

HISTORICAL NOTES

RĀHU AND KETU IN MYTHOLOGICAL AND ASTRONOMOLOGICAL CONTEXTS

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Our aim is to examine, in a joint mythological and astronomical-astrological (“astronomological”) context, how the textual meanings of Rāhu and Ketu have evolved with time. They were possibly deployed as planetary deities after the mathematical theory of eclipses propounded by Āryabhaṭa.

INTRODUCTION

Ancient Indian perception of the moving cosmic environment two millennia ago was bipolar. Orbits of the seven geocentric planets (*graha*) by virtue of their predictability represented cosmic order, while phenomena like meteors, comets and eclipses which did not fit into any pattern were classified as *utpāta*, portent or calamity. This world view is preserved in a Buddhist Sanskrit text, *Sārdulakarnāvadāna*, the legend contained in which is known to have been translated in an abridged form into Chinese in 265 AD (Vaidya 1999, p.xi). As the 5th century AD came to a close, the status of eclipses was modified.

Mathematical theory of eclipses was propounded in India in 499 AD by Āryabhaṭa (born 476 AD) in his influential *siddhāntic* treatise simply known as *Āryabhaṭīyam* (see Ohashi 2009 for a recent review). According to this theory, solar and lunar eclipses occur when the moon is at either of its orbital nodes. These theoretical points move in a direction opposite to that of the planets and complete an orbit in the rather short period of 18.6 years. This development was immediately taken note of in astrological literature, which classified the two nodes as planets, implying that they were now amenable to mathematics. Since they were hypothetical they were dubbed shadow planets. The 6th century AD text *Bṛhajjātaka* (2.2-3) by Varāhamihira (died 587 AD) includes Rāhu and Ketu in

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the list of planets, and even gives their synonyms: *Tamas*, *Agu* and *Asūra* for Rāhu; and *Śikhi* for Ketu (Rao 1986, p.76), which however never gained currency. The two nodes are 180 degrees apart so that specifying one fixes the other. It would thus have sufficed to include just one of them. Both were listed no doubt to bring the planetary number up to nine which was considered sacred.

If new words had been coined to designate the two nodes, matter would have rested there. But both Rāhu and Ketu are terms of Vedic vintage. The term Rāhu had previously been used as a proper noun and exclusively in connection with eclipse so that its deployment represents an attempt at integrating new scientific developments with ancient tradition. On the other hand Ketu was merely a common noun employed variously but never in association with eclipse. Here then was an old term which was given an entirely new identity, representing expansion of mythology in the light of new scientific developments.

It is not uncommon to see even earlier references to Rāhu and Ketu being interpreted in terms of their later status. This is unfortunate, because it distorts the history of the evolution of “astronomical” thought. Our aim is to investigate how the textual meanings of the terms Rāhu and Ketu have evolved with time. We must keep in mind some notable features of the available source material. Most texts remained open for a long time and were contributed to by generations of authors. There is no reason to expect or demand internal self-consistency from them. The texts were often composed in metrical poetry and were meant for a select audience. Very often the meaning assigned to a particular word depends on the context in which it is used.

An important source of information on ancient India is the *Mahābhārata* which was expanded over a long period of time to include matter that went beyond the description of the *Bhārata* battle which it had originally set out to describe. The astronomical content of the *Mahābhārata* is consistent with Vedic astronomy in that it marks sky positions with the help of bright stars or star groups known as *nakṣatra*. The *Mahābhārata* is not familiar with the twelve zodiacal signs which make their appearance in post-Mauryan India in about the first century BC at Baudha Gaya where they are depicted on the railing pillars (Kane 1975, p. 598). Given the size and the nature of the contents of the *Mahābhārata* it is reasonable to assume that if zodiacal signs had been introduced into India when the *Mahābhārata* text was still open they would have found their way into it. We thus conclude that the *Mahābhārata* text had been closed by about 1st century

BC (Kochhar 2000, p.56). This is an important datum. At one place the *Mahābhārata* (*Vānaparva* 188. 87-88) does say that “when the moon, the sun and Jupiter in *Tiṣya* come together in one *rāsī*, *kṛta* age will begin”. The term *rāsī* is used here in the general sense of a portion of sky, not in the precise sense of a zodiacal sign.

The *Mahābhārata* does not make any reference to the week days either. There is no unanimity on the epoch when they were introduced into India. Varāhamihira, already referred to, in his other works, *Pañcasiddhāntikā* and *Bṛhatsaṃhitā*, mentions week days while quoting authorities who had lived much earlier. From this it has been inferred that week days were introduced into India in the first century AD (Kane 1975, pp. 680-1). A more plausible case has been built by Markel (1991) to suggest that the week made its appearance in India only in fourth century AD.

VEDIC RĀHU AND KETU

The *Ṛgveda* does not know of Rāhu. *Ṛgveda* (V.40:5-9) describes how Svarbhānu, son of an Asura, pierced the sun “through and through with darkness”. The eclipse caused great distress among observers: “All creatures looked like one who is bewildered, who knoweth not the place where he is standing”. The sun himself appealed to Atri: “Let not the oppressor with this dread, through anger, swallow me up, for I am thine, O Atri”. In response, “By his fourth sacred prayer Atri discovered Sūrya concealed in gloom that stayed his function”. “The Brāhmaṇa Atri, as he set the press-stones, serving the Gods with praise and adoration, established in the heavens the eye of Sūrya, and caused Svarbhānu’s magic arts to vanish. The Atris found the Sun again, him whom Svarbhānu of the brood of Asuras had pierced with gloom. This none besides had the power to do.” (Griffith 1896, p. 255) .The Atris were prominent contributors to the *Ṛgveda*. The whole of the fifth *maṇḍala* is authored by them. The passage quoted above is mentioned and embellished at a number of places in the Vedic literature: *Tāṇḍya Brāhmaṇa* (IV.5.2; IV.6.13; XI.6.8; 14.11. 14-15; XXIII.16.2), *Gopatha Brāhmaṇa* (8.19), *Satapatha Brāhmaṇa* (5.3.2.2), and *Saṅkhāyana Brāhmaṇa* (24.3) (Dikshit 1896, Vol.1, p.58; Kane 1975, pp. 241-242). What the Atris probably did was to chant *mantras* while the eclipse lasted. The *Ṛgvedic* description is significant. An eclipse was seen as the demon’s work in disrupting the cosmic order. Propitiation was needed to restore that order.

Dikshit (1896, Vol. 1, p. 57) while translating a passage from the *R̥gveda* renders Svarbhānu as Rāhu and goes on to give its meaning as the lunar ascending node. Similarly Kane (1975, p.569), while discussing a reference in the *Maitrāyani Upaniṣad*, equates Rāhu and Ketu with the ascending and descending node respectively. Svarbhānu's career as an Asura did not last long. It is not clear when and how Svarbhānu made way for Rāhu, who appears for the first time, and as the sun's enemy, in *Atharvaveda* (XIX, 9-10). *Chandogya Upaniṣad* (VIII.13) makes an interesting analogy: The "soul that has acquired true knowledge is said to shake off the body after casting off all evil" like "the moon becoming free from the mouth of Rāhu" (Kane 1975, p.569). The Pāli Buddhist sources refer to the moon and the sun freeing themselves from the clutches of Rāhu by invoking Buddha's name (*Candima Sutta, Samyutta-nikāya* 2.9; *Sūriya Sutta, Samyutta-nikāya* 2.10).

Mahābhārata (*Bhīṣmaparva* 13.39-45) uses both Svarbhānu and Rāhu as interchangeable names. Rāhu is a *graha*, 12000 *yojanas* in diameter, bigger than both the moon (11000 *yojanas*) and the sun (10000 *yojanas*). Rāhu had to be bigger than the sun and the moon so that it could grab them. Note that the term *graha* here carries the sense of a grabber and not that of a body in orbit. In course of time, the name Svarbhānu came to be de-stigmatized so much so that a son of Lord *Kṛṣṇa* was given the name (Mani 1975, p. 778).

Atharvaveda (XIII.16-24) employs Ketu to mean ray of light. These nine verses are taken from *R̥gveda* (I.50.1-9) in the same order and more or less in the same form. They are also found "in one or more other Vedic texts" (Whitney 1905, Vol.2, p.722). More typically Ketu meant combination of fire and smoke. The *Atharvaveda* passage (XIX.9.10) quoted above refers to Dhūmaketu as an epithet of *mṛtyū* [death]. It either means a comet or literally as "smoke-bannered" to the smoke rising from a funeral pyre (Whitney 1905, Vol. 2, p. 914). *Atharvaveda* (XI.10.1-2, 7) uses Ketu in the plural, as *aruṇah ketavaḥ* [ruddy Ketus]. Here the reference seems to be to comets or meteors. Varāhamihira's *Bṛhatsamhitā*, composed in 6th century AD but containing much older material, quotes a still earlier astronomer Garga on a class of 77 comets, called Aruṇa, which are dark red in colour (Bhat 1981, Vol. 1, p.138).

PŪRĀNIC RĀHU AND KETU

If the demon Rāhu devours the sun or the moon to cause an eclipse, how do they become visible again? The answer is provided by the well - known story

samudramanthana (churning of ocean), described in *Mahābhārata*, *Viṣṇupurāṇa* and elsewhere. In the story, the demon Rāhu's head is chopped off, which survives. It is the Rāhu head which causes an eclipse. Since the rest of the body is missing, there is an escape route for the sun and the moon. Note that the name Rāhu now belonged to the body-less head. The head-less body would remain unclaimed; see below. *Bṛhatsaṃhitā* (5:1-3) while narrating this story also refers to a prevalent alternative belief that Rahu is of a serpentine form with only the head and the tail. The ancient Iranian text *Bundahišn* talks of goshir, an eclipse-causing serpent. It is not clear whether Varāhamihira is referring to the Iranian legend or an unrecorded Indian one. Al Biruni writing in the 11th century reserves the name Rāhu for the dragon's head and calls the tail Ketu (Sachau 1888, Vol. 2, p.234). There were some half-hearted attempts to relate eclipses to predictable phenomena. Thus it was speculated that an eclipse took place when five planets get together (*Bṛhatsaṃhitā* 5.17)

Mahābhārata (*Ādiparva* 65. 11-12, 31) names Kaṣyapa as the father and Simhika as the mother of Rāhu, who is at times designated Simhikeya after her. His three other real brothers are also mentioned, their given names, Sucandra, Candraharta and Candrapramardana, all being associated with moon. Kaṣyapa from another wife Dānu had 34 named sons including one called Ketuman (not Ketu). Curiously the names Sūrya, Candramas and Svarbhānu figure in the list (*Ādiparva* 65.22-26). These 34 demons are thus Rāhu's half brothers. This naming is an exercise in meaningless creativity. This association may have an astronomical basis which does not seem to have been noted before. Varāhamihira in his *Bṛhatsaṃhitā* (3.7; 11.22) mentions a class of 33 comets known as *Tamaskilakās* (dark shafts), called children of Rāhu. They were noticed by the 11th century astronomer and chronicler Al-Biruni also. Described as black, and shaped like a crow or a beheaded man or a sword, or bow and arrow, they are always in the neighbourhood of the sun and the moon. It is likely that this category include sunspots (Bhat 1981, pp.25-26). An ancient authority quoted by Varāhamihira on *Tamaskilakā* is Garga, who figures in *Mahābhārata* also as an astronomer and advisor (Mani 1975, p. 280). He may well have been responsible for constructing a myth about 34 half-brothers of Rāhu out of the description of *Tamaskilakās*. It is noteworthy that from independent considerations Garga has been placed at about 100 BC (Kane 1975, p.681), the epoch we have assigned to the closure of the *Mahābhārata*.

ASTRONOMY IN *MAHĀBHĀRATA*

The *Mahābhārata* talks about the prevalent astronomical knowledge albeit often in an inverted manner. It will be useful to inspect the context in which these references were made.

When the two rival armies stood confronting each other, and the *Bhārata* war looked imminent, last ditch efforts were made to avert it by appealing to the ineffectual king Dhṛtarāṣṭra whose villainous sons were widely held responsible for bringing things to such a pass. To convey the enormity of the sense of impending genocide, the king was told that in anticipation of the war the natural order had already broken down. The effect was heightened by the fact that the so-called eye witness account was brought to the sightless king by his own biological father. The revered Ved Vyāsa tells Dhṛtarāṣṭra (*Bhīṣmaparva* 3.46) as follows.

“Cows are giving birth to asses; and elephants to dogs. Sons are enjoying sexual pleasures with their mothers. Idols of gods are laughing, vomiting blood, feeling sad, and falling off their pedestals on their own. Animals are being born with three horns, four eyes, five feet, two urinary organs, and two tails. Women are giving simultaneous birth to four –five girls, who immediately start singing, dancing and laughing. Trees are flowering out of season. Lotus and water-lily are blossoming on tree tops. Even koel, peacock and parrot are making fearsome sounds. There is a downpour of blood and bones from the sky.”

The imagined weirdness of the world in anticipation of the fratricidal war was extended to the skies as well. “Arundhati well known for her devotion to her husband Vasīṣṭha has left him behind. [The reference here seems to be the star pair in Urṣā Major rather than to individuals.] Dawn and the dusk look like as if they are on fire. Vyāsa tells Dhṛtarāṣṭra that he could not make out the difference between day and night, because the sun, moon and the stars all were burning bright throughout. This is a fearsome sign. Although it was the Kārtika full moon night, the moon was not visible; its luster had given way to fire.

It is in this background that even the more-reasonable sounding descriptions of celestial phenomenon should be seen. A recurring theme is the reference at various places in the *Mahābhārata* to Rāhu, as if the occurrence of an eclipse was at par with holocaust on earth. “Rāhu has seized the sun” (*Bhīṣmaparva* 3.11). “Rāhu is approaching the sun” (*Bhīṣmaparva* 141.10). “Rāhu swallowed the sun most untimely” (*Śalyaparva* 55.10). “Rāhu eclipsed the sun and the moon simultaneously” (*Aśvamedhaparva* 76. 15, 16, 18). Meteors (*ulkā*) and

earthquakes are also similarly invoked. As part of the celestial foreboding it is stated that a very dangerous *Dhūmaketu* has overcome the *nakṣatra* Puṣya. This will bring destruction to both sides. (This ill-omen appears in the 4th century AD Buddhist text *Sārdulakarnavādaṇa* as well; see below).

Continuing, his listing of ill omens, Ved Vyāsa tells Dhṛtarāṣṭra that the *śveta graha* (white planet) has transgressed Citrā, while the *parūsa graha* (harsh planet) has established itself between Citra and Svāti (Bhīṣmaparva 3.11, 16). The translators have exercised their own discretion in rendering these terms. *śveta graha* has been left untranslated (Sathe et al. 1985, p.39) or equated with Ketu (Ganguli 1884-1896, Book 6, p.12). *Parūsa graha* has been identified with Rāhu by one translator (Ganguli 1884-1896, Book 6, p.12) and with Ketu by another (Sathe et al. 1985, p. 39). The arbitrariness is obvious. As we have argued it would be anachronistic to associate Rāhu and Ketu with a planet in pre-Varāhamihira times.

Greek astronomical elements made their documented appearance in India in 149 AD when a Greek astro-text was translated into Sanskrit by Yavaneṣvara. It was versified in 269 AD by Sphujidhvaja under the title *Yavanajātaka* (Pingree, 1978). The versification was a significant development, because it signifies assimilation of Greco-Babylonian elements into Indian tradition. And yet, Vedic astronomical tradition remained extant even after the introduction of Yavaṇa texts, as can be seen from passages in *Sārdulakarṇāvadāna*, already referred to. “Irrespective of the *nakṣatra*, when the sun or the moon is seized by Rāhu, the king along with his subjects comes to pain.” “Irrespective of the *nakṣatra* when Ketu enters the moon, the neighbouring enemy king gets the upper hand.” “When *Dhūmaketu* establishes itself in the Puṣya *nakṣatra*, then defeat in enemy’s assault from all four directions is guaranteed” (Vaidya 1999, p. 374, couplets 462,463, 466). As we have already noted, *Dhūmaketu* in Puṣya as a bad omen is mentioned in the *Mahābhārata* also. It is significant that Ketu and *Dhūmaketu* are listed separately and along with Rāhu under *utpata*.

Once the mathematical theory of eclipse was propounded, Rāhu ceased to be an *utpāta*; its predictability however did not remove the fear associated with it. On the other hand, Ketu as comet continued to be an *utpāta*. *Bṛhatsaṃhitā* assigns separate chapters to a discussion on eclipses under the heading Rāhu and on comets under Ketu. *Bṛhatsaṃhitā* does not mention Ketu in the context of eclipse. As mentioned earlier, it is Varāhamihira’s other text

Bṛhajjātaka which twins Ketu with Rāhu as the eclipse-causing shadow planets, introducing the concept of *navagraha*. Ketu was now given a brand new identity; the torso which had been lying lifeless after the detachment of the Rāhu head was now resurrected and named Ketu.

We have argued that inclusion of the demon Rāhu in the list of mathematically tractable planets took place after 499 AD. Support for this conclusion comes from iconographic data. The “first surviving depiction of Rāhu occurs in a relief of the ‘Churning of the Ocean’ carved over the façade of the doorway of cave-temple number nineteen at Udayagiri in the Vidiṣa district of Madhya Pradesh, which can be dated to c. 430-450 AD. Earliest known representations of Rāhu as a member of the planetary deities are those on two stone lintels, 100cm by 20cm, originally from the villages of Nācnā and Kuthāra in the Panna district in the Bundelkhand region of Madhya Pradesh, most likely sculpted during the reign of the Uccakalpa king Jayanatha (r. ca. 490-510 AD)” (Markel 1990, pp.11-13). If the assigned dates are correct, it is remarkable that Rāhu’s planetization occurred within a decade of Āryabhaṭa’s theory. Ketu as a planetary deity appears in about 600 AD or a little later, in Uttar Pradesh. In the eastern state of Orissa, Ketu was not counted in until the tenth century, which thus had only eight *grahas* till then (Markel 1990, p.21). One wonders whether it was from Orissa that Rāhu as Yāhu travelled to Burma as one of the eight nats (spirits).

Astronomical literature employs the term Rāhu in connection with eclipse but in a number of ways. Āryabhaṭa does not use either Rāhu or Ketu; he and following him many others refer to a node as *pāta*. Brahmagupta (b.598 AD) in his long career displays signs of intellectual evolution. Taking a position contrary to Āryabhaṭa, he in his *Brāhmasphuṭasiddhānta*, prepared in 628 AD, expresses his faith in the demon Rāhu as the cause of eclipse. Al Biruni noted this (Sachau 1888, Vol. 2, p.110). Brahmagupta’s later text, *Khaṇḍakhādyaka* (665 AD), however, calculates eclipses in a matter-of-fact way employing the technical term *pāta* and without naming Rāhu or Ketu (Chatterjee 1970, pp. 80-85).

The 689 AD astronomical handbook *Karaṇaratna* by Devacārya (Shukla 1979) uses Rāhu to denote the eclipse shadow (2.2) as well as the ascending node (e.g.1.15). Significantly, at one place (1.13) the latter is called *Rāhumukha* (Rāhu head). A tersely written basic astronomical text will have no reason to mention Ketu. As comet, meteor or the like Ketu lay outside the scope of theory while as descending node it would be redundant once the ascending node Rāhu or *pāta* was mentioned.

In later Iranian (and Arabic) mythology the ascending node Rāhu and the descending node Ketu become the head and the tail of the dragon Al –Djawzahr. Ketu as comet is not forgotten; he figures as al-Kayd (Hartner 1965, pp. 501-502). Rāhu and Ketu as part of mathematical astronomy were introduced into China during the Tang dynasty (618-907 AD), but with modified meaning. While Rāhu was retained in the sense of the lunar ascending node, Ketu was used as a designation for lunar apogee (Niu 1995)

The imagery and iconography of Rāhu and Ketu have evolved over time, with the latter having been more difficult to conceptualize. While Rāhu has been well-defined since the days of the *samudramanthana* story, Ketu had in the sixth century AD the eclipse role thrust upon him in addition to the cometary and not the other way round as Neugebauer (1957, p.211) suggests.

The tradition of eclipse calculation has continued uninterrupted till relatively recent times. A copper plate inscription tells us about the grant of a village by the Kālacuri king Ratnadeva II to an astronomer, Jagannātha by name, for correctly predicting the lunar eclipse of 1128 AD. He knew two *siddhāntas* and succeeded where other astronomers in the court failed. Hence the reward (Mirashi 1933-34,p.161). Seven centuries later, a Pondicherry-based traditional astronomer calculated for the benefit of John Warren the lunar eclipse of 1825 AD, May 31-June 1, with the help of shells, placed on the ground, and from tables memorized “by means of certain artificial words and syllables”. The results were remarkably accurate for the time. There was an error of +4 minutes for the beginning, -23 minutes for the middle and -52 minutes for the end (Neugebauer 1983, p.436). Traditional almanacs still use old algorithms for their planetary position calculations, but have taken to using modern methods for calculating eclipses as a concession to the greater time consciousness of the present times.

CONCLUSION

To sum up, the terms Rāhu and Ketu have been continuously in use since the early Vedic times, but their meaning has not remained static. Rāhu was an eclipse-causing demon whose name was confined to the severed head in the *samudramanthana* story. In the sixth century AD, Rāhu was identified with the ascending node of lunar orbit and designated the eighth planet.

From the earliest time till the sixth century AD, Ketu was not a proper noun but a dictionary word used to denote phenomena like comets and meteors.

This meaning continued later as well. But in the sixth century AD, Ketu was made into a proper noun by identifying it with the descending node of the lunar orbit and designating it the ninth planet. The headless body of the demon left behind from the *samudramanthana* days was retrospectively named Ketu. This evolutionary sequence needs to be kept in mind while interpreting textual references. More specifically, identification of Rāhu or Ketu with a planet in a text prior to Varāhamihira would be an exercise in anachronism.

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REFERENCES

- Bhat, M. Ramakrishna, Varāhamihira's *Bṛhat Saṃhitā*, Motilal Banarasidass, Delhi, 1981
- Chatterjee, Bina, *The Khandakhādya* of Brahmagupta with the commentary of Bhaṭṭoṭpla, Vol. I. Motilal Banarasidass, Delhi, 1970
- Dikshit, Sankar Balakrishna, *History of Indian Astronomy*, 1896 (Eng. Tr. by R.V. Vaidya, Pt I, 1968; Pt II, 1981, India Meteorological Department, New Delhi).
- Ganguli, Kisari Mohan (1884-1896), *Mahābhārata* of Kṛṣṇa-Dvaipāyana Vyāsa (on-line)
- Griffith, Ralph T. H., *The Hymns of the Ṛgveda*, 1896 (Reprint : Motilal Banarasidass, Delhi, 1973).
- Hartner, W., "Al-Djawzahar", *Encyclopedia of Islam*, Vol.2, pp.501-502, Brill, Leiden, 1965.
- Kane, Pandurang Vaman, *History of Dharmasāstra*, Vol. 5, Bhandarkar Oriental Research Institute, Poona, 1975.
- Kochhar, Rajesh, *The Vedic People*, Orient Longman, Hyderabad, 2000.
- Mani, Vettam, *Purāṇic Encyclopaedia*, Motilal Banarasidass, Delhi, 1975.
- Ohashi, Yukio, "The mathematical and observational astronomy in traditional India", *Science in India*, Vol. 13, Pt.8, pp. 1-88, ed. J.V. Narlikar, Viva Books, New Delhi, 2009.
- Markel, Stephen, "The genesis of the Indian planetary deities", *East and West*, 41 (1991) 173-188.
- Markel, Stephen, "The Imagery and Iconographic Development of the Indian Planetary Deities Rahu and Ketu". *South Asian Studies*, 6 (1990) 9-26.
- Mirashi, V.V., *Epigraphia India*, Vol. XXII, 159-165, 1933-34.
- Neugebauer, Otto, "Notes on Al-Kaid". *J. Amer. Oriental Soc.*, 77 (1957) 211-215.
- Neugebauer, Otto, *Astronomy and History : Selected Essays*, Springer-Verlag, New York, 1983.

- Pingree, David, *The Yavanajātaka of Sphujidhvaja*, vol. 1, Edited Text with notes, vol. 2. Eng. Tr. with Commentary, Harvard Univ. Press, 1978.
- Rao , Bangalore Suryanarain, Varāhamihira's *BṛhatJātaka*, Motilal Banarasidass, Delhi, 1986 (Reprint 2008).
- Sachau, Edward C, *Al Beruni's India*, 1888, (2 vols reprinted as one, Atlantic Publishers, Delhi)
- Sathe, Shriram, Deshmukh, Vijaya, and Joshi Prabhakar, *Bhārtīya Yuddha: Astronomical References*, Shri Babasaheb Apte Smarak Samiti, Pune, 1983.
- Shukla, Kripa Shankar, *Karaṇa-Ratna of Devācārya*, Lucknow University, Lucknow, 1979.
- Vaidya, P. K. (ed.), *Divyavādana*, Mithila Institute, Darbhanga, 1999.
- Whitney, William Dwight, *Atharva-veda-saṃhitā*, 2 vols., Harvard University, Cambridge, USA, 1905.
- Yano, Michio, "Calendars, astronomy and astrology", Blackwell Companion to Hinduism, ed. Cavin Flood, Blackwell, Oxford, 2003.