

CH. 14: CAVE 26-COMPLEX—INAUGURATED ON THE DHAMMA DAY (Āṣāḍha Pūrṇimā) OF CIRCA 383 ŚAKA ERA, AND ALIGNED TO THE SUNRISE OF DHAMMA DAY AND THE FIRST DAY OF THE ĀTURMĀSA

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PURVA-PAKṢA: SPINK'S 'SOLSTICE' AND 'CHANCE' THEORIES

CAVE 26 at Ajantā, i.e. the stupa-temple (Figures 12, 179-182) patronised by monk Buddhābhadda, is fascinating also from an archaeo-astronomical point of study⁸¹. Attention in this direction was first drawn by Spink. He suggested that Cave 26 (N20°33 - E75°41⁸²) maintains a close orientation to the sunrise of summer solstice (21/22 June), but it was not initially planned so:

By chance, it [Cave 26] was already nearly aligned with the summer solstice - being a mere three degree off . . . (W. M. Spink 2006, 66). Such a significant astrological alignment must have had both meaning and importance to those who gave the order, although the particular justification has been lost to us today [. . .]. [(W. M. Spink 1985)]

In his multi-volume series, Spink (2005-2013) elaborates further on the alignment of the three fifth-century stupa-temples (Caves 19, 26, and 29). An excerpt is quoted here for our further detailed investigation on the matter:

Suddenly, in 465, the planners of these two most important caves [No. 19 and 26] received an unexpected shock. Word must have come down from the capital that the controlling officials had suggested, in fact decided, that the two *śaitya* halls should be oriented to the solstices: *Cave 19 to the winter solstice and Cave 26 to the summer.*⁸³ That is, the sun's rays as they appeared on the horizon at the very moment of dawn should coincide with the axis of the caves. *Such a significant astrological alignment must have had both meaning and importance to those who gave the order, although the particular justification has been lost to us today; all we*

know is that the main temple in the old Vākāṭaka capital of Vatsagulma (modern Basim) itself has such an alignment.

This was all very well—or would have been, had the excavation of the two caves not already been started at a quite different angle, and had proceeded to the point that the now “required” adjustment could not possibly be effected, as “required,” even by wrenching the caves out of their present alignment. In fact, the realignment was more or less achieved, without too much difficulty and given some highly expedient adjustments, in Cave 26, for that great hall had, *purely by chance*, been cut from the start at *an angle only a few degrees different from that described by the summer solstice's rays*. . . .

In Cave 26, happily, the deepest portions of the great hall had not been reamed out by this time, even though the interior's angle was already fixed. Thus, when the order came down, the excavators were able to locate the stupa (still only roughly defined) forward almost two feet from its “normal” position. In fact, this would seem to be the only *śaītya* hall in India where the space around the stupa is not equidistant at left, rear, and right. They then shifted it about seven inches to the right. . . . Then, at the same time, by adjusting the frame of the great inner arch under the outer vault rightward in relation to the outer façade arch, the planners were able to rather subtly achieve the desired solstice alignment through the “sun-window” to the stupa. [(W. M. Spink 2009, 21-22)]

The importance of establishing the proper solstitial orientation is manifest when one sees the remarkable adjustments made in the struggle to achieve it both in Cave 19 and Cave 26. Had the planners and architects known from the start, there would be no problem; they could merely have shifted the layout of their halls at the start in such a way that they were properly aligned—thus avoiding all of these troubling twists and turn. This would seem to be the case in

Cave 29, which was not begun until 469, by which time the solstitial orientation for *caitya* halls was apparently conventional; however definite conclusions in this regard must await more careful measurements. . . .

Is it possible that Upendragupta (or his advisors), having heard that the rival Cave 26 was being oriented to the summer solstice, and knowing or believing that his own *caitya* hall was still only barely begun and presumably could be adjusted, ordered that it be shifted into alignment with the winter solstice, even though in fact the work of reaming out the interior had progressed too far to make this really feasible. However, orders are orders, especially when they come from on high, and as a result--so we hypothesize--the planners and workers at the site, out of respect, fear, enthusiasm, stupidity, or pride, went boldly ahead attempting to do what really could not be done. [(W. M. Spink 2009, 21-22)]

The farthest point of curvature [in Cave 19] is in direct orientation with the rays of the rising sun at the *winter solstice* (Dec. 22). In the same way, but less dramatically, the 'rival' Aśmaka *caitya* hall [Cave 26] was apparently intended to have its axis oriented to the *summer solstice*. [(W. M. Spink 2009, 21-22)]

PROBLEMS IN SPINK'S 'SOLSTICE' AND 'CHANCE' THEORIES

Solstices in Gregorian calendar (21/22 June/Dec)

Before applying the idea of the solstice to the case of Ajantā, the modern historian must at least note that the Gregorian calendar did not exist in fifth century, and the Julian calendar was not obviously followed by the makers of Ajantā. It is not only Spink, even the noted scholar Michael

Willis—who has studied the fifth-century Gupta temples of Udaigiri near Vidiśā from the angle of archaeo-astronomy⁸⁴-- has relied on the dates of solstices in the modern Gregorian calendar, thus assuming that the makers of the monuments had the knowledge of solstice dates falling on 21/ 22 December and 21/22 June. It may be noted that the original *Sūryasiddhānta* text (Surya-Siddhanta 1860) (Surya Siddhanta 1861) of third century CE mentions the phenomena of solstices, but does not provide specific dates of their occurrences. Only in later updates, the calendars and almanacs based on the *Sūryasiddhānta* came to have the dates of solstices. Again, however, the dates were not as in Julian or Gregorian calendar. They are January 14/15 for winter solstice and July 15/16 for summer solstice. These dates, even if erroneous, have continued to prevail in Indian almanacs, and people in India still observe festivals on these very dates.

Solstices in Indian calendars: Makara-Saṅkrānti and Karkaṭa-Saṅkrānti (14/15 Jan/July)

Now let us examine in detail whether the orientation could be aligned to summer solstice on the date given in Indian calendars. Solstices are celebrated as festivals in India. Winter solstice is known as Uttarāyana⁸⁵ or Makara-Saṅkrānti⁸⁶. The word Uttarāyana, as in the original *Sūryasiddhānta* text, was initially meant to indicate the six month's period when the sun moves to the north, but in later course, the date of

winter solstice also came to acquire this name. Summer solstice is known as Dakṣiṇāyana⁸⁷ or Karkaṭa-Saṅkrānti⁸⁸. The word Dakṣiṇāyana similarly came to be used in later period to designate the date of summer solstice.

There are 12 *Saṅkrāntis* (passages or transitions) in a year according to the 12 *rāśis* (zodiacs),⁸⁹ and importance is attached to each of them. Makara-Saṅkrānti falls on January 13 or 14⁹⁰ while Karkaṭa-Saṅkrānti falls on July 15 or 16. Thus, these dates fall 23 or 24 days after the dates of the solstices in the Gregorian calendar. The difference in date is due to an astronomical error that was noticed quite early, but was never corrected in the later *pañcāngas*.⁹¹ This is pointed out by P. V. Kane:

The people in India, who rely on the almanacs created according to ancient systems, consider the beginning of Uttarāyana from January 14. Hence, they are 23 days behind the Makara-Saṅkrānti proper. The fact is mentioned in Dharmaśāstras of the medieval period, for example Hemādri (*Kāla*: 436-37) has said that the sacred occasion falls 12 days prior to the prevalent Saṅkrānti. Therefore, the prescribed almsgiving and other propitious karmas can be performed even 12 days prior to the day of the prevalent Saṅkrānti. [(Kane 1973, Part I, p. 83)]

Uttarāyana is regarded an auspicious day. In Buddhism too, it seems to have some significance. For example, Kaṇiṣka the Kuṣāṇa king who was a great patron of Buddhism and Buddhist art selected the day of Makara-Saṅkrānti for his royal

enthronement. The Hindus celebrate this day as a major festival known variously as Uttarāyana, Makara-Saṅkrānti, Lohaṛī, Pomgal, Bhogali Bihu, and so on. Even Dakṣiṇāyana or Karkaṭa-Saṅkrānti is regarded somewhat auspicious, as are in general all the twelve *Saṅkrāntis*. Kane observes:

Every Saṅkrānti is acceptable as a sacred day [...] (Kane 1973, Vol. V, Part II, p. 361). The duty of almsgiving and propitious acts has lasting effect when performed on Viṣūva-Saṅkrānti (Meṣa and Tulā). And the same is true of Viṣṇupada- and Ṣaḍaśita-mūkha-Saṅkrāntis [...] (Kane 1973, Vol. V, Part I, p. 80). In *Rajamārtanḍa*, there are two ślokaś on the benefit and religious merit of performing almsgiving and propitious acts on Saṅkrānti -- 'The virtue of donation performed on Ayana-Saṅkrāntis is many times greater than the alms given on ordinary days [...]'. In *Bhaviṣya-Purāṇa*, abundant virtue is described in bathing in the Ganges on Ayana- (Makara- and Karkaṭa-) and Viṣūva-Saṅkrāntis [...]. In the words of *Viṣṇu-Purāṇa* [...], 'Catūrdaśi, Aṣṭami, Amāvasyā, Pūrṇimā, and Saṅkrāntis are called festivals'. [(Kane 1973, Vol. Part II, pp. 360-361)]

For the Hindus the importance of the *ayana-Saṅkrāntis* (Makara- and Karkaṭa-Saṅkrāntis) is 'unparalleled'.

Uttarāyana is most preferred because it is situated in the path of the *devayāna mārga* (the path to the world of Gods leading finally to emancipation or salvation). Dakṣiṇāyana is less preferred because it lies on the *pitṛyāna mārga*, the path to the world of ancestors leading to the eventual comeback into the world (Kane 1973, Vol V, Part 2, pp. 360-361). (Hiuen Tsiang 1884) The *pañcāṅgas* specify *māsa*

Śivarātrī vrata (monthly fast for worshipping Śiva) to be observed on Dakṣiṇāyana. The holy Srāvaṇa *māsa* begin from the next day of Karkaṭa-Saṅkrānti. This may coincide with the commencement Buddhist *varṣāvāsa*. In 2011, for instance, July 15 was the date for Karkaṭa-Saṅkrānti as well as Guru Pūrṇimā. This was also the date Dhamma Day. The next day was the beginning of the holy Srāvaṇa month for the Hindus and *varṣāvāsa* for the Buddhists.

Cave 26 is not connected to Karkaṭa-Saṅkrānti

In spite of the above incidence when the date of Guru Pūrṇimā, summer solstice (Karkaṭa-Saṅkrānti), and Dhamma Day are the same as in 2011, we cannot jump to the conclusion that the *śaītyagṛha* had anything to do with summer solstice of Indian calendar. This is primarily because, as said earlier, the Buddhists had little to do with *ayana-Saṅkrāntis*. The life of a monk and monastery was governed more by the cycles of the moon rather than the sun. Let us, therefore, see what the Buddhist calendar is like. We need to examine the Buddhist calendar to understand the point.

**UTTARA-PAKṢA: A NEW THEORY OF CAVE 26'S ASTRONOMICAL
ALIGNMENT TO THE DHAMMA DAY AS WELL AS TO THE COMMENCEMENT OF
THE CATURMĀSA AND THE MONSOON SEASON**

The present researcher has found some critical problems in Spink's observations, measurements, and conclusions. Thus, I spent about eight years of research on the issue. In my study, some startling revelations have come to light⁹². Many details of my study has been shared with Spink and other Ajanta scholars. We also visited the site together and had numerous brainstorm sessions on many finer details. Yet Spink does not agree with my conclusions and I cannot agree with his. Therefore, a detailed presentation of the related facts and observations are presented here.

I hold that the said orientation was achieved by performing *disā-vidhāna* (an old traditional Indian practice for ascertaining the direction of edifices). I hold that the alignments have nothing to do with solstices (21/22 June and 21/22 December), as mentioned in the European/ modern/ Christian calendar. I argue first of all that the planners of the temple or the saṅgha, or the people of the fifth-century Deccan are least likely to have had the knowledge of the European calendar, which was invented by Julius Caesar in fifth-century Rome. I then argue that the makers of Ajanta would have followed the calendar that was prevalent then in

the Deccan, or a calendar that the Buddhists in particular followed. This is important because the dates (*tīthis*) of solstices in Indian calendars are different. It is common knowledge that the solstices in India are known as Uttarāyana and Dakṣiṇāyana or Karkaṭa-Saṅkrānti (meaning the sun's southward progress). The *tīthis* in Indian *pañcāngas* (almanacs) fall on or starts from 14/15 January for Uttarāyana and 15/16 July for Dakṣiṇayana or Karkaṭa-Saṅkrānti. Thus, assuming that the temples are connected to solstices, the dates would have been 14/15 January or 15/16 July, and certainly not 21/22 December or June, as claimed by Spink. I further argue that the very attempt to connect the temples to solstices is ill founded, baseless, and untenable. Spink's theory totally disregards the Buddhist and historical contexts.

I gather that the Buddhists and their almanacs of antiquity and the present times, whether in India or other countries, maintain the lunar or the lunisolar calendar. They do not follow the solar calendar. Solstice is a phenomenon that has a place in the solar calendar; it has a place even in some lunisolar calendars; but there is no proof of any kind that suggests that the Buddhists of ancient India followed any such calendar, almanac, religious festivities, or ceremonies that marks solstices as an important date.

On the contrary, what is most unequivocally true is that the Buddhists monasteries of ancient and modern times follow the phases of the moon for the observance of various rites, festivities, and occasions round the year. This is mainly because the major events in the life of Gautama Buddha happened on the *pūrṇimās* (full moons). The Buddha was born on *pūrṇimā*, he left home on *pūrṇimā* (*mahābhiniṣkramaṇa*), he got enlightenment on *pūrṇimā*, he started *dharmacakrapravartana* on *pūrṇimā*, and he left the world (*mahāparinirvāṇa*) on *pūrṇimā*. All these *pūrṇimās* are celebrated as festivals (Table 12).

Although for practical purposes the Buddhists of ancient India followed the prevailing broader divisions of time, but for observing religious practices, rites, ceremonies, and ecclesiastical schedules, they relied on the moon's cycle. Therefore, if a Buddhist edifice has to have astronomical connection to a celestial body, it would be the cycles of the moon and not the sun that govern the Buddhist holy days known as *upoṣathas*. And, this is what is seen at Ajanta. I argue that the saṅgha that was in charge of the planning of the renaissance of Ajanta in the fifth century meticulously planned these orientations to *upoṣathas*. My research suggests that Cave 26 is aligned to not just one but two of the most important *upoṣathas* in the Buddhist calendar. The first is Dhamma Day that falls on the first Āṣāḍhī *pūrṇimā*. The second *upoṣatha* is the first day of *varṣāvāsa* that begins from the

next day of Āṣāḍhī *pūrṇimā*. These are among the most important dates in the Buddhist calendars. Precise dates of these holy days are found only in the traditional Saka calendar of the *amanta* type, which I seek to prove, was being followed by the fifth-century makers of Ajanta. It was the Śaka calendar and of the *amanta* type that was and still is being followed in Maharashtra. The makers of Ajanta followed the same calendar. This is proved through various sources and factors to be explained in detail ahead. For the moment, let us note that in the Śaka *amanta* calendar, Āṣāḍhī *pūrṇimā* often falls on the 14th and occasionally on the 15th *tithī*. Thus, it was 14/15th of Āṣāḍha that was and still is the *tithī* of Dhamma Day; and the next day begins the *varṣāvāsa*. The problem comes when we covert the date in Julian or Gregorian calendar. Invariably, the *tithīs* of Indian calendars do not match with the Gregorian calendar, that is, the calendar of Christian Era, followed widely in modern times.

Thus, in the Gregorian/ Julian calendar of the Christian Era Āṣāḍhī *pūrṇimā* or Dhamma Day would fall on just any date of June and sometimes of July. In circa 461 CE, i.e. the year we believe Cave 26 was inaugurated ((W. M. Spink 2009, fig. 39), (Singh 2012b)) Dhamma Day fell on 8 June (Table 13)⁹³. Table 13 shows how the *tithīs* of Dhamma Day is always 14th or 15 of Āṣāḍha month of the Śaka Era, which changes widely when converted in the Christian Era. It falls on different dates

of June or July in Christian Era. This span of change is up to five weeks. It can also be seen that the sun's angle in this span changes up to 2 degree, i.e. a negligible measure for practically casting any adverse impact on the purpose to which the cave's axis was aligned. For, the wide *śaitya* arch permits a wide beam of the sunrays inside the nave (Figure 182). It is so wide that the difference of 2 degree is not going to impact severely on the purpose to which the alignment was intended.

Speaking of the purpose, we have noted how Spink finds himself unable to think of a possible justification of the alignment. Spink's inability is due to his misplaced adherence to an imagined solstice-theory, while the fact is that a solstitial theory has never been linked to ancient Buddhist *saṅghārāmas* of India. My study and conclusions do not suffer from such imagined justifications. I shall be able to explain why the makers of the fifth-century phase of Ajanta decided to orient the three temples to Buddhist *upoṣathas*. In this chapter, I shall focus on Cave 26. The study of Cave 19 is included in Chapter 20.

There would have been great merit in aligning Cave 26 to the sunrise of Dhamma Day. On this day, the Buddha had given the First Sermon to the *Panāvargīya bhikṣus* at the Deer Park, Sarnath thus starting the *dharmaśakra-pravartana* (setting in motion the Wheel of Law). The Buddhist religion

was founded on this day. The day is also connected significantly to mark a major change in Indian seasons and climate. This is the time when the monsoon hits north India. In south India monsoon comes a few weeks earlier. Because the Buddha lived and travelled in north India, Āṣāḍha Pūrṇimā bears the imprint of the monsoon's arrival there. That is why, the four-month annual rainy retreat season, called *Varṣāvāsa* by the Jains and Buddhists alike, starts from the next day. It is not a coincidence that even for the Hindus the holy *Śrāvaṇa māsa* begins on this very date, i.e. from the next date of Asadhi Purnima. Technically, in the Indian calendar systems the date after Āṣāḍhī pūrṇimā, i.e. the first date of *varṣāvāsa*, is called *Āṣāḍha pratipāda kṛṣṇa*.

It would be seen that such an orientation was not solely on theological grounds. There was a practical necessity. In the era of early monasticism, such *śaila-saṅghārāmas*, which were ancient pilgrimage sites (Ray 1994) (Ray 1987) were apparently the places where the travelling monastics would stay and spend the season of *varṣāvāsa*, be it for participating in the various ecclesiastical ceremonies that continue for all the four months, or for observing the *vinaya* in the event of a *pārājika* offence (Clarke 2009).

The alignment to *varṣāvāsa* meant that the interiors of the temple would be receiving the maximum lighting during the *varṣāvāsa* season. Thus, it was not merely for marking the

Dhamma Day, the planners might also have been thinking of the entire period of *varṣāvāsa* or *ċaturmāsa* (literally, 'four months') when the site was expected to be full of visitors and many ecclesiastical activities would have been expected to be going on during the *varṣāvāsa* season.

Lastly, one may add that the given alignment would not have been feasible without the given location and the elevation at the semi-circular scarp (Figures 1, 12). Another location or elevation on the cliff could not have permitted the orientation to Dhamma Day and *Varṣāvāsa*.

Measurements, angles, and other data

In my measurement data the axis of the nave of Cave 26, when measured from the centre of the stupa, is 63° E-NE⁹⁴. My measurement for the sunrise of Dhamma Day in c. 461 CE is 65° E-NE (Table 13). In c. 461 CE, Dhamma Day fell on 8 June (8 June 461 CE = 14 Āṣāḍha, 383 SE). The next year, Dhamma Day fell on 27 June (27 June 462 CE = 14 Āṣāḍha 384 SE). However, the sunrise angle remains constant for both years, i.e. 65° (Table 13). In other years, the angle can vary from 64° to 66° E-NE (Time and Date.com, Solar calculator 2013)⁹⁵ at the Ajantā hill (Table 13)⁹⁶. Thus, on Dhamma Day, the maximum difference between the angle of the axis and the angle of the sunrise can be merely 3° . Needless to mention even at this

difference, the 11 ft. wide beam of light would surely hit the stupa, albeit not exactly in the centre of the stupa.

During our discussion in the last eight years Spink has made a great fuss about the precision of the angles and measurements, which I feel, is needless. Yet, in order to satisfy even a microscopic analysis, I welcome his data, as reproduced below:

The reading that I have, from an archaeoastronomer using a theodolite is 67.71° for azimuth of solstice sun at sunrise; and 64.46° for axis of the cave (taken through the porch), which is not aligned with the stupa and, therefore, is probably not intended as the real axis. [Spink, email personal communication, 2013]

Spink's measurement pertains to his solstice theory. He observes 67.71° for solstice sunrise (21 June) and 64.46° for the axis of the frontcourt (not the nave). Even for his solstice theory, he gets a difference of nearly 3° , i.e. the same difference that I get for my Dhamma Day and Varṣāvāsa theory. Let us keep this difference in mind, because it deserves scrutiny ahead.

For the moment, let us focus on a critical observation Spink has made above. This relates to the orientation of the nave and the frontcourt. Spink indicates that the two are not exactly on the same axis. He indicates that the nave seems to have been wrenched for greater alignment.

Spink explains that the twist was effected to get the interior's alignment when the workers found that the 'great hall [Cave 26] had, purely by chance, been cut from the start at an angle only a few degrees different from that described by the summer solstice's rays...' It is this 'chance-theory' of Spink that I wish to contest while agreeing with him that the axes of the nave and the frontcourt do indeed have a slight but important difference. I agree with him that there was an attempt of wrenching the nave for greater alignment, but I do not agree that this was for solstice. I cannot also subscribe to his 'chance-theory'.

On the contrary, I seek to explain here and in Chapter 20 that the orientations were pre-designed. I argue that for ascertaining the direction of the edifices (Caves 26, 19, and 29) *diśā-vidhāna* must have been performed on the *bhūmī*. *Diśā-vidhāna* is as scientific as ceremonial. I argue that it was performed on the Dhamma Day of c. 461 CE. If performed in other months, the sun would change the direction. Thus, the gnomon would produce shadow on another angle, giving a different result of the exercise. About the twist and wrenching of the nave, I argue that it was done not because they found something by chance, but because the next year when the sun again came on the hill, on the Dhamma Day, they realised that the workers had gone a few degrees off the line

while excavating the interior. It is this error that was being fixed.

Choosing the location and height for alignment

The primary reason why the orientation could not have been 'by chance' comes from the site's history and archaeology, more particularly from the sequence of excavations. It may be worthwhile to consider, in this context, the circumstances prevailing on the hill when the renaissance was being planned in c. 460-461 CE. Because Cave 26 is among the earliest initiative of the fifth-century phase, as seen in the previous chapter, let us go back to the times and visualise the scene on the hill when the first chisel was yet to strike the cliff in the fifth century.

First, we shall have to assume that the centuries-old Sātavāhana-period temples were very much in worship. The hill could not have been an abandoned place. It must have been a known *tīrtha* being situated on a major trade route (Figures 5-7); it must have been connected to other monastic sites. There is no reason to assume to the contrary that the site was dead during the lull period of Ajantā (2nd c. CE – mid 5th c. CE). There is no reason to assume that the monks and laity had stopped visiting the site during the lull period, for there were existing, after all, two attractive *śaityagṛhas* (Caves 9 and 10) and three *vihāras* (Caves 12, 13, and 15A).

During these centuries the site must have been maintained by an Order, the Saṅgha must have been present in some form. Politically or administratively, the saṅghārāma fell in the territory of the ancient Ṛṣika *janapada* i.e. approximately the upper Khāndesh region (Mirashi 1963). Therefore, the Ṛṣikas must be given some credit for engineering or, at least, cradling the inception of the renaissance in the fifth century CE.

We like to believe that the first chisel of the fifth-century phase was struck on Cave 8; Cave 26 was only the subsequent. Notably, Cave 8 was visualised as an *upāśraya*; it was not a temple. It indicates that an *upāśraya* was of greater priority. After having addressed this priority, the next edifice started was Cave 26—a temple. And this edifice was being donated by the monk Buddhabhadra who belonged evidently to the neighbouring *janapada* of Aśmaka (or Asika or Assaka, approximately Aurangabad of today).

Cave 26 is about 500-600 metres far from Cave 8. It is also located very high on the cliff; roughly 50 metre from the riverbed wherefrom an exclusive, costly, and painstakingly long flight of steps was excavated for accessibility. Contrast this with the fact that the Sātavāhana period caves are hardly twenty metre high from the riverbed and so easily approachable. The unusual distance and elevation as compared to the other, pre-existing caves

warrant a justification. Perhaps, inscriptions may help us here. The patron of Caves 17-20 (king of Ṛṣika who is named Upendragupta [II] by Spink and Dharādhīpa by Shastri)⁹⁷ and monk Buddhābhaddra (who claimed friendship with the minister of the Āśmaka king 'since many previous births') have left some clues regarding the nature of relationship between the two neighbouring *janapadas*: the Ṛṣika and the Āśmaka. It seems that the two were not friendly, to say the least; they entered into conflict, and claimed victories over one another in their respective dedicatory inscriptions.

It may, in part, have been due to this problematic relationship between the two *janapadas* that the two temples were not excavated side-by-side. It may probably have been the troubled relationship, which influenced the choice of location for the two temples. Shastri has rightly observed—'places of pilgrimage are nobody's fiefdom' (Shastri 1997). No wonder why an Āśmaka affiliate, monk Buddhābhaddra, was able to come to the rival region. The site-planners, who drafted the layouts of the fifth-century *upāśrayas* and temples, appear to have been remarkably innovative. Given the large number of donors—some of them royals, nobles, and wealthy merchants—who responded to the Saṅgha's call for the renaissance of Ajanta under the liberal and supportive regime of Hariṣeṇa, it was only appropriate that all the edifices were planned properly, including the earmarking of their

bhūmīs on the cliff. They decided then, based on the example of Sanchi, that the two new temples must be oriented to the sun and moon on important days. Thus, if Cave 26 was so located as to welcome *varṣāvāsa*, Cave 19 was given a location to felicitate the end of *varṣāvāsa*, and the next 4 *pūrṇimās*.

Lighting

The planners knew that during *varṣāvāsa*—when monks in large number come to lodge at the monastery and even the laity visited the *tīrtha* for daily sermons and other propitious acts—maximum lighting in the forenoons would have been ideal. The concern posed peculiar challenges at Ajantā, as the shape of the cliff is arched like a horseshoe (Figure 12). Every cave on the horseshoe shaped cliff gets sunlight only for an hour or two, which fact is true for all seasons. Due to the nature of the horseshoe shape of the scarp, the caves are facing different directions so much so that Cave 1, for instance, is facing Cave 26 because they are situated on either ends of the 'horse-shoe'. The edifices around Cave 26 are lit at dawn while those near Cave 1 are lit at dusk. The lighting therefore travels from Cave 26 going toward Cave 1 in the evening. In the era without electricity, concerns for lighting must have played a crucial role in decision-making, when it was still possible to choose the desired location. Thus, it is quite likely that getting adequate lighting

during the mornings, especially during the *varṣāvāsa* season would have been a prime consideration for the planners.

BUDDHIST CALENDAR IS LUNI-SOLAR

There are three types of calendars in general: solar, lunar, and luni-solar. While the Hindu *pancāngas* chiefly follow the solar calendar after the *Suryasiddhānta*, the Buddhists follow the luni-solar calendar. Without resorting to any particular calendar the Buddha had accepted the broader divisions of time as was prevailing in his times. He had accepted the prevailing names of seasons, months, fortnights, and other smaller units of time, but based the calculation of months after the phases of the moon.

Actually, the Buddhist astrology is a complex interweaving of stellar, solar, and lunar data, as well as readings from nature and the seasons. Based on the original third century *Suryasiddhānta*, the months in the Buddhist luni-solar calendar alternate between 29 and 30 and at regular intervals, an intercalated day and a 30-day month added to it. The people living in the Southeast Asian countries mainly use the Buddhist calendar. These countries include Cambodia, Laos, Thailand, and Myanmar (formerly Burma).

The luni-solar intercalation system of the calendar has seven extra months (*adhikamāsa*) every 19 years, and 11 extra days (*adhikavāra*) every 57 years. On an average, a year consists of 365.25875 days, deemed from the *mahāyuga* of 43,20,000 years. While the Hindu version makes additions and deduction the moment the astronomical formulae require, the Southeast Asian one delays it. Then, we have the Thai/ Lao/ Cambodian version in which there cannot be an extra day in the year having an extra month.

The Burmese version is exactly the opposite. It permits an extra day only in the years having an extra month. Thus, each of the four versions of the calendar has different days, i.e. 354, 355, 384, or 385 days respectively. The names of the months are in Sanskrit, namely Chaitra, Vaiśākha, Jyēṣṭha, Āṣāḍha, Śrāvan, Bhādrapada, Āśvina, Kārtik, Mārgaśīrṣa, Pauṣa, Māgha and Phālguna. The old Burmese month names were Tagu, Kason, Nayon, Wazo, Wagaung, Tawthalin, Thadingyut, Tarzaungmon, Natdaw, Pyatho, Tabodwe and Tabaung. There were/are mainly four eras in the Buddhist calendars:

AnchanŚakarāt	From 10 March 691 CE
BuddhaŚakarāt	Buddhist Era (BE), from 11 Mar 545 CE
MahāŚakarāt	17 Mar 78 (same as the Śaka Era in India)
ChulaŚakarāt	22 March 638

Since all years are elapsed/ expired/ complete years, their epochal year is not year 1, but year 0. As regards the era, it was either the so-called Buddhist Era (BE) or Śaka Era (SE) both of which were prevalent. The former started on the day of the Buddha's Enlightenment or Mahāparinirvāṇa whereas the latter started from the day of the coronation of King Śālivāhana Śaka. Some argue that SE started after the coronation of Kaṇiṣka, the great Kuṣāṇa king.

Xuanzang's account of Buddhist calendar

That the Buddhists of ancient India were following the lunar calendar is also indicated by an account of Xuanzang (c. 602 – 664 CE) who visited India about one and a half centuries after the date of Ajantā's Vākāṭaka phase. The great traveller has succinctly described the calendrical systems prevailing in India. He has also described the divisions of time 'according to the holy doctrine of Tathāgata' (Hiuen Tsiang 1884, 72-73). The information contained in his description is collated and presented in a tabular format in Table 14.

According to the above description of Xuanzang, a table has been prepared for reference (Table 14). From Xuanzang's account, it is clear that the Buddha had accepted the prevailing names of the months and their durations. There were two separate divisions for seasons, and two spells of

varṣāvāsa collectively called *ċaturmāsa*. Even today, the Buddhists and Jains follow this division of time in South Asia including the observance of important events or festivals that are based on lunations.

Our calculators show that it is the same calendar indicated by Xuanzang that was followed in the fifth-century Maharashtra. It was followed alike by the Hindus, Buddhists, and Jains. It is still followed today. It is the *amanta* Śaka calendar.⁹⁸ From Xuanzang's description we learn that it was the *amanta* luni-solar calendar that the Buddhists in the age of Ajantā followed (Table 15). In this, the lunar year starts at the *amanta* month of Chaitra. The luni-solar calendar is called the Chaitra calendar for convenience. The luni-solar eras that are used in the Indian luni-solar calendars are the Śālivāhana Śaka, Vikram Samvat (Chaitrādi), Vikram Samvat (Kārtikādi) and Vikram Samvat (Āṣāḍhadi) eras. My research shows that it was the Śālivāhana Śaka Era that was prevalent in the Buddhist India in centuries around Zuanxang's visit (Table 15). The Buddhist Era begins from the date of the Buddha's Mahāparinirvāṇa (544 BCE). The Śālivāhana Śaka Era begins from 78 or 79 years BCE after King Śālivāhana's accession to the throne followed as reference in most astronomical works in Sanskrit literature written after 500 CE (Table 15).

**FURTHER ON THE NEW THEORY OF THE ASTRONOMICAL ALIGNMENT TO
THE DHAMMA DAY AND THE FIRST DAY OF THE CATURMĀSA)**

The tīthi of Dhamma Day (Āṣāḍha Pūrṇimā) and varṣāvāsa in 462 CE

Now let us observe in detail what connection the *śaityagṛha* has with Dhamma day and *caturmāsa*. For a clear understanding of this, we will have to find out the *tīthi* of Dhamma Day and *varṣāvāsa* in the year of the *śaityagṛha*'s inauguration. Spink has specified circa 462 CE as the year of the commencement of the *śaityagṛha*. I place this date to c. 461 CE based on our astronomical data. Dhamma Day always falls on the first full moon of the fourth lunar month, i.e. Āṣāḍha *māsa*.

Accordingly, we have tried to know the *tīthis* of Āṣāḍha Pūrṇimā for two decades: 450s and 460s (see Table 13, Figures 230-235). I have also tried to find the conversion dates in Julian calendar. As seen in Table 14, the first full moon of Āṣāḍha always falls on 14th or 15th Āṣāḍha of Śaka Era. In Julian calendar, it will be different dates in June, and even July for some years. Dhamma Day of 461 CE fell on 8 June, which was 383 Śaka Era (NASA Eclipse Web Site n.d.), (Time and Date.com 2012), and (Gislén and Eade 2007).

Dhamma Day being the date of inauguration of the śaityagṛha

Now, can we also know the date of the inauguration of the śaityagṛha? The answer is yes. For this, we will have to compare the angle of the śaityagṛha's orientation with the angle of sunrise on Dhamma Day. As seen in Table 13 (note 1), the śaityagṛha's orientation is 63° - 64.46° E-NE (from the porch or stupa) while the angle of sunrise on Dhamma day (14 Āṣāḍha, 383 SE = 8 June 461 CE) is 65° E-NE. There is a difference of 1° - 2° in the line of alignment here. Ahead, we shall probe the reason for the difference. Right now it is suffice to observe that the alignment is close. The point I wish to make here is that this orientation, to this degree, on Dhamma Day can only be achieved if *diśā-vidhāna* was performed on the very date of Dhamma Day in 461 CE. In other words, the alignment indicates that *diśā-vidhāna* was performed on Dhamma Day that was also the date of the śaityagṛha's inauguration.

THE JUSTIFICATION OF THE ASTRONOMICAL ALIGNMENT TO THE DHAMMA DAY AND THE FIRST DAY OF THE CATURMĀSA

Why alignment to Dhamma Day?

As to why the planners of the śaityagṛha would choose Dhamma Day for inauguration and the consequent orientation to the sunrise of this day needs hardly any explanation. Generally,

astrological orientation of sacred spaces is linked to an important ecclesiastical date pertaining to the faith to which the edifice belongs. On Dhamma Day, homage is paid to the Buddha for commemorating the Buddha's first teaching when the Turning of the Wheel of Law (*dharmacakrapravartana*) began. Gautam Buddha on this day started preaching the Law beginning with the five ascetics (Pancavargīya Bhikṣus) at the Deer Park (Sarnath) near Benares, where Kondanna, the senior ascetic attained the first level of enlightenment (the *sotapanna* level of mind purity). Dhamma Day is now seen as a chance to express gratitude that the Buddha, and other enlightened teachers, has shared their knowledge with others. It is usually celebrated with readings from the Buddhist scriptures, and is an opportunity to reflect deeply on their content. If an individual practices Buddhism within a monastic tradition, Dhamma Day is, wherever possible, celebrated in a temple, Buddhist centre or monastery in the presence of monks or nuns'.

Why alignment to śaturmāsa?

As mentioned earlier, the orientation is not merely linked to the sunrise of Dhamma Day, for the *śaityagṛha* also seems to be connected to śaturmāsa. From the day after Dhamma Day, the first of the two spells of *varṣāvāsa* begins. For those who missed the first spell can begin it from the next full moon, which would be the first full moon of Śrāvaṇa *māsa*. Thus,

altogether four months are granted for *varṣāvāsa* called *caturmāsa* (Table 14). The selection of the date of *varṣāvāsa* is very important, since the first full moon of Āṣāḍha is often marked by the arrival of monsoon in most parts of India. An alignment to the direction of the sun during *caturmāsa* has practical advantages. It ensures optimum lighting inside the *caityagṛha*-complex, especially in the mornings, for the whole period of *varṣāvāsa*. Adequate lighting must arguably have been a major point of consideration. *Varṣāvāsa* was, of course, a crucial season—if not the most important purpose of the making of the *śailagṛhas*—for a monastic establishment. During *caturmāsa* the travelling monks were expected to rest, retreat, meditate, give sermons to the laity, or reflect for atonement of any *pārājika* offence (Clarke 2009). During the *vāsa* season, the Buddha and his monks and nuns would suspend their nomadic lifestyle for three months. They would shelter together until the monsoon season was over, and use this time as a period of further meditation and reflection. At the end of this time, they would resume their travelling, passing on the Buddha's teachings to those who were interested.

At the close of the *vāsa* season, the monks have to perform the *pavarana* ceremony. At this ceremony, held in place of the *patimokkha* recitation, each monk invites his fellows to point out to him any faults he has committed

during the *vāsa* period. On any day following the day of *pavarana* in the period terminating with the next full-moon day, the *kathina* ceremony is held. Different monasteries will hold the *kathina* on different days within this month, though any given monastery may hold only one *kathina* ceremony. The main event in this ceremony is the offering of the special robe known as the *kathina-civara* to the Saṅgha, who in turn present it to one monk who has observed the retreat. The laity traditionally offers unsewn cloth to the monks. Before the offering takes place, the robe is generally taken, with drumming, etc., around the village in the early hours of the morning. Once the robe is given to the Saṅgha, certain monks are selected to do the cutting, sewing, and dying of the robe--all in a single day. Public contributions are very often solicited to buy the robe if it is not a personal offering.

This ceremony, which is performed with keen interest and devotion, has today become an important occasion of great social and religious significance for the Buddhist laity. This seems to have been so even in historical times when many Sinhala kings made this offering with much interest and devotion (e.g. Mhv. xliv, 48, xci, etc.).

WAS *DISĀ-VIDHĀNA* PERFORMED ON DHAMMA DAY OF 383 SE?

Let us now probe how the orientation must have been achieved. What principles or methods were available for this purpose? One of the most prevalent methods is called *disā-vidhāna*, still practiced by many Indians who wish to make edifices after the principles of *vāstu*.⁹⁹ Many *śilpa* texts and *vāstu śāstras* provide comprehensive accounts of the procedure, method, and tools required for *disā-vidhāna*¹⁰⁰. Often a *śanku* (gnomon) is pegged on earth on an auspicious date according to relevant almanac. The location of pegging is often the centre of the *bhumi* (plot) earmarked for construction. A small thread or rope is tied toward the top of the gnomon. A circle on earth is then made round it. Now, after the sunrise on the day of *disā-vidhāna* when the long shadows get shorter and touch the circle, the point of the periphery where the shadow touched is marked. The same act is repeated in the afternoon when the shadows start getting longer and touch the periphery of the circle again; that point too is marked. Then, the two points are aligned together with a straight line that may or may not be touching the centre of the circle. The line thus obtained is broadly east-west, and provides the desired orientation and axis of the edifice. A building made on that axis would face the exact angle discovered on the day of *disā-vidhāna*. The sunrise of that day, every year, would invariably enter the depths of the

edifice and light the interiors. Needless now to say that a similar practice of *disā-vidhāna* must have been performed for discovering the axial orientation of the *caityagrha*. We can also safely say that such a *disā-vidhāna* must have been performed on the very day of Āṣāḍha Pūrṇimā.

THE CAVE'S HIGH ELEVATION ON THE CLIFF

Cave 26 is excavated at the height of 40-50 metres from the riverbed, which was extraordinary in view of the fact that all the other existing *śailagrhas* at the time of its inception (Caves 8, 9, 10, 12, 13, and 15A) were close to the riverbed being situated low on the cliff at the height of 10-20 metres. The reason of the extraordinary height must again have been the orientation. One ought to survey the terrain a bit to understand the point. The cliff, where the caves are carved, is on a lower stratum of the *ghāṭs* (slopes) of the particular stretch of Deccan Plateau. The lower stratum is clearly visible from 'the viewpoint' located at the level of the plateau. The sunrise takes longer to reach down to the level of the caves as compared to other caves. It reaches earlier to Cave 26, because of its great elevation, and will reach after 10-40 minutes to the other caves that are near the riverbed (Table 15). Therefore, for the objectives of the orientation it was imperative to get the maximum possible elevation depending on the quality of rock on the cliff. If

the particular elevation to the edifice was not selected, say, if the *śaityagrha* was excavated on a lower level like Caves 9 and 10, it would take longer for the sunrise to reach that level from the plateau across; and by that time the sun would change its angle. Consequently, the sunrays would not enter the interiors as desired. This is the clearest justification why Buddhabhadra went far from the Sātavāhana caves and why he chose that elevation.

EXPLAINING THE ALIGNMENT GAP OF 1-3 DEGREES

Now we should like to address the question as to why the nave's axis seems to have been wrenched. The axis of the frontcourt is much closer to the intended alignment. This was achieved later, after the planners discovered that the nave inside has missed the line of axis that was discovered during the inaugural year in *disa-vidhana*. There was little that could be done to fix the problem in the nave but the frontcourt that was exposed next year could be corrected, as much as was possible. The angle they wanted was 64° or 65°, i.e. the angle of the sunrise on Āṣāḍha Pūrṇimā of circa 461 CE (Table 13). The error in excavation would not have occurred had it been a structural edifice where the line of axis would have been drawn on the *bhumi* (ground) along with the marking for various architectural units of the plan. The case of a monolithic excavation is rather complex, for in this case it

is not possible to draw or retain the obtained line of axis on the *bhumi* because the *bhumi* does not exist before revealed by excavation. Instead of the *bhumi*, there stands a perpendicular cliff. So, in this case, the discovered line of axis after *disā-vidhāna* had to be memorised before proceeding for the excavation. One had to expose the façade first, and before reaching the floor level, one must penetrate into the full depths, for the process in rock-cut architecture is exactly the opposite of the process in structural constructions. Here, one must start from the top and move downwards, as well as into the depth. It would take months before the interior is reached, and by the time, the angle of the sunrise would change. In other words, the sun would no longer be the guide of the line of axis. For this reason, one must had to rely on the 'memorised angle' of the axis as work progressed in the interior. Only the next year when the sun again came round on the particular angle of Dhamma Day it would be known whether the excavated axis followed the 'original axis' or not. In the case of both the temples (caves 26 and 19), it appears that there certainly took place a deviation from the intended axes. This is why, in the subsequent years of the cave's development, there were attempts to fix the error by trying to wrench the frontcourt. It is only an illusion that we feel it is the nave, which is wrenched; while the case is that the frontcourts were

wrenched. This is also, why they also tried unsuccessfully to slightly shift the location of the stupa forward.

Notwithstanding the attempts, the whole exercise was eventually not very successful (particularly in Cave 26), which explains the difference between the angle of axis and the angle of sunrise on Dhamma Day, which is to the tune of 1° - 2° . Due to this, the sunrise will not squarely fall on the image or the stupa. It would only fall on the sides of the stupa on Dhamma Day. This was a problem well corrected in Cave 19, for there the morning sun (not necessarily the first rays) gets into precise alignment of the axis for the whole winter season—starting from the close of *ċaturmāsa*.