspicious occasions for granting gifts. These records amply demonstrate how the celestial circumstances and events influenced the lives of the rulers and the folks. As the records are dated, the eclipses have helped to fix the timelines or refine the ones arrived at by other means.

There are illustrations in many medieval temples in India that show the Sun and the Moon being swallowed by Rāhu and Ketu in the form of a serpent. There are memorial stones in Karnataka, starting from the ninth century,

Figure 1: A close-up view of the top part of a Memorial Stone installed on the occasion of a solar eclipse, depicting a round disc being swallowed by a snake (top), as if Rāhu were swallowing the Sun (https://karnatakaitihasaacademy.org/memorial-stones/ accessed 22 December 2020).

about persons who invited death in a religious way at the time of solar eclipses with a view to attain salvation. In Figure 1 we see the top of one such Memorial Stone installed to mark the occasion of a solar eclipse. It depicts a round disc being swallowed by a snake (top), as if Rāhu, the demon, were devouring the Sun.[1]

In ancient Indian texts, e.g., in the *Srimad-bhāgvata* (2011; *Skandha* 8, Ch. 7–11; ≥500 CE; Hazra, 1940: 55), the *Skanda Purāṇa* (2009; SP: *Kedār Khanda*: Ch. 24–27; >700 CE; Hazra, 1940: 165) and the *Matsya Purāṇa* (1892; MP: Ch. 248–250; >850 CE; Hazra, 1940: 176–177), we come across the story of the great *Samudra Manthana*, the churning of *Kshīrsāgara* (the ocean of milk) and the struggle among the Devas and the Asuras (the demons) to gain access to the pitcher of *Amrutam*—the elixir of life and the most valuable find of the endeavour. In the struggle, Rāhu the demon disguising himself as a Deva sneaked in among them for a preferential sip. As he began drinking it, Lord Visṇu beheaded him when he was called out by the Sun and the Moon about his deceit (MP: 250: 12–13). In revenge, Rāhu's immortal head constantly chases the Sun and the Moon. His severed body came to be personified as Ketu in a serpentine form.

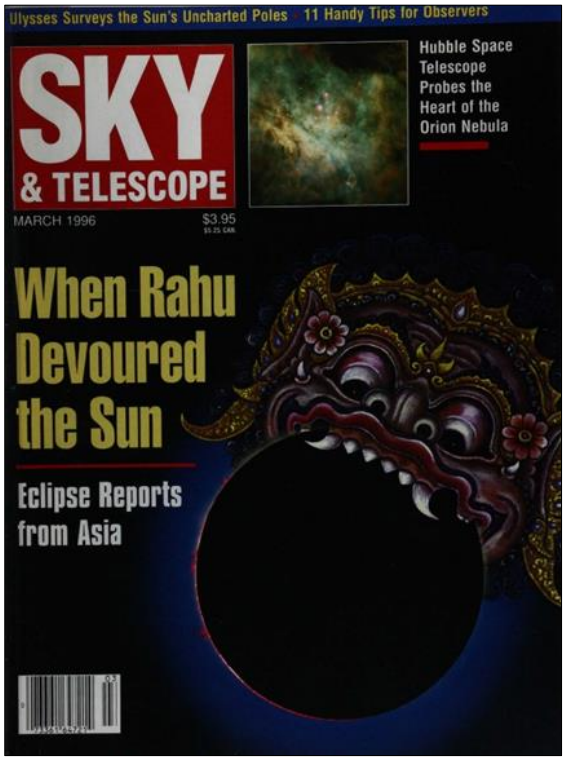


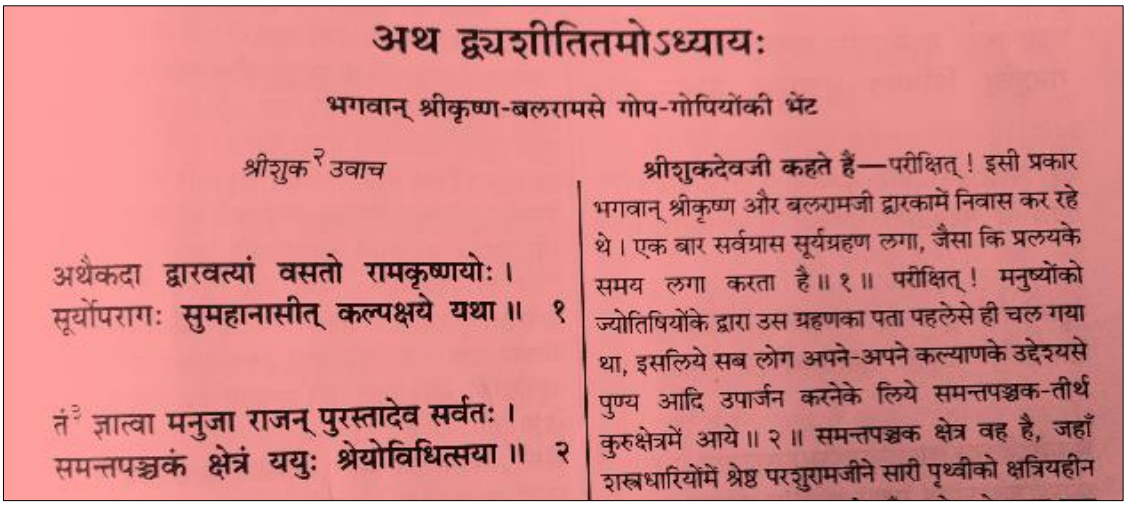
Figure 2: Rāhu, the eclipser as per the Purāṇas, shown on the cover of the March 1996 issue of *Sky & Telescope* (© *Sky & Telescope*; used with permission).[2]

The incident of Rāhu chasing and trying to devour the Sun and the Moon and thus causing the respective eclipses finds expression in many artforms, from poetry and paintings to sculptures in South-East Asia. An interesting imagery is presented in the collage in Figure 2.[2] The Moon's orbit intersects with the Ecliptic at two points, called the Ascending Node and Descending Node of the Moon. In a bid to adapt the demon theory, the Ascending Node was referred to as Rāhu (*Brhat Samhitā*: V: 15). Subsequently, as Rāhu's counterpart, the other node came to be identified with Ketu. Among the nine *grahas* (planets) in classical Indian astronomy, Rāhu and Ketu are considered as *chhāyagrahas* (virtual planets).

In this paper, we focus on a reference to a total solar eclipse in *Srimadbhāgvata* (also the *Bhāgavata Purāṇa,* or, *Bhāgavata*). The same eclipse features in a thirteenth century Marathi composition related to the *Dasham Skandha* (the 10th Canto) of the *Bhāgavata*, and in an illustration in a late eighteenth century *Bhāgavata* manuscript from the Punjab Hills. Lastly, there is a Guler painting from late eighteenth century depicting a religious bath at Kurukshetra during a solar eclipse. It probably is a leaf from the book of a Hindi play, *Karuṇā Bharaṇa Nātaka* by Krishna Jiwan Lachchiram whose theme is the *Bhāgavata* eclipse (Singh, 1981: 71). We believe that the eclipses inspiring these works are from different times and we try to see if it is possible to identify them.

2 THE BHĀGAVATA ECLIPSE

The sage Vedavyāsa has been credited as the author of the *Srimadbhāgvata.* As the work is considered to be from a period between 500 CE–800 CE (Hazra, 1940: 55), and as late as



अथ द्व्यशीतितमोऽध्यायः

भगवान् श्रीकृष्ण-बलरामसे गोप-गोपियोंकी भेंट

श्रीशुक[२] उवाच

अथैकदा द्वारवत्यां वसतो रामकृष्णयोः ।
सूर्योपरागः सुमहानासीत् कल्पक्षये यथा ॥ १

तं[३] ज्ञात्वा मनुजा राजन् पुरस्तादेव सर्वतः ।
समन्तपञ्चकं क्षेत्रं ययुः श्रेयोविधित्सया ॥ २

श्रीशुकदेवजी कहते हैं—परीक्षित्! इसी प्रकार भगवान् श्रीकृष्ण और बलरामजी द्वारकामें निवास कर रहे थे। एक बार सर्वग्रास सूर्यग्रहण लगा, जैसा कि प्रलयके समय लगा करता है॥ १॥ परीक्षित्! मनुष्योंको ज्योतिषियोंके द्वारा उस ग्रहणका पता पहलेसे ही चल गया था, इसलिये सब लोग अपने-अपने कल्याणके उद्देश्यसे पुण्य आदि उपार्जन करनेके लिये समन्तपञ्चक-तीर्थ कुरुक्षेत्रमें आये॥ २॥ समन्तपञ्चक क्षेत्र वह है, जहाँ शस्त्रधारियोंमें श्रेष्ठ परशुरामजीने सारी पृथ्वीको क्षत्रियहीन

Figure 3. A page from *Srimadbhāgvata*; *Skandha* 10, Ch. 82; Stanza 1: Sri Suka spake – Parikshita! Then once, while Lord Kṛṣṇa and Balarāma were living in Dwarka, there happened a very great eclipse of the Sun the like of which takes place at the end of the *Kalpa*, the End of Time (End of Brahmā's Day); Trnsl: Prem Shastri.

around the tenth century (Bryant, 2002) which includes the emendations, Vedavyāsa who authored the epic *Mahābhārata* (compilation between 400 BCE–400 CE; Winternitz, 1927(I): 476) cannot be the same author here. In fact, there is no one date of these works and likewise no one author.

Srimadbhāgvata is a tale of the incarnations of Lord Visṇu, spread into twelve major Cantos (the *Skandhas*). In essence, it is a poetry of devotion. The tenth *Skandha* is about the life of Lord Kṛṣṇa. Here, in the Chapter 82, there is description of the visit of his entire clan from Dwārka to Kurukshetra on the occasion of a forthcoming solar eclipse. It had attracted people from all parts of the country (*Bhāgavata* 10: 82, 1; translation of Stanza 1 in Figure 3):

> Sri Suka spake – Parikshit! Then once, while Lord Kṛṣṇa and [brother] Balarāma were living in Dwārka, there happened a very great eclipse of the Sun the like of which takes place at the end of the *Kalpa*.

The text further states that people learnt about the impending *suryoparāgah sumahāna* (very great solar eclipse) from the ones who knew the ropes (the astronomers), and so came from all over to the Samanta-panchaka Tirtha (the Five Lakes at Kurukshetra—the sacred place of the Kurus) and stayed on for ablution and oblation (*Bhāgavata* 10: 82, 1–2, 9).

A *Kalpa* consists of 1000 *Mahāyuga* and equals 4,320,000,000 solar years. It is one day of Brahmā, the Creator. His night is also of 1000 *Mahāyugas*. The end of *Kalpa* is the End of Time and of the World (Burgess, 1860: 10 [*Sūrya Siddhānta*: I, 20]). Over the centuries, there have been innumerable commentaries of the *Bhāgavata* that elaborate upon it and interpret the underlying philosophy in simpler terms. Of these the oldest and most influential is *Bhāvārtha Dīpika* by Sridhara Swamy (between 1350 and 1450 CE, Gode, 1949: 283; 1300–1350 CE, Bharat, 1999), a highly acclaimed Sanskrit litterateur (Dash, 2021), where he says that the eclipse over Kurukshetra was said to be like the one that happens at *Kalpakshaye* (the End of Time) when the Sun is incapable of being seen, i.e., a *Sarvagrās* (total) eclipse (Sarma, 2003: 323–324).

Srimadbhāgvata mentions that the occasion drew not just Lord Kṛṣṇa and his brother Balarāma and the Yādavas of their clan from Dwārka. Here, they met their foster parents Nanda and Yashodā and the folks from the Braj region, their father Vasudeva of long separation, as also the prominent personages from the epic *Mahābhārata*, namely, the Pāndava family, Bhisma and Guru Droṇa. The Kuru king Dhrtarāshtra, his son Duryodhana and his brothers too had come over to Kurukshetra for the occasion. The royalties had arrived in carriages pulled by horses and by riding elephants, including the cows brought for charity. As the eclipse happened, the congregation took a dip in the sacred Sarovar (pond), observed fast for a specific duration and gave away cows and valuables as charity. The occasion turned into a grand surprise meeting of the relatives and of the friendly royalties. All the kings who had come from far and wide became greatly delighted seeing Lord Kṛṣṇa and his clan. Distinct from the epic *Mahābhārata* (400 BCE–400 CE; Winternitz, 1927(I): 475) attributed to the same author, *Srimadbhāgavata* does not speak about the Great Mahābhārata War. So, here the association of Kurukshetra with eclipses does not come from the Great War.

In the *Bhāgavata* eclipse narrative, there is

no allusion to Rāhu and the eclipse is nowhere called ominous. However, there is no date and no phenomenology that is associated with a total solar eclipse. That is unusual knowing that a total solar eclipse is so overwhelming for the viewers and the way it casts its spell over humans, the birds and the animals.[3]

The Kurukshetra eclipse episode in Lord Kṛṣṇa's life is unique because no other *Purāṇa* devoted to him has it. All we can say is that the Bhāgavata episode was possibly inspired from an eclipse that happened in the life of a *Bhāgavata* author or of a later compiler. It occurred over Kurukshetra, or, at the abode of the later author who then made additions or alterations by transposing it to Kurukshetra. In the latter case, the eclipse cannot be identified. For the former, we suggest in a later Section that it could be the eclipse visible from Kurukshetra.

3 THE BHĀGAVATA ECLIPSE IN MEDIEVAL MARATHI POETRY

Bahirā Jātaveda was a Marathi poet belonging to the period of Deogiri Yādavas who ruled the region from 1187 to 1317 CE. Jātaveda occupies a prominent position in Marathi literature and is highly acclaimed for being the first commentator of the *Dasham Skandha* (the 10th Canto) of *Srimadbhāgvata* in Marathi. As the commentary was available only in the form of a hand-written manuscript, not much study could be done by scholars, and the poet, his work and his period remained largely unknown. According to the historian Dr N.G. Deshpande, the author probably wrote the first-ever poetic composition worth the name in Marathi (pers. comm., 6 June 1988). Previously, Bahirā Jātaveda was believed to belong to the later period of the fourteenth century or early fifteenth century. In Jātaveda's commentary of the 10th *Skandha*, Deshpande (1990: 13) focused on the reference to a *Sūryagrahaṇa Sarvagrāsī* (total solar eclipse) that occurred on the day of *Vadya paksha Amāvasyā* in the month *Fālguna*:

> *Garga mhane Fālgunamāsi, vadya paksha amāvāsyesi,*
> *Sūryagrahaṇa sarvagrāsī, dekhāl tumhi* (82.20).
> Garga says that in the month of *Fālguna*, on the *vadya paksha amāvasyā*
> you will see solar eclipse as total (82.20).

Deshpande (1990: 13–14) raised the issue that the original *sloka* (stanza) in Sanskrit mentions just the *Sūryagrahaṇa* but not the date, whereas Bahirā Jātaveda clearly mentions the *Vadya paksha Amāvasyā* of *Fālguna.* Why did he do so? Deshpande argued that writers while narrating earlier events often introduced recent events in the development of the narratives. Possibly, this kind of eclipse may have taken place around the time of writing the specific part that would have been seen where Jātaveda lived—which was in Māndavgaṇ, in the district of Ahmednagar. Believing what the poet mentioned might have been an event of his own times, Deshpande (1990: 15) tried to fix this period from astronomical considerations. He consulted with Professor Jayant Narlikar from the Tata Institute of Fundamental Research, and at his suggestion he wrote to Professor K.D. Abhyankar (Department of Astronomy, Osmania University) and to me in December 1983 searching for a solar eclipse somewhere between 1200 and 1350 CE whose shadow path crossed the Ahmednagar district (i.e., around 19° N and 75° E). If he could get the exact date, he would be able to determine the poet's period. Upon consulting Theodor von Oppolzer's *Canon der Finsternisse* (von Oppolzer, 1887: 237; Blatt No. 118), we independently concluded that Jātaveda's reference could correspond to the eclipse of 1 March 1253 CE.

Quoting from the communication from K.D. Abhyankar, Deshpande (1990: 14) also stated that if the lunar month *Fālguna* was *Amānta* (New Moon ending month), *Amāvasyā* would have occurred between 4 March and 3 April in the year 1253 CE. The *Pūrnimānta* is a Full Moon ending month and starts one fortnight earlier than the *Amānta*. If *Fālguna* was *Pūrnimānta*, *Amāvasyā* would occur between 2 February and 4 March. He further said that, though at present south of River Narmadā, *Amānta* months are in use, during the thirteenth century *Pūrnimānta* months were also used. This input led Deshpande to fix the date when the poet was born as between 1225 and 1230 CE.

In the present context, we proceed a little further. We note that *Vadya paksha Amāvasyā* of *Fālguna* implies the New Moon of the *Amānta Fālguna.* Working with the *Pancānga* (version 3.14) by M. Yano and M. Fushimi (ref. CalendarHome.com) gives the date 1 March 1253 CE as that of *Amānta Fālguna Krsna-paksa* 15 (15th of the dark half of the New Moon ending *Fālguna* month). This sets at rest any ambiguity about the date. So, it was a *Fālguna* eclipse. It happened on a Saturday afternoon. A stanza in a later chapter of *Srimadbhāgvata* (10: 84, 70) states that many visitors who had come to Kurukshetra for the eclipse stayed on for quite some time and returned only when the rainy season drew to a close. That is interesting because the month of *Fālguna* precedes the season by about three months.

It turns out that Ahmednagar (19.095° N, 74.748° E) itself was about 55 km north of the north fringe of the path of totality and here this eclipse was partial, with a magnitude 0.985 and an obscuration of 98.56%. Māndavgaṇ is a village in the Shrigonda Block of Ahmednagar District in Maharashtra. While Srigonda lay near the northern fringe of the path of totality of the 1253 CE eclipse, Māndavgaṇ was 24 km north of the same. It saw the eclipse as partial; the circumstances are as listed in Table 1 (after Espenak, 2020), where 'Alt' is for the Sun's altitude and 'Az (N-E)' its azimuth. At an obscuration of 99.5% reached at the time of the Maximum eclipse, the Sun would appear almost covered. However, it is also the moment when there is a sudden change in the ambience. With over a hundred times drop in the illuminance, it would draw people outdoors wondering about what exactly was happening. It being the day of *Amāvasyā*, Bahirā Jātaveda rightly inferred it as an eclipse of the Sun and he thought it was total.

However, 50 km east of Māndavgaṇ there is another place by the name of Māndavgaṇ Pharāta. It is in the present-day Shirur Block of the adjoining district of Pune and is situated on the northern bank of the Bhimā River. Māndavgaṇ Pharāta fell about two kilometres within the path of totality. Here, the eclipse was total and the circumstances are as listed in Table 2 (after Espenak, 2020).

That leaves us with the puzzle: which Māndavgaṇ did Jātaveda reside at when the eclipse took place? But that is not all. While writing about Bahirā Jātaveda's commentary on the *Dasham Skandha* of the *Bhāgavata*, Koparkar (1990: 16) independently mentioned about the poet having seen the total eclipse on 1 March

Table 1: The partial solar eclipse of 1 March 1253 CE over Māndavgaṇ (18.846° N, 74.818° E).

Event	Time (UT)	Alt (°)	Az (N-E)(°)
Start of partial eclipse (C1)	10:17:41.8	38.6	247.5
Maximum eclipse	11:30:39.3	22.2	256.6
End of partial eclipse (C4)	12:34:59.9	07.2	262.6
Magnitude: 0.993; Obscuration: 99.49%			

Table 2: The total solar eclipse of 1 March 1253 CE over Māndavgaṇ Pharāta (18.544° N, 74.487° E).

Event	Time (UT)	Alt (°)	Az (N-E)(°)
Start of partial eclipse (C1)	10:17:04.7	39.2	247.4
Start of total eclipse (C2)	11:30:07.2	22.7	256.5
Maximum eclipse	11:30:19.9	22.7	256.6
End of total eclipse (C3)	11:30:32.3	22.6	256.6
End of partial eclipse (C4)	12:34:53.5	07.6	262.5
Duration of Totality: 0m 25.1s; Magnitude: 1; Obscuration: 100.00%			

1252 from Ghogargaon (18.808° N, 74.900° E).

Koparkar's year of the eclipse is not correct. The place is about 8 km from Māndavgaṇ and lay about 20 km north of the northern fringe of the path. Here too, the eclipse was partial, with a magnitude 0.995 and an obscuration of 99.66%. The various places of interest are indicated in Figure 4.

Incidentally, the eclipse of 1 March 1253 CE happened on the day following *Mahāshivaratri*. The latter is the most sacred festival of Lord Shiva and is celebrated on the fourteenth night of the dark half of *Fālguna*. That is when the Moon is only a few notches above the Sun, so that, the rising Sun symbolizes Lord Shiva

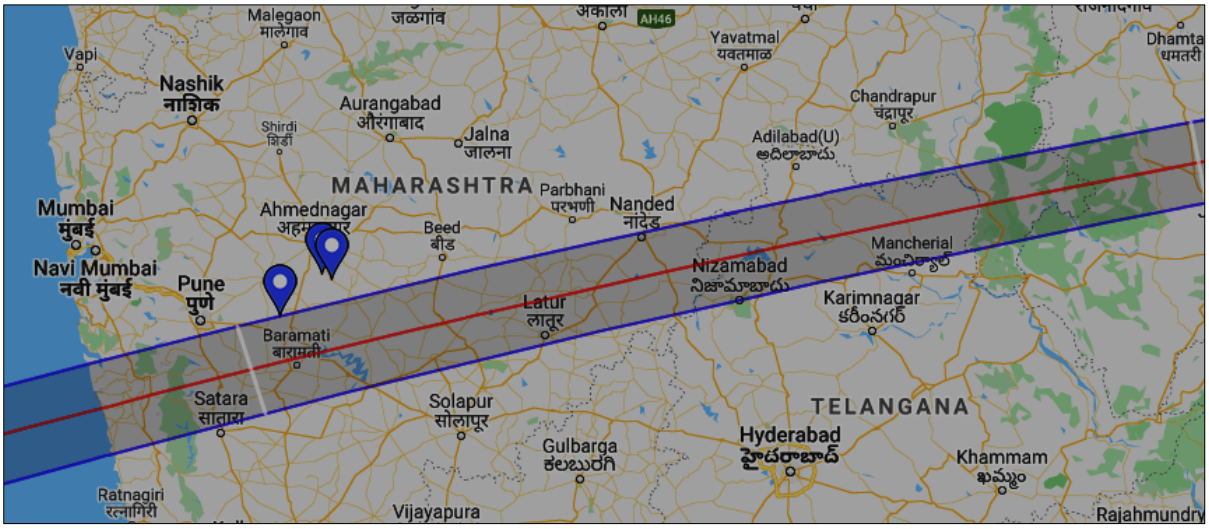


Figure 4: Path of the eclipse of 1 March 1253 CE over the western part of the state of Maharashtra. The blue marker at the top is Māndavgaṇ and to its right is Ghogargaon. Māndavgaṇ Pharāta is the lower left marker (after Espenak, 2021; Google Maps; map modifications: Ramesh Kapoor).

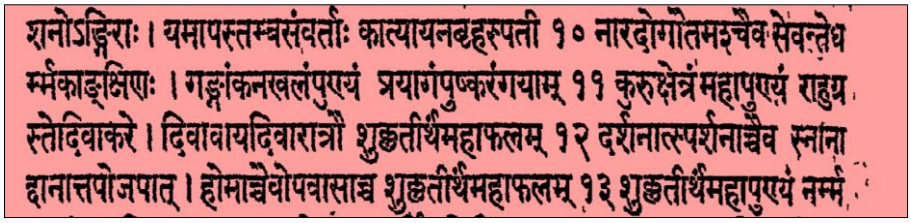

शनोऽङ्गिराः । यमापस्तम्बसंवर्ताः कात्यायनबृहस्पती १० नारदोगौतमश्चैव सेवन्तेध
र्म्मकाङ्क्षिणः । गङ्गांकनखलंपुण्यं प्रयागंपुष्करंगयाम् ११ कुरुक्षेत्रंमहापुण्यं राहुग्र
स्तेदिवाकरे । दिवावायदिवारात्रौ शुक्लतीर्थंमहाफलम् १२ दर्शनात्स्पर्शनाच्चैव स्नाना
द्दानात्तपोजपात् । होमाच्चैवोपवासाच्च शुक्लतीर्थंमहाफलम् १३ शुक्लतीर्थंमहापुण्यं नर्म्म

Figure 5: An extract from the Chapter 191 in the *Matsya Purāṇa* where Stanza 12 is about the religious significance of Kurukshetra. It says that it is most blissful to visit Kurukshetra on the occasion of a solar eclipse and increase religious merit.

with the Moon over his forehead. To sum up, Bahirā Jātaveda possibly saw the *Fālguna* eclipse as a replay of the *Bhāgavata* Event. He has called the eclipse a total. Notably, Bahirā Jātaveda is post-Bhāskarācharya (Bhaskara II; 1114–1185 CE) and belongs to a period when Indian astronomy north of the Vindhyas was reaching a plateau. We cannot say if Bahirā Jātaveda was aware that a total eclipse would be locality-specific. The eclipse phenomenology is also missed here. A crucial conclusion that we can draw is that the period of the *Bhāgavata* eclipse episode is pre-thirteenth century.

4 KURUKSHETRA: THE ECLIPSE DESTINATION

The fact that the Dwārka congregation decided to proceed to Kurukshetra to be there in time for the total eclipse (*Srimadbhāgvata* 10: 82, 1–2) implies that Kurukshetra was already an eclipse destination at the time the 10th Canto of *Srimadbhāgvata* was being written or emended. The wording in the particular stanza suggests that a "very great eclipse" was to happen over Kurukshetra, which therefore was the reason for everyone to go there.

Kurukshetra has been called a place of pilgrimage in many early Indian texts, viz., the *Sri-Visṇu Purāṇa* (2010; VP: 6:8:29; 275–325 CE; Hazra, 1940: 24), and later in the *Bhāgavata Purāṇa* (7:14: 30), the *Skanda Purāṇa* (SP: *Vishṇu Khanda*: p. 393; >700 CE; Hazra, 1940: 165) and in the *Matsya Purāṇa* (MP: 108: 3; Ch. 108: >850 CE; Hazra, 1940: 45). Kurukshetra, also known as Samanta-panchaka Tirtha, was considered sacred from much earlier times because of its association with the exploits of Lord Parasu Rāma. He had exterminated all the kshatriyas in the world twenty-one times over and formed five lakes with the blood of the tyrant Kshatriya kings. Despite staying far off worldly attachments, he performed a *yagna* to restore order for the good of the people (*Bhāgavata*, 9: 16, 17–20).

Table 3: Solar eclipses over Kurukshetra and Dwarka.

Kurukshetra		Eclipse Type*	Dwarka	Mag ≥0.9
–309	15 August	T		
–231	19 November	A		
–111	18 June	A		
+120	18 January	T		
178	27 November	A		
388	18 August	A		
671	**07 December**	**A**	**P**	**0.89**
892	**02 February**	**T**	**P**	**0.97**
1135	16 January	A		
1162	**17 January**	**A**	**P**	**0.89**
1290	05 September	A		
1307	03 April	T		
2020	21 June	A		
* Eclipse Type: T = Total, A = Annular, P = Partial				

The first reference to Kurukshetra as an eclipse destination is found in the *Vana Parva* in the *Mahābhārata* that stresses the importance of drinking the water from the Sannihiti pond at the time of *rāhugraste divākare* (Sun grabbed by Rāhu), which in religious merit equals a hundred *asvamedhas* (*Mahābhārata* 3: 81: 166–170). In later works also, the reference to its religious importance during eclipses is found, e.g., in the *Skanda Purāṇa* (SP: p. 393). The *Matsya Purāṇa* (MP: 191: 12; Ch. 191: >800 CE; Hazra, 1940: 46) observes that it is most blissful to visit Kurukshetra on the occasion of a solar eclipse and increase religious merit (Figure 5).

For Kurukshetra to attain the coveted position, there has to be a past event that was seen as a most profound happening in living memory, scaring people into believing that the World's end was imminent and paving the way for its association with solar eclipses. Over the ages, Kurukshetra, like any other place, would see umpteen eclipses that were partial but very few as annular or total. Here in Table 3 is a list of eclipses, total (T) and annular (A) drawn from Espenak (2020), whose paths passed over Kurukshetra, from the fourth century BCE until present, where the obscuration was 100%. The condition is rather stringent but we want to find the eclipse that would have been seen as if the world was about to end. For a later reference, we have also included a few eclipses over Dwarka where the magnitude exceeded 0.9.

From Table 3 one would be tempted to associate Kurukshetra with any of the earliest eclipses, although not even one of them is a *Fālguna Amāvasyā* eclipse. Annular eclipses

are talked about for the first time in the *Brhat Samhitā* (505/550 CE) of Varāhamihira (Bhat, 2010: BS, V, 51). Such a statement is possible only if an annular eclipse had actually been seen. There were two such that happened in Varāhamihira's time—on 22 October 496 CE and, on 24 November 550 CE, both near Ujjain where he lived. However, he said nothing about either of these eclipses. Prior to the appearance of the *Brhat Samhitā*, there is no Sanskrit text saying that eclipses can also be annular.

By the time of the composition of the *Bhāgavata*, an efficient eclipse calculation regime should have been in place (see Section 7). The total solar eclipse of 2 February 892 CE, a *Māgha* eclipse, would therefore be the earliest one to consider. At that time, Kurukshetra was under the Pratihāra ruler Mahendrapāl (885–910 CE).

The circumstances of the eclipse of 892 CE over Kurukshetra are given in Table 4 and the shadow path is shown in Figure 6. It was a winter eclipse that happened in the afternoon and was seen in a southwestern direction.

Notably, the eclipse path passed fairly close to Dwarka (22.238° N, 68.968° E), which was less than 100 km from the southern fringe of the path (see Figure 6). Over Dwarka the eclipse was partial, reaching a magnitude of 0.974 and an obscuration 97.33%. If this was *the* "very great" eclipse mentioned in the *Bhāgavata*, the astronomer who made the prediction for Kurukshetra did not realize that those in Dwarka itself would also see a "very great" eclipse. In this respect, a similar situation also occurred during the winter eclipses of 671 CE and 1162 CE, both of which were annular events (Table 3).

Historically, Kurukshetra attained importance during the period of the Pushyabhūti Dynasty that ruled a major part of north-western and north India from the beginning of the sixth to mid-seventh century with capital in Thānesar and where down the line Harshavardhana ruled from 606 CE to 647 CE. Historically, Kurukshetra attained its highest glory during the reign of Harshavardhana. The great Sanskrit poet Bāṇabhatta, the court poet of Harsha and composer of his biography *Harṣacarita* is all praise for Thānesar, the capital. Thānesar, from Sthānesvara, is part of Kurukshetra, then known by the name Srikantha Janapada. In his accounts, the Chinese monk Hiuen Tsang who travelled through India during 630–644 CE mentions Sthāneswara (Beal, 1914: 78). His Sthāneswara is the modern Thānesar. Al Berunī in his book *Kitāb taḥqīq mā li-l-Hind* (ca. 1030 CE) identified Thānesar with Kurukshetra, and the two places with Mahābhārata (Sachau, 1888(I): 308). For the history of Kurukshetra, one may see Muztar (1978) and Haryana District Gazetteer (2009: Chapter 2). For Kurukshetra's history as the eclipse destination, see the thesis by McCarter (2013).

Table 4: The total solar eclipse of 2 February 892 CE over Kurukshetra (29.962° N, 76.827° E).

Event	Time (UT)	Alt (°)	Azi (N-E)(°)
Start of partial eclipse (C1)	08:15:56.1	41.7°	201.8°
Start of total eclipse (C2)	09:33:47.1	32.6°	222.5°
Maximum eclipse	09:34:38.6	32.5°	222.7°
End of total eclipse (C3)	09:35:30.0	32.4°	222.9°
End of partial eclipse (C4)	10:45:55.0	20.7°	236.7°
Duration of Totality: 1m42.9s; Magnitude: 1.007; Obscuration: 100.00%			

Al Berunī (973–1048 CE) in his book noted Kurukshetra's astronomical significance. He says that the line which astronomers base their calculation on passes from Lanka to Meru, and in between through Ujjain, Kurukshetra, i.e., the plain of Thānesar, and Rohitaka (Sachau, 1888(I): 308; (II): 145); Rohitaka is possibly the present day Rohtak. That is about Hindu astronomy's Prime Meridian—the line of zero longitude. Thus, by eleventh century, Thānesar had been connected with the epic *Mahābhārata* and become a centre of pilgrimage at the time of solar eclipses and received important patronage. After a careful study of ancient Purāṇic literature, the accounts by Hiuen Tsang and al Berunī, the historical works and the early Muslim and Mughal chronicles etc., McCarter (2013: 196) concluded that "Kurukshetra, Thānesar, the Solar Eclipse Festival, and the *Mahābhārata* had begun to coalesce by the sixteenth century." Here below are a few inscriptions and records from the eleventh and twelfth

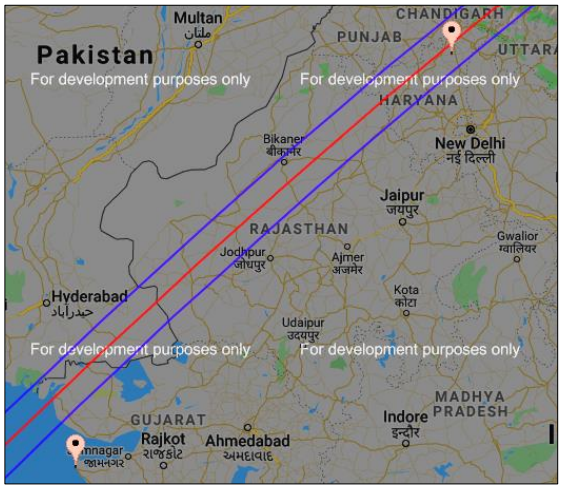


Figure 6: The path of totality of the solar eclipse of 2 February 892 CE; the marker for Dwarka is at the lower left and the one for Kurukshetra at top right (Espenak, 2020).

century about Kurukshetra as the eclipse destination.

While talking about the rulers of Chamba (32.55° N, 76.13° E) at the turn of the second millennium, Hutchinson and Vogel (1933/1994) drew attention to the now famous Kulait Copper Plate. It recorded a grant of land on the occasion of solar eclipse by the King Somavarman, the son of Sālavāhan (Vogel, 1911). A part of the inscription reads thus:

> Pravardhamana-kalyana-vijaya-rajye samvat 7 Bha suti 3.
>
> Of the Mushana race, Sahilladeva, who vanquished the Kira troops of the Lord of Durgara (Dugar) and their allies Saumatikas, whose alliance was sought by the ruler of Trigarta (Kangra), who forced his suzerainty on the Lord of Kuluta (Kullu), who was styled Karivarsha because he undertook a pilgrimage to Kurukshetra on the occasion of a solar eclipse and made a gift of elephants to the Sun-god who ensured the continuity of his family, and who thought his prowess acquired such epithets as Sahassanka, Nissankamalla, and Matamatatasinha. An ornament of the House of Sahilla was Somavarman … devout worshipper of Mahadeva (Siva) and of Visnu. (Bhandarkar, 1983: 256).

The inscription dates the occasion as the 7th regnal year of Somavarman. As he belonged to the eleventh century (Vogel, 1911: 183), Vogel observed (Hutchinson and Vogel, 1933/1994: 275, 287) that:

> The earliest of the copper-plates in question purport to have been granted by Soma-Varman, son of Salvahana-Varman, in the seventh year of his reign, in the month of Bhadon, and on the occasion of a solar eclipse. There was a solar eclipse in Bhadon A.D. 1066 and though the day does not exactly correspond with that on the plate, it is near enough to raise a strong possibility that this is the eclipse referred to. In ancient times it was customary to date such plates on the very day of the eclipse, as it was considered to add to the merit of the gift …

The eclipse referred to above should be the annular eclipse of 22 September 1066 CE; it was partial over Chamba at a magnitude of 0.22 (and a magnitude of 0.16 over Kurukshetra). As noted by Vogel (1911: 99), Sahilla's pilgrimage to Kurukshetra was in keeping with the prevailing custom. Incidentally, while the eclipses got due references in the inscriptions, Halley's Comet, which had appeared only months earlier, in April, found no takers.

Another early reference is found in Kalhaṇ's *Rājtarangiṇi* (twelfth century) a major source of history where a king of Kashmir visited Kurukshetra on the occasion of a solar eclipse. This we find in the stanza 2220 in Chapter VIII in the *Rājtarangiṇi*:

> 2220. The prince who had come to Kurukshetra on occasion of the solar eclipse,
> met there the Lavanya and abandoned from necessity his former enmity [against him]. (Stein, 1900).

According to Hutchinson and Vogel (1933/1994: 289), this eclipse was on 23 July 1134 CE. The eclipse was total over Maharashtra, Karnataka, Telangana and Andhra Pradesh but partial over Thānesar, where it reached a magnitude of 0.569.

During the Muslim rule in Delhi, Kurukshetra continued to be visited by the Hindu devout on the occasion of solar eclipses, despite imposition of religious taxes by the incumbent rulers from time to time. In due course, a number of bathing platforms were built by the various princely states. There are references in the Sikh literature and in the historical accounts related to the Sikh Gurus visiting Kurukshetra on the occasion of solar eclipses (see Kapoor, 2017).

5 THE BHĀGAVATA ECLIPSE IN TWO EIGHTEENTH CENTURY PAHĀRĪ PAINTINGS

Images and sculptures featuring Rāhu can be found in Indian and South-Asian art aplenty, where the demon is depicted as a black half-bodied *Asura*, devouring the Sun or the Moon, (e.g., as in Figure 2). However, there are very few Indian works of art where an actual eclipse event has been depicted.

5.1 Lord Kṛṣṇa and his Family Admire a Solar Eclipse

Here, we refer to a beautiful Indian miniature painting where Lord Kṛṣṇa along with his family are shown pointing at a thin crescent, faintly distinguishable from the blue sky (Figure 7). The painting, now in the Freer Gallery of Art and Arthur M. Sackler Gallery, Smithsonian Institution, has the accompanying information:

> Krishna and his family admire a solar eclipse, folio from a Bhagavata Purana
> India, Himachal Pradesh, Kangra, 1775–80
> First generation after Nainsukh, Opaque watercolor and gold on paper
> Purchase from the Catherine and Ralph Benkaim Collection—Charles Lang Freer Endowment
> Freer Gallery of Art, F2017.13.5
> (Diamond, 2018).

In the painting we do not find any text of its own. As per the Gallery's description, this folio is perhaps a page from the "Kangra/Modi" *Bhāga-*

Figure 7. 'Krishna and his family admire a solar eclipse, perhaps a page from the "Kangra/Modi" Bhagavata Purana'; opaque watercolor and gold on paper; origin: Kangra, Himachal Pradesh, 1775–1780; First generation after Nainsukh (active ca. 1710–1778) (http://n2t.net/ark:/65665/ye37601-38a9-7ed2-41f8-a34b-516865fabd76; accessed 27 May 2021).

vata Purāṇa and is attributed to the first generation (son or nephew) after Nainsukh (active ca. 1710–1778 CE). Nainsukh was a highly acclaimed artist of the Guler family of painters in the Punjab Hills.

As Debra Diamond, who is the Curator of South and Southeast Asian Art at the Freer and Sackler, put it, the artwork is from a manuscript probably illustrated at the Kangra Kingdom, and is a recreation of an event at Kurukshetra as described in the 10th Canto of *Bhāgavata Purāṇa*:

> This folio depicts a little-known event in Krishna's life. After he defeated the evil king Kamsa and embarked on princely adventures with his brother Balarama, Krishna reunited with his adoptive family at the banks of a river in Kurukshetra (modern-day Haryana). Together they observed a solar eclipse, an event described in the Bhagavata Purana (BP 10.81–82). Although such celestial events were traditionally considered inauspicious, this particular eclipse was predicted to bring blessings to all who witnessed it. (Diamond, 2018).

The Pahārī miniature paintings were mainly devoted to religious themes and the preferred ones were *Mahābhārata*, *Rāmāyāna*, *Bhāgavata Purāṇa* and *Gītagovinda*. Back in the seventeenth-eighteenth century, for manuscript illustration, the 10th Canto of the *Bhāgavata* was a favouirite with the court artists in northern India (*ibid*.). *Modi Bhāgavata* is how an extensive *Bhāgavata* series of illustrations is widely known after the industrialist Mr Jagmohandas Modi who had owned it until the 1950s (Singh, 1981: 61; Singh, 2018).

Figure 8 gives a closer view of the celestial object in the painting. One may ask, is that a crescent Moon or the Sun in eclipse? It could be either. The painting drew a lot of attention when it surfaced in a public domain in June 2018. Soon, different versions were proposed for its interpretation. According to some, Kṛṣṇa was pointing out the Eid Moon to a few Muslim companions, and the painting represented harmony among the different religious communities in India. This view was contested.

According to Kavita Singh (2018), Dean of the School of Arts and Aesthetics at Jawaharlal Nehru University, one sees Mughal influence in the style, and it is not the Eid Moon but could be the occasion of Lord Kṛṣṇa's family preparing for the Govardhana Pūja:

> This was to take place on the night of the

> new moon, and Krishna and Balarama might just be telling Nanda that the opportune moment has arrived. Krishna holds his hand to Nanda's chest – over his heart, in fact – because he will soon persuade Nanda and the others to break with tradition and do the puja in an entirely new way. (*ibid.*).

The Govardhana Hill is a sacred site for the Hindus as it is related to Lord Kṛṣṇa's early life. It is located in Mathura district and about 20 kilometres from Vrndāvana. The Govardhana worship is an important festival of the Vaishṇavites and is held on the first day of the bright half of the month of *Kārtika*, i.e., a day past the night of New Moon—which is *Dipāvali*, the festival of lights

A day after her post, Singh (2018) learnt from Debra Diamond that this painting was in a private collection that had been gifted to the Gallery and, as stated in her post (Diamond, 2018), the crescent form represents the Sun in eclipse. Singh (2018) updated her post to accommodate this.

Figure 8. A close-up of the purported eclipse shown in the painting "Krishna and his family admire a solar eclipse, folio from a Bhagavata Purana" in Figure 7.

In the painting, the very thin bright limb is on the right (Figure 8). If this is the Moon, it should be the evening of the first day of the bright half of the month. Should this be the Sun in eclipse, then we have a dilemma. The phenomenon depicted in the sky has been called an eclipse because it is in a folio from a *Bhāgavata Purāṇa* manuscript illustrated to represent the eclipse episode from the *Dasham Skandha*. As per the *Bhāgavata*, the Kurukshetra visitors knew beforehand that there was going to be a very great eclipse. On their part, the painters illustrating the manuscripts knew their mythology. However, the painter here depicted the eclipsed Sun in the form of a crescent, not knowing how to represent a total eclipse (Sarvagrāsi). That is understandable because only a person who had seen a total solar eclipse in its full glory would be able to paint it realistically, namely, a dark disc surrounded by a bright halo (the corona) in the sky, with possibly a number of stars also shown.[3]

The eclipse shown here is partial (Figure 8), with the bright limb on the right. As the Moon travels west to east, the phase as shown suggests the eclipse to be only a minute or two past the totality, therefore still at a very large magnitude, say, well above 0.9. It should be an afternoon eclipse as the Sun and Moon are towards the Western horizon. Under the circumstances, the story teller could not have missed the dramatic Diamond Ring moment of which there is no sign here. The depiction is not quite representative, as the visitors shown are the 'Braj' people from Lord Kṛṣṇa's early life only. There are no *Mahābhārata* characters or the royalty who also had flocked to Kurukshetra. Most importantly, in the *Bhāgavata* eclipse episode, Kurukshetra was the theatre but its central attraction, the huge Sannihita Sarovar (pond) where they took the sacred bath during the eclipse, is nowhere to be seen. There are hills seen here but Kurukshetra is in the plains. Kangra is in a hilly region. The folio therefore presents an artist's impression of an eclipse, rather than that of an actual total solar eclipse. It is part imagination, part from memory of a deep eclipse, and part from anecdotal accounts.

Nevertheless, the artist has created a storyline of his own. It is possible that the Manaku-Nainsukh family had witnessed a partial solar eclipse of a very large magnitude, well above 0.9. Manaku (1700–1760), the elder son of Pandit Seu (1680–1740) of Guler, was a highly acclaimed painter. Nainsukh (1710–1778), his younger brother, has about a hundred paintings to his credit. Inspired by the natural scenery, his landscapes are full of birds and flowers but have few figures (Singh, 1981: 23). Nainsukh moved in 1740 to the Rajput state Jasrota where he got attached to Prince Balwant Singh. After the Prince's death in 1763, he moved to Basohli to work under its ruler Amrit Pal (Archer, 1973: 294; Goswamy, 2021). As observed by Losty (2011: 17), the paintings from the three manuscripts of the great classics, *Rāmāyāna*, *Bhāgavata Purāṇa* and *Gītagovinda* are the most beautiful among the Indian paintings. These were produced by the sons of Nainsukh and Manaku, where probably Nainsukh was involved too. These are referred to as the Early Kangra manuscripts. Archer (1973: 294) states that "The Bhagavata Purana is concerned with the full career of Krishna among the cowherds and cow-girls of Brindaban." The illustrations were commissioned in 1775–1780 by Maharaja Sansar Chand II (b. 1765; r. 1775–1823), a Ka-

Figure 9: The religious bath at Kurukshetra during an eclipse. Note at the top right a brown disc, representing the Sun in total eclipse (after Singh, 1981: Plate IX).

toch Rajput and great patron of art under whom Kangra flourished. The work was possibly assigned to mark the auspicious occasion of his marriage to a princess of Suket in 1780–1781 (Archer, 1973: 294; Losty, 2011: 17).

5.2 The Religious Bath at Kurukshetra During an Eclipse

In Figure 9 is a reproduction of another Pahārī painting, which depicts the religious bath at Kurukshetra on the occasion of a solar eclipse. The painting is in the Bharat Kala Bhavan Collection, Varanasi and is by a Guler painter, circa 1780 CE. According to Chandramani Singh (1981: 71, and her cross-references 48 and 49), the painting probably is a leaf from the book of a Hindi play, *Karuṇā Bharaṇa Nātaka* by Krishna Jiwan Lachchiram. The play recreated the *Bhāgavata* eclipse episode in verse. This painting does not have any text of its own. However, one of the line drawing illustrations from the same source in the Bharat Kala Bhavan Collection carries a brief descriptive text on top in Devnagari—see Singh (1981: Plate 48).

This painting is extraordinary, showing in every possible detail the figures devoutly engaged in a sacred bath in the tank, the rituals and the charity. Singh (1981: 71–72) has described the painting in great detail and even identified the figures in it with the *Bhāgavata* figures who had congregated in Kurukshetra at the time of a solar eclipse, including Lord Kṛṣṇa and his consort Rukmiṇi. The eclipsed Sun is shown as a brown disc at top right. So, one is looking approximately East/West.

The location in the image is suggestive of the Mahadeva Temple at Kurukshetra, which is devoted to Lord Shiva (e.g., see Pande and Dorje, 2016: 44 and 96). The pond near the Temple is believed by the devout to have therapeutic qualities.

6 IDENTIFYING THE ECLIPSE IN THE PAHĀRĪ PAINTINGS

One may ask whether the demand for totality is necessary when identifying the eclipses in the Pahārī paintings (Figures 7 and 9). Therefore, we examine the solar eclipses between 1701 and 1800 CE that reached levels of obscuration >85% at the locations of interest. We find six total and annular eclipses that deserve to be considered. In Table 5 we list these eclipses, which occurred over the princely towns of Guler (31.998° N, 76.148° E; h ~561m), Jasrota (32.473° N, 75.408° E; 500m), Basohli (32.501° N, 75.818° E; 1200m) and Kangra (32.087° N, 76.256° E; 733m). These places are not far apart (see Figure 10), and so, the eclipses are common. Within Table 5, the most important of

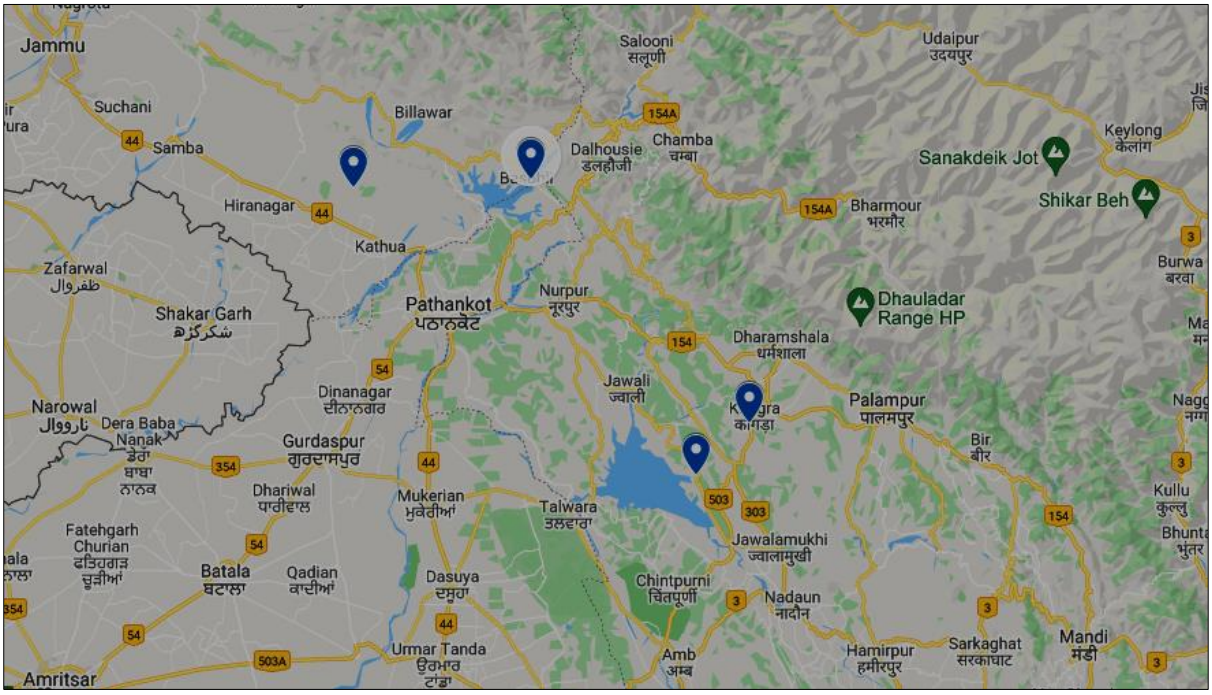


Figure 10: The princely towns of Jasrota (top left), Basohli (top right), Kangra (extreme right) and Guler (lowermost) (Google Maps; map modifications: Ramesh Kapoor).

Table 5: The solar eclipses with obscuration of >90% visible at selected Indian locations between 1701 and 1800 CE.

Location	Guler			Jasrota			Basohli			Kangra		
Date	Obs* %	Eclipse Type*	Alt (°)	Obs %	Eclipse Type*	Alt (°)	Obs %	Eclipse Type*	Alt (°)	Obs %	Eclipse Type*	Alt (°)
1708.09.14	99.2	P	44	99.7	P	45	99.0	P	44	98.9	P	44
1719.02.19	84.8	P	47	85.5	A	46	85.5	A	46	84.9	P	46
1720.08.04	96.5	P	37	97.8	A	36	97.8	A	.36	96.8	P	37
1762.10.17	**96.8**	**P**	**34**	**96.9**	**P**	**34**	**96.3**	**P**	**34**	**96.5**	**P**	**34**
1788.06.04	**100.0**	**T**	**47**	**100.0**	**T**	**48**	**99.8**	**P**	**47**	**100.0**	**T**	**47**
1793.09.05	**86.0**	**A**	**01**	**86.1**	**A**	**02**	**86.1**	**A**	**02**	**86.0**	**A**	**01**
*Key: Obs: Obscuration at maximum; Type: P= Partial, *A = Annular, *T = Total; Alt: altitude of the Sun at maximum eclipse												

the eclipses are bold-faced.

From Table 5, it is clear that the eclipses of the latter half of the eighteenth-century matter, and among them the eclipse of 17 October 1762 CE captures our attention the most.

The eclipse was a total whose path passed over northern parts of India (Figure 11). It was partial over all of the above-mentioned places in the Punjab Hills. A commoner, and that includes the artists, may not notice until a partial eclipse has reached an obscuration ~90%. However, the eclipse of 1762 CE reached a highobscuration level of >96%, that would have stayed in a memory long enough to influence a prospective artwork. An eclipse at this obscuration level would seem to be as good as total. As the dateline of the painting of the religious bath at Kurukshetra on the occasion of a solar eclipse (Figure 9) was arrived at independently as circa 1780, here too the eclipse of 1762 CE is suggested.

The 1762 eclipse is worthy of our attention for reasons of its historical significance. It took place on a Sunday afternoon that also happened to be the day of Dipāvali, the festival of lights. The eclipse has been thought by some historians to have cast a decisive impact on the course of history in Punjab over which the path of totality passed. The backdrop here is the turbulent times Punjab was passing through over most of the eighteenth century. The incident in question happened during the times of Ahmed Shah Abdali (1722–1772), acclaimed as the greatest warrior of Asia, who was attempting to establish Afghan rule in the Panjab, with the Sikhs thwarting him tooth and nail (Singh, 1959; Singh, 1979). The total eclipse affected a fierce battle on the day between Ahmed Shah Abdali's forces 60,000 strong and 50,000 Sikhs at Amritsar, forcing an early retreat by the former. On that count, it was a 'War Eclipse' (Kapoor, 2010). Stories of the battle with a backdrop of the great eclipse would be coloured in all their weirdness and spread quickly, eventually travelling to the Hill states where Abdali's rule also had influence.

The total eclipse of 1788 CE should not be

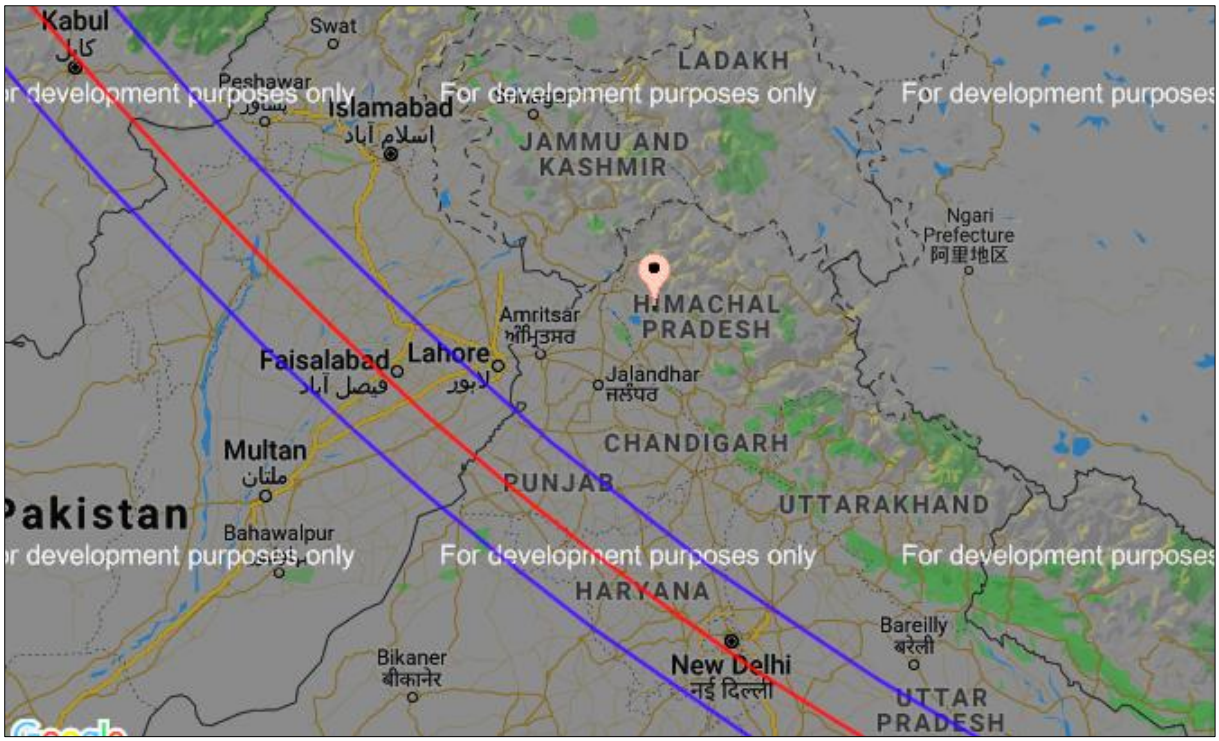


Figure 11. Path of totality of the solar eclipse of 17 October 1762 CE; the location of Kangra is as indicated (after Espenak, 2020).

overlooked even though we are restricted to the timelines of the painters and their works as arrived at by the independent sources. The information of an oncoming eclipse would come from the priests and the astrologers and their missionaries and it spread quickly. In 1788, the people who were illustrating mythology also might have witnessed an actual total eclipse occurring right in their midst. It would have left everyone spell-bound by the sudden, dramatic change in the ambience. However, no one has put this eclipse in the chronicles or in images; over Kangra the totality lasted 1m 55s, with maximum eclipse occurring at 10:05 UT. The next total eclipse Kangra was to see was on 17 July 1814, with totality lasting 4m 55s.

It has recently been suggested by Shylaja (2021) that the eclipse featured in the Kangra miniature of Figure 7 might be the solar eclipse of 5 Sept 1793 CE. We differ on this.

The eclipse of 1793 was annular over every place listed in Table 5. The obscuration at the moment of maximum eclipse was 86% which happened when the Sun's altitude dropped to ~1°. The eclipse circumstances specific to Kangra, extracted from Espenak (2021), are given in Table 6.

An obscuration of 86% at maximum implies a drop in the illuminance to ~1/7. The sky would still be very bright. Deep eclipses with maxima occurring at altitudes around ±1° make the twilights the most interesting, something a painter cannot ignore.

The computed altitudes in Table 6 correspond to the mathematical horizon. Amidst the hilly surroundings of Kangra, the Sun set rather earlier before the eclipse could reach its maximum. The altitude of the eclipsed Sun as shown in the painting depends on the perspective. The Sun as shown is certainly not at an altitude of ~1°. One has to place it much higher, somewhere between 15°–45°. A good indication comes from the pointing hands of the boy in the front, and Lord Kṛṣṇa and Balarāma. This strongly disfavours the 1793 eclipse where

Table 6: The annular solar eclipse of 5 September 1793 at Kangra (32.087° N, 76.256° E; h ~730m).

Event	Contact	Time (UT)	Alt (°)	Az (N-E)(°)
Partial Eclipse Begins	C1	11:56:02.8	15.6	268.0
Annular Eclipse Begins	C2	13:02:54.3	01.4	276.8
Maximum eclipse		13:04:55.7	01.0	277.1
Annular Eclipse Ends	C3	13:06:57.1	00.6	277.4
Partial Eclipse Ends	C4	14:06:39.8	–11.8°	285.6
Duration of Annularity: 4m 02.8s; Magnitude: 0.944; Obscuration: 0.860				

the altitude itself was 15.6° when the partial eclipse began. The disproportionate dimension of the eclipsed Sun is the painter's way to highlight the eclipse. Most importantly, there is no valid reason to discount the dating of the painting by the art historians, according to whom the contract was commissioned between 1775 and 1780 and the illustrations were done to mark the auspicious occasion of Maharaja Sansar Chand's marriage in 1780–1781 to the princess of Suket (Archer, 1973: 294; Losty, 2011: 17). Assigning the painting a date later than 1781 does not conform with the history of the princely state.

Therefore, the eclipse of 17 October 1762 CE is a strong contender as inspiration for the Kṛṣṇa painting (Figure 7). Over Kangra, the altitude at the maximum eclipse was 34° and the obscuration was 96.5%.

Incidentally, the three eclipses that we have identified in the foregoing, namely, those of 892 CE, 1253 CE and 1762 CE were all perigee (Supermoon) eclipses, the Moon being at around 58 Earth radii in each case.

7 PREDICTING A TOTAL SOLAR ECLIPSE DURING THE FIRST MILLENNIUM

Only in one ancient Indian epic do we come across a narration that could be of a total solar eclipse. This is in Sage Vālmiki's *Rāmāyaṇa*, a third century BCE composition, closed towards the end of the second century CE (Winternitz, 1927(I): 516–517). When Lord Rāma, the Prince of Ayodhya in exile fights the demon Khara in the forests, the poet describes the battle scene thus (Vālmiki: *Aranyakānda*: 3, 3, 1–16):

> Capturing the sun a blackish corona with blood-red outer circle has formed and nested around it like the fiery ring formed by circling a fireball … A spherical object like that of a human trunk is revealed near the sun, while the sun is rendered shineless as though Rahu, the great eclipsing-planet, has eclipsed him inopportunely, and the wind too whirled frantically … Stars sprang up with the brilliance of fireflies though it is not night, and at that moment fishes and waterfowls stood still in lakes, lotuses have dried up, flowers and fruits have dropped from trees as though it is night …

The poet does not explicitly specify it, but the description can only be that of a total solar eclipse.

In its 5th *Skandha*, the *Srimadbhāgvata* (≥500 CE; Hazra, 1940: 55) delineates a worldview through several important astronomical concepts. These include the ecliptic, the equinoxes and solstices, and the zodiac. It describes the Sun's movement through the zodiacal circle, the planets' movement and time-reckoning, including the planetary order, namely Earth-Sun-Moon-Stars-Venus-Mercury-Mars-Jupiter-Saturn (*Bhāgavata*: 5, 22, 1–17). The order is the same as the one given in *SriVisnu Purāṇa* (275–325 CE; VP: 2, 7, 5–10) except for an interchange between Venus and Mercury. Among these, the Sun is the nearest the Earth—one hundred thousand yojanas above it. The Moon is another one hundred thousand yojanas above it; therefore, it cannot eclipse the Sun and planetary transits are not possible. It is Simhikā's son, Svarabhānu (Rāhu), the demon, who lies ten thousand yojanas below the Sun and causes eclipses of the Sun and the Moon (*Bhāgavata* 5: 24, 1–3). Āryabhatta wrote the *Āryabhatiya* in 499 CE giving the first account of eclipses, and the algorithm used to compute one. The planetary order here was as follows: Earth–Moon–Mercury–Venus–Sun–Mars–Jupiter–Saturn–fixed stars. This work took over a century to start being accepted. The *Srimadbhāgvata* was composed around this time or sometime later, then it was emended, but it maintained the Purāṇic worldview, independent of developments in *Siddhāntic* astronomy. There also followed a number of commentaries on the *Bhāgavata* through the centuries, but the original worldview was not changed. So, on one hand, its author admired the astronomers' skills in the art of computing and predicting eclipses based on the lunar intervention, and on the other hand, Rāhu--the demon—remained the eclipser.

Over the ages, prediction of solar eclipses to the desired accuracy has been very difficult. A solar eclipse that was predicted to be total at some location and actually turned out to be total could be accidental and make for the rarest of rare cases. The calculations required accurate knowledge of the true longitudes of the Sun and Moon, the true longitude of the lunar node (Rāhu), their true daily motion and updated astronomical constants. One needs to factor in the Moon's parallax in longitude and latitude to finally determine the eclipse circumstances like the instant of apparent conjunction, magnitude etc. (see Rao, 2014: Chapter 19). The calculation is performed for two consecutive days around the time of New Moon. By interpolation one then finds the moment of the syzygy for the location. Actual eclipses provided the best opportunities to test and refine the algorithm and the astronomical constants used in the calculations.

In the matter of computing eclipses, the *Siddhāntic* texts that held their place after Āryabhatta (476–550 CE), Brahmagupta (598–670 CE) and Bhāskara I (ca. 600–680 CE) were those of the astronomer and mathematician

Haridatta (650–700 CE; Sarma, 1972: 43–44; Sharma, 2013: 150) and Lalla (720–790 CE), respectively. Haridatta belonged to the Kerala School and is credited with introducing in 683 CE a new system for computations known as the *Parahitagaṇita* that improved upon the Āryabhattan system by simplifying it, and with the due corrections made to the astronomical constants (Sarma, 1972: 43–44). That was the first major revision, and the Parahita system went on to become very popular. It continued to be in use even after the introduction in 1431 CE of the more accurate *Driggaṇita* system by Parameśvara (1360–1455 CE) to compute planetary positions. Lalla belonged to Dashapura (Mandasaur; 24.04° N, 75.08° E) in the Malva region. Lalla's time is 670 Saka, or ca. 748 CE, according to P.C. Sengupta (see Chatterjee, 1981: xii). His work, the *Śiṣyādhivrddhida Tantra*, covers the standard topics of a *Siddhāntic* text. It included calculations of solar and lunar eclipses and the necessary corrections done to the positions of the planets based on his own observations. It is this knowledge system that was available at the time when the authors of the *Bhāgavata* wished to predict an eclipse with a certain accuracy.

The path of totality during an eclipse is very narrow, between 0 and ~250 kilometres. One therefore needed an accurate geographical position of the place of observation with respect to a standard meridian. The *Surya Siddhānta* (SS) defined the Prime Meridian as a line that passed through Lanka—the abode of the demons—and the Meru Mountain in the North, the seat of the gods and on which are situated Rohitaka (possibly the present day Rohtak), Avanti (Ujjain) and the Sannihiti Sarovar (Kurukshetra; SS: I: 62). In the three slokas that follow, it gives guidelines: as how by knowing the differences in the observed total lunar eclipse timings from the calculated ones at a particular place, one could determine its longitude with respect to the Prime Meridian. The difference was expressed in yojanas, east (decreasing) or west (increasing) of the meridian of Ujjain. It is not clear what exact length a yojana represented. The value has been variously evaluated. Taking a cue from the distances recorded by Hiuen Tsang during his travels in India, 1 *yojana* was calculated to be equivalent to 5 miles (Dikshit, 1981(II): 199–200).

Determining latitudes is easy and has been done since ancient times, for instance, with the observations of the Sun or the altitude of the Pole Star. It is longitude that has been difficult to determine since it required accurate measurement of the time difference between a reference meridian and a particular place. The idea that Ujjain, Rohitaka and Kurukshetra were on the same meridian (see Rai, 1974: 45–50) was assumed at the time, but in fact the latter two places were actually east of Ujjain by nearly one degree (1° ≡ 111 km). This disparity can make or mar a total eclipse prediction.

However, far more critical was the Moon's latitude, which determined the magnitude of the eclipse. A small mismatch with the computed value would shift the umbral path by a large distance. Consider this for the total solar eclipse of 2 February 892 CE over Kurukshetra. Its path was a little over 90 km wide. Kurukshetra lay 25 km into the path from the southern fringe (Figure 6). In order for the Sannihiti Sarovar (the sacred pond) to be within a circle of 25 km in the path touching the southern fringe of the umbra, the error in the computed position of the Moon with respect to the Sun should be ≤14 arcseconds in the plane of the sky. This could happen only if the observational precision was able to keep step with the computational accuracy. The former is limited by the quality of measurement. The latter is built up through precise, continuous observations of eclipses spread over decades, and with instruments that enabled constant updating of the astronomical constants used in the algorithm. At another place, all of that would need to be recast.[5]

Our knowledge of the longitudes of places with respect to the Prime Meridian was never very good until the middle of the eighteenth century when modern observations were initiated to determine the same, culminating in the Great Trigonometrical Survey of India in the first half of the nineteenth century.

8 CONCLUDING REMARKS

In the foregoing pages we have explored a total solar eclipse that figures in the *Dasham Skandha* of the sixth–tenth century text the *Srimadbhāgvata* (*Bhāgavata*), and also in subsequent works, namely, a thirteenth century Marathi composition relating to the *Dasham Skandha* of the *Bhāgavata*, in a folio of a late eighteenth century *Bhāgavata* manuscript from the Punjab Hills, and lastly a Guler painting from ca. 1780 depicting a religious bath at Kurukshetra during a solar eclipse. The last-mentioned painting probably is a leaf from the book of a Hindi play, *Karuṇā Bharaṇa Nātaka* by Krishna Jiwan Lachchiram, whose theme was the *Bhāgavata* eclipse. All the above works apparently refer to the same eclipse, the one in the *Bhāgavata*. We believe that these works were inspired by three different eclipses from the respective authors' times, who then transposed the same to Kurukshetra. They chose, how-

ever, to put the spotlight on the rituals and the celebration of the grand union of the visitors who had been drawn to Kurukshetra on the occasion.

The *Srimadbhāgvata* (*Bhāgavata*) is one of the most popular of the *Purāṇas*. Its *Dasham Skandha* (10th Canto) has been read by millions with great reverence, and also has been widely commented upon. Extracting history out of mythology is risky since the inferences drawn seldom have independent supporting evidence. Thus, the *Bhāgavata* eclipse could be a literary construct. However, its author's emphasis on the eclipse being total is somewhat hard to dismiss. The wording reflects his awareness and confidence in the astronomers of his time. The eclipse is spoken of as total, but there is no further description of it. In the few minutes of totality, it is an 'out of this world' spectacle that renders the onlookers spell-bound, making it the most unforgettable event of a lifetime. How is it that this aspect does not figure anywhere in the words or in the images?

What does an eclipse mean, which takes place at the end of the *Kalpa*? As a solar year begins with the *Mesh Samkrānti*, we may assume that the eclipse happened around the time of the Vernal Equinox. An indication of this comes from the *Bhāgavata* (10: 84, 70), which says that after the grand union, when everyone had left Kurukshetra, the Yādavas who regard Kṛṣṇa as their only Lord and had stayed on for quite some time, left for Dwarka when the rainy season drew close. At very least, the eclipse occurred between *Chaitra* and *Āshādha*.

To see if it was possible to find a total eclipse that could fit in the account in the *Bhāgavata*, we had two options:

1. To find a best-fit total eclipse visible from Kurukshetra; or
2. To find a total eclipse visible from where the author of the *Bhāgavata* or the commentator making additions resided.

Unfortunately, we lacked the relevant information to investigate the latter option.

For option 1 above, it is possible to cross-check with the annular and total eclipses that were visible from Kurukshetra between, say, the 4th century BCE and 2020 CE. Keeping this period in mind, eclipses that occurred from 500 CE onwards draw attention, and if we disregard annular eclipses, the earliest total eclipse that we may consider is that of 02 February 892 CE (totality: 1m 43s), a *Māgha* eclipse. The next total eclipse over Kurukshetra happened about four centuries later on 3 April 1307 CE (totality: 2min 17 sec), a *Chaitra* eclipse.

The solar eclipse over the place where the Marathi poet Bahirā Jātaveda resided has been suggested to be that of 1 March 1253 CE. This led Deshpande (1990) to suggest that Jātaveda was born between 1225 and 1230 CE. This means that the eclipse that inspired the *Bhāgavata* eclipse episode occurred well before Jātaveda was born. The depiction in the Kangra painting (Figure 7) in our opinion, may have been inspired by the solar eclipse of 17 October 1762 CE that was total over parts of Punjab, Uttar Pradesh, Bihar, etc. The same may have been the inspiration behind the other painting from Guler Collection, depicting a religious bath in the sacred pool at Kurukshetra (Figure 9).

Paintings by Guler School artists that depict episodes or events from the great classics are plentiful (Archer, 1973(I): 292–295). Amongst them, the Kangra painting that shows Lord Kṛṣṇa taking the reins of a guide to address the curiosity of his folk and dispel any misgivings about eclipses is most innovative. It is quite another matter that at this very phase of an eclipse, the Sun's rays can damage the eyes of the onlookers.

As was the prevailing custom, people travelled to Kurukshetra and other centres of pilgrimage for the religious benefit, regardless of the fact that the destination was sometimes outside the penumbral path of a solar eclipse. Most people in India would not travel any distance to witness a solar eclipse since people would avoid looking at the eclipsed Sun. A solar eclipse in progress was seen or shown to people through its reflection in water in a vessel or in a pond.

However, while observing this extraordinary celestial event, the expression of wonder and joy on the faces in the painting of the *Bhāgavata* eclipse is obvious. By taking a departure from the original text, the Kangra painter has left us an artwork that is one of a kind. It celebrates the eclipse as *Gyān Parva* (the festival of knowledge), and the author of this paper has not come across anything like it except for a nineteenth century mural in the Gurudwara Baba Atal Sahib Ji at Amritsar (Figure 12). This shows the great poet-saint Guru Nanak (1469–1539 CE) at Kurukshetra on the occasion of a solar eclipse, explaining to people that an eclipse is a natural phenomenon that has no influence on people's affairs on Earth (Figure 13; the text is in the Gurumukhi script). This mural is very beautiful, and is as exceptional as the Kangra painting. It is most likely about the solar eclipse of 13 January 1507 CE (Kapoor, 2017), which was partial at Kurukshetra, where it reached a magnitude of only 0.43 at maximum.

Figure 12: The Gurudwara Baba Atal Sahib Ji in Amritsar is a seven-storey building with several murals devoted to Guru Nanak's life on the inner wall of the First Floor (photograph: R.C. Kapoor, March 2017).

To sum up, we can say that a total solar eclipse was visible from Kurukshetra and it inspired the author of the *Bhāgavata* to create a beautiful legend around Lord Krsṇa. The themes in the respective Pahārī paintings were worked upon by different artists several centuries later. However, taken together, they complete the picture of the *Bhāgavata* event.

The celebrations in the *Bhāgavata Dasham Skandha* mark the first solar eclipse 'fair' of the kind that Kurukshetra now observes with great fanfare.

9 NOTES

1. There are some inscriptions on stones found in South India that are unique and date from the fifth century to the nineteenth century. There are hero stones (*Veeragallu*) dedicated to persons who gave their life for the king in battles, in cattle-raids or while defending the dignity of their women. Also, starting from the ninth century there are memorial stones, about persons who invited death in a religious way, with a view to attain salvation.

Figure 13. The mural at the Gurudwara Baba Atal Sahib Ji in Amritsar, showing Guru Nanak dispelling misgivings about eclipses (photograph: R.C. Kapoor, March 2017).

The *Uri uyyale* (swing of fire) was a riual in which, on the day of a solar eclipse, one voluntarily sacrificed one's life by swinging over a religious fire (*uri*: to burn). It was depicted by way of a person holding his hands together, the head part carved in the form of the Sun being swallowed by a snake—as if Rahu was swallowing the Sun. In the sculpture, they carved a swing hung by rope that was held by two persons. Below the swing the fire was lit. There are many such memorial stones found, e.g., in Shivamogga and Dharwad district (see Dharwad District Gazetteer, 2002: Chapter 17).

In the *Epigraphia Carnatica*, VIII (Rice, 1904: 111, 54), the following is extracted from an inscription in Kannada traced to Sorab Taluka (14.381° N, 75.100° E) in the Shimoga district (now Shivamogga); its English translation is given at the end:

> 310
> At Muguru (same hobli), on a stone in front of the Ramesvara temple: Srimatu Bhulokamalla-varshada 9 neya Sauumya-samvatsara-Magha-ba-amavaa … surya-grahanadalu kali … taleda … Racheya-jiya … Bhatta agni-pravesa madi … ka-praptau ada avar-anna Na.simha Kalaya kala katti
>
> 310
> Date? 1129 A.D.
>
> In Bhulokamalla's 9th year (the date specified), at the time of the eclipse of the sun, …. Racheya-jiya-bhatta entered the fire and gained the world of gods. His elder brother Na[ra]simha … set up this stone.

Al Beruni notes (Sachau, 1888(II): 191):

> Most propitious times are, further, the times of solar and lunar eclipses. At that time, according to their belief, all the waters of the earth become as pure as that of the Ganges. They exaggerate the veneration of these times to such a degree that many of them commit suicide, wishing to die at such a time as promises them heavenly bliss. However, this is only done by Vaisyas and Sudras, whilst it is forbidden to Brahmans and Kshatriyas, who in consequence do not commit suicide.

The Brahmans and Kshatriyas do that at the *Akshaya Vata* (the indestructible tree) in Prayag (now Prayagraj; Sachau, 188: II: 171).

2. About the cover of the March 1996 issue of *Sky & Telescope* shown here in Figure 2, Sabrina Garvin, Editorial Assistant of *Sky & Telescope* informed me by email (pers. comm., 2 July 2021):

> The original image is a collage, so there were several artists involved. The image of the October 1995 eclipse was captured by Jacques Guertin, and Rahu was a detail from a painting by I.M. Sidigrta that at the time was in the collection of Don Trombino.

3. A total solar eclipse has to be actually seen before it can be depicted properly or

talked about. At any given place, a total solar eclipse will repeat in 350–400 years only. Those in areas lying outside the path of totality see a partial eclipse. In ancient times, most Indians would not know if there was a forthcoming eclipse, or if it would be total. For most this would be a sudden event, and quite unsettling. That an eclipse was in progress would only become obvious when the Moon had covered ~85% of the Sun's disc. The temperature would fall by several degrees; birds would head for their nests; nocturnal bats would appear, and animals would act strangely. The

> … more intelligent animals – chimpanzees, dolphins and llamas – appear to stop and stare at the sky, showing signs of understanding a celestial phenomenon is occurring, or at least that something is off. (Chan, 2017).

The ambience starts to get scary, gripping, and eventually stunning. The last minute before the beginning of totality and the one just after it are the most dramatic. The surroundings get darker and as the Sun's light disappears, the corona suddenly becomes visible as a white cloud around the black disc of the Sun. In a total eclipse, the Sun's brightness drops by a factor of ~400,000, while in the darkened surroundings, the corona shines with a brightness equivalent to that of the Full Moon. The blue sky turns greyish-blue, and the planets Venus and Mercury and a few bright stars may be visible. Before one can overcome the sensation and appreciate the beauty in the sky, the scene ends, giving way to a burgeoning 'diamond ring' that is simply indescribable (Kapoor, 2019). This is portrayed in Figure 14.

The impact of a total eclipse on viewers is profound and lasting, and anecdotes based on this sensational experience travel far and wide.

4. One of the Referees has asked if there is a record of the solar eclipse of 5 September 1793 CE observed from elsewhere in India, particularly when surveyors and engineers of the East India Company (EIC) were around.

That is just after William Petrie's private observatory at Egmore in Madras (now Chennai) had passed to the EIC and moved in 1792 to Nungambakkam as Madras Observatory under the Company's new astronomer and marine surveyor, Michael Topping (1747–1796). At the end of March 1793, Topping was deputed to Masulipatam to undertake a survey of the Kistna and Godavari Rivers, and report on the possibility of an irrigation project, leaving John Goldingham (1766–1849), Topping's Assistant, in charge of the Observatory (Phillimore, 1945(I): 7, 173, 338, 391).

At Masulipatam (now Machilipatnam 16.19° N, 81.14° E), the solar eclipse of 5 September 1793 commenced at 12:24 UT at a very low altitude in the west (Alt. 04.2°, Az. 275.6° N-E; sunset at 12:44 UT), with similar circumstances over Madras. A fortnight earlier, on 21 August 1793, there also was a lunar eclipse. It was partial, the umbral magnitude reached 0.712 and mid-eclipse happened over Masulipatam at 14:55 UT at altitude 28° (Espenak, 2020). It is difficult to believe that these eclipses were not observed, knowing that eclipses gave valuable data for fixing the ephemeris and the clocks, and local longitude, etc. The "Madras M.S. Records" in the Indian

Figure 14: The Diamond Ring begins to show up marking the end of totality during the total solar eclipse of 2 July 2019; taken at La Higuera, Chile with a Nikon P900; 1/100 sec. f/5.6 178mm, ISO 800 (after Kapoor, 2019).

Institute of Astrophysics Archives contain official correspondence between the acting Astronomer and other Senior Government Officers, from 5 January 1794 to 1 July 1812, but there is nothing about these eclipses. As the records of the previous years are not easily readable, the following extract from Topping's description of his survey for the Kistna-Godavari Irrigation Project, quoted by Phillimore (1945(I): 192–193), might set the speculation at rest:

> To render the whole useful in a Geographical as well as Political sense, many observations of the Sun and Stars were taken both for establishing a scale of Latitudes probably correct to the nearest second, and for ascertaining the declination of the needle in these parts: and to prevent these observations from being committed to a separate Paper, I have thought it advisable to enter their results together with the com-

pleat series of levels, on the Chart itself. No observations for the Longitude of any station have, as yet, been obtained; since neither the celestial phenomena, the weather, nor my more immediate avocations would admit of my taking any.

Topping and Goldingham may have had access to the *Nautical Almanac and Astronomical Ephemeris* published by the Commissioners of Longitude, London. The relevant page in the *Almanac* for the year 1793 (published in 1790) carries information on two lunar and two solar eclipses, as at Greenwich (The Royal Observatory Greenwich, 2021).

5. In the classical and medieval times, to accurately predict the circumstances of a solar eclipse specific to a location required decades of observations, and an accurately determined geographical position. Another crucial need was precision time-keeping.

From the pages of the *Vijnana Bhāshya*, Prasad (1956: 148–149) narrated an interesting calculation of a solar eclipse made by Mahavir Prasad Srivastava according to the *Surya Siddhānta* (Srivastava, 1940: II: 515–543). It was the solar eclipse of *Māgha Krshna Amāvasya* of VS 1982 (14 January 1926 CE), and the idea was to see how it was going to be visible over Kashi (Varanasi). Srivastava's original computation ran to 40 pages. It showed that the eclipse magnitude would be about 26 *kalās* (arcminutes) or over ¾ of the Sun's diameter, and last for 6 *gharis* 44 *palas* (over 2 hours). Prasad (1956) states that no eclipse took place that day, and the city folk who made attempts to view it also did not see anything, adding that the modern calculation also showed that an eclipse would not be visible.

The eclipse was a total one, and its path started in Central Africa, passed over the Indian Ocean and Indonesia, etc., and ended in the Pacific. Referring to Espenak (2020), the eclipse circumstances computed for Varanasi (25.311° N, 83.011° E) give a magnitude 0.024 and an obscuration of 0.46%. An error amounting to ¾ of the Sun's diameter in magnitude translates to an error of ~24 arcminutes in the Moon's position in declination. The stipulated magnitude was reached 3000 km away, south of the Maldives.

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11 REFERENCES

Archer, W.G., 1973. *Indian Paintings from the Punjab Hills*. Two Volumes. Delhi, Oxford University Press.

Beal, S., 1914. *The Life of Hiuen Tsang*. London, Kegan Paul, Trench, Trübner.

Bhandarkar, D.R., 1983. A list of the inscriptions of Northern India in Brahmi and its derivative scripts, from about 200 A.C. Appendix to *Epigraphia Indica*, XIX to XXIII, New Delhi, The Director General Archaeological Survey of India.

Bharat, A., 1999. Srimad BhAgavtam: Commentaries-1 & 2, *Bhakti List Archives*, *rāmānuja.org*

https://ramanuja.org/sri/BhaktiListArchives/Article?p=sep99%2F0009.html; accessed 21 June 2021).
Bhat, M.R., 2010. *Brhat Samhita*. New Delhi, Motilal Banarsidass.
Bryant, E.F., 2002. The date and provenance of the Bhāgavata Purāṇa and the Vaikuntha Perumal Temple.*Journal of Vaishnava Studies*, 11, 51–80.
Burgess, E., 1860. *Sūrya Siddhānta*. New Haven, The American Oriental Society.
Chan, M., 2017. How will animals react to the solar eclipse? Depends on how smart they are. *Time*, 17 August (https://time.com/4882733/total-solar-eclipse-animals-react/; accessed 27 October 2021).
Chatterjee, B., 1981. *Śişyadhivrddhida Tantra of Lalla*. New Delhi, Indian National Science Academy.
Dash, S., 2021. *Sridhar Swamy: The First Legend of the Emotional Comments on The Bhagbat Gita* (https://independent.academia.edu/DashSudhansu; accessed 13 June 2021).
Deshpande, N.G., 1990. Bahira Jataveda: his times and his identification. *Bhartiya Itihas Shodhak Mandal Quarterly*, 68, 9–18 (in Marathi, with summary in English).
Dharwad District Gazetteer, 2002. Office of the Chief Editor. *Karnataka Gazetteer*, Government of Karnataka.
Diamond, D., 2018. Krishna and his family admire a solar eclipse (https://asia.si.edu/krishna-and-his-family-admire-a-solar-eclipse/ accessed June 20, 2018).
Dikshit, S.B., 1981. *Bharatiya Jyotish Sastra*, Two Volumes. New Delhi, The Controller of Publications
Espenak, F., 2020. *Five Millennium Catalog of Solar Eclipses -1999 to +3000* (https://eclipse.gsfc.nasa.gov/eclipse.html).
Espenak, F. 2021. "Eclipse Predictions by Fred Espenak, EclipseWise.com" (http://www.eclipsewise.com/solar/solar.html).
Gode, P.K., 1949. The date of Sridhara Svami, *Annals of the Bhandarkar Oriental Research Institute*, XXX, 277–283.
Goswamy, B.N., 2021. Nainsukh, in *Encyclopedia of India*. *Encyclopedia.com* (https://www.encyclopedia.com; accessed 29 May 2021).
Haryana District Gazetteer 2009. *Kurukshetra*, Chandigarh, Haryana Gazetteers Organization, Department of Revenue and Disaster Management (Chapter 2).
Hazra, R.C., 1940. *Purāṇic Records on Hindu Rites and Customs*. Dacca, The University of Dacca.
Hutchinson, J., and Vogel, J.P., 1933/1994. *History of the Panjab Hill States*. *Volume 1*. New Delhi, Asian Educational Services.
Kapoor, R.C., 2010. On the historical significance of the total solar eclipse of Oct 17, 1762 that passed over Panjab. *Indian Journal of History of Science*, 45, 489–503.
Kapoor, R.C., 2017. Records of sighting of Halley's Comet in the 1531 apparition and an eclipse in Guru Nanak's references. *Current Science*, 113, 173–179.
Kapoor, R.C., 2019. Chasing the total solar eclipse 2019. *Science Reporter*, 56 (September), 45-47.
Koparkar, D.G., 1990. Bahira Jatveda yachi Bhagavata-Dashamskandhavareel Adya Marathi Teeka, *Sri Saileela*, August, 16-20 (in Marathi).
Losty, J., 2011. Indian Painting 1730–1825. In Beach, M.C., Fischer, E., and Goswamy, B.N. (eds.), *Masters of Indian Painting*. Zurich, *Artibus Asiae*. Pp. 579–94.
Matsya Purana. Lucknow, Munshi Navalkishore Press (1892).
McCarter, E.C., 2013. *Kurukshetra: Bending the Narrative into Place*. PhD Dissertation, The University of Texas at Austin, Texas, USA.
Muztar, B.K., 1978. *Kurukshetra Political and Cultural History*. Delhi, B.R. Publishing Corporation.
Pande, B.M., and Dorje, C., 2016. *Thanesar & Its Vicinity*. New Delhi, The Director General, Archaeological Survey of India.
Prasad, G., 1956. *Bharatiya Jyotish ka Itihaas*. Lucknow, Prakashan Bureau, Uttar Pradesh Sarkar (in Hindi).
Rai, R.N., 1974. The prime meridian in Indian astronomy.*Indian Journal of History of Science*, 9(1), 45–50.
Rao, S. Balachandra, 2014. *Indian Astronomy: Concepts and Procedures*. Bengaluru, M.P. Birla Institute of Management.
Rice, B.L., 1904. *Inscriptions in the Shimoga District, Bangalore*. *Epigraphia Carnatica*, VIII, Part II. Mysore Government Central Press.
Sachau, E.C.,1888. *Alberuni's India*. *Two Volumes*. London, Trübner & Co.
Sarma, K.V., 1972. *A History of the Kerala School of Hindu Astronomy*. Hoshiarpur: Vishveshvaranand Institute.
Sarma, M.S. (ed.), 2003. *Srīmad Bhāgavata Mahāpurānam of Maharshi Vedavyasa*, *Skandha – X*. *Volume III.* Tirupati, Executive Officer, Tirumala Tirupati Devasthanams.
(https://archive.org/details/Bhagavata_Purana_With_Multiple_Commentaries_TTD_Critical_Edition).
Sen, S.N., 1975. Al-Biruni on the determination of latitudes and longitudes in India. *Indian Journal of History of Science*, 10, 186–197.
Sharma, P.D., 2013. *Hindu Astronomy*. New Delhi, Global Vision Publishing House.
Shylaja, B.S., 2021. Record of a solar eclipse in an eighteenth-century painting from Kangra, India. *Journal of Astronomical History and Heritage*, 24, 607–618.
Shylaja, B.S., and Ganesha, G.K., 2016. *History of the Sky – On Stones*. Bangalore, Infosys Foundation.
Singh, C., 1981. *Centres of Pahari Paintings*. New Delhi, Abhinav Publications.
Singh, G., 1959. *Ahmad Shah Durrani: Father of Modern Afghanistan.* Bombay, Asia Publishing House.
Singh, G., 1979. *History of the Sikh People*. New Delhi, World Sikh University Press.
Singh, K., 2018. Krishna wasn't pointing at Eid moon. He was pointing at a solar eclipse. *Scroll.in*, 20 June 2018 with update on 21 June 2018 (https://scroll.in/article/883249/krishna-wasnt-pointing-at-eid-moon-but-the-controversial-painting-reminds-us-of-miniatures-lost).

Skanda Purana. Gorakhpur, Gita Press (2009).
Stein, M.A., 1900. *Kalhan's Rajatarangini. Volume II.* Westminister, Archibald Constable.
Srimadbhāgavata Mahapurāṇa. Two Volumes. Gorakhpur, Gita Press (2011).
Srivastava, M.P., 1940. *Surya Siddhanta ka Vigyan Bhashya. Two Volumes*. Allahabad, Dr Ratnakumari Svadhyaya Samsthan (in Hindi).
SriVisṇu Purāṇa. Gorakhpur, Gita Press (2010).
The Royal Observatory Greenwich, 2021. *The Nautical Almanac and Associated Publications* (http://www.royalobservatorygreenwich.org/articles.php?article=935 accessed 30 October 2021.
Valmiki. *Ramayana* (https://www.valmikiramayan.net/utf8/aranya/sarga23/aranya_23_frame.htm).
Vogel, J.P., 1911. *Antiquities of Chamba State. Part 1*. Calcutta, Superintendent Government Printing.
Von Oppolzer, Th., 1887. *Canon der Finsterrnisse*, Vienna, Kaiserlich-Königliche Hof- und Staatsdruckerei.
Winternitz, M., 1927. *A History of Indian Literature*. *Volume I.* Calcutta, University of Calcutta.

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