

Theme 1 - Enclosure 2

# History of Indian Astronomy

## A Handbook

Volume brought out on the occasion of  
IX International Conference on Oriental Astronomy  
November 14–18, 2016

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However, considerable new information, beyond the published material, can be found in the following pages.

## 2 Comets and meteorites in the *Rgveda*

The *Rgveda Samhitā* is the most ancient literature of India available for our study. The three other *Vedas* namely the *Yajurveda*, *Sāmaveda* and the *Atharvanaveda* along with their ancillary texts are closely linked to the *Rgveda* in several ways. The remote antiquity of the *Rgveda* and the live tradition of oral transfer of the *Vedas* by complex linguistic artifices are evidences for the utmost importance attached by Hindus in preserving the original information as precisely as possible. It is an attested fact that even after several millennia, *RV* containing 10 books (*maṇḍala*) with 1028 hymns (*sūkta*) totaling 10552 verses (*mantra*) is learnt and recited with exactly the same content and sequence all over India. This is the primary source for finding the most ancient celestial observations made in the Indian skies. Even though *RV* is not a book on astronomy or on natural sciences, it is a collection of hymns covering a large variety of themes ranging from the physical to the spiritual, human to the superhuman, religion to philosophy, individual to the collective, earth to the sky to the universe. It spans several centuries in its compositional spread and represents a wide area of land also in its coverage with names of rivers, mountains, lands and lakes. The language of *RV* is by definition, Vedic Sanskrit and its style can at best be described as inspired poetry emanating out of spontaneous intuition, revelation or contemplation. Hence explaining the text strictly through analytical methods of grammar, etymology, dictionaries and linguistics will make us miss the forest for the trees.

Any one approaching the *RV* faces the daunting problem of extracting the meanings of the hymns. This difficulty is known since the time of Yāska who already noted that *RV* hymns can be interpreted in several different ways. Due to the archaic nature of the Vedic language, precise meanings may remain unknown, but the overall contextual implications when read with other similar hymns should be reasonably clear. Hence when a particular event or deity is described more number of times, a clear picture of what the ancient composers meant emerges. To approach the *RV* in this fashion, we have to follow the ancillary texts and the traditional Sanskrit commentaries, instead of going by modern day translations. This helps us to find whether the origin of a later Vedic ritual can be traced to the sky pictures of the *RV*. Among the various editions of the *RV* available, the Mysore Palace edition of the *Rgveda* (*abbr. MPRV*) is versatile.<sup>1</sup> This gives in thirty six volumes an exhaustive

<sup>1</sup> *Rgveda Samhitā*; edited by a group of ten scholars, published by the Mysore Palace, 1950. This thirty-six volume series in Kannada script is complete with *Samhitā* and *Pada Pāṭha*, *Khāla*, *Sāyaṇa's* commentary, *Anukramaṇi*, *Rgvidhāna*, *Aitareya Brāhmaṇa*, the *Bṛhaddevatā* and the *Nirukta* with elaborate traditional explanations which are indispensable to follow *RV*.

introduction, the text, traditional meaning, ritual application, grammatical explanation, and the complete Sanskrit commentary of Sāyaṇa along with the ancillary texts needed to follow the *Rgveda*. The translations and interpretations of the hymns given here follow closely the commentary of Sāyaṇa and the traditional explanations given by the compilers of the *MPRV* edition.

## 2.1 Description of *Dhūmaketu* in *Rgveda*

There are several RV hymns that employ the word *dhūmaketu*. Hymn (I.27) starts comparing *agni* to a tailed horse.

अश्वं न त्वा वारवन्तं वन्द्या अग्निं नमोभिः। सम्राजन्तमध्वराणाम्॥ (I.27.1)

In the second verse of the hymn this object is qualified as having wide motion (*pr̥thupragāmā*). In the sixth verse this *agni* is called *citrabhānu*, that is one having varied colors. This fire is qualified in the tenth verse as *rudra*, one with ferocious form. This is followed by a prayer with a specific name for the fire in question.

स नो महान् अनिमानो धूमकेतुः पुरुश्चन्द्रः। धिये वाजाय हिन्वतु॥ (I.27.11)

May the great, illimitable, brilliant *dhūmaketu* (smoke-bannered) be pleased with our rite and inspire us.

MPRV aptly points out that there can be no special similarity between *agni* and a tailed horse as in this hymn, even as a figure of speech. The hymn is clear that the object of its attention is stationed in the sky. If this *agni* were to have a tail, have perceptible movement, be large without specific measure (*mahān animāno*) and look like a big bright celestial herald (*viśpatiḥ daivyaḥ ketuḥ br̥hadbhānuḥ* | v.12) it could as well have been a comet described aptly by the word *dhūmaketu*. The epithet *viśpatiḥ* signifies the object to be closely connected with *maruts*, who are called *viś* in the RV. This point will be considered later.

Next we come across this word in a hymn by Praskaṇva of the Kaṇva family to which belong the authors of the eighth book.

अद्या दूतं वृणिमहे वसुम् अग्निं पुरुप्रियम्।  
धूमकेतुं भाक्रजीकं व्युष्टिषु यज्ञानाम् अध्वरश्रियम् ॥ (I.44.3)

We choose today at day break as messenger the good *agni*, the beloved of many, the smoke-bannered, who shines with his brightness and who is the protector of the doer of sacrifice.

Here the action of selecting *agni* as messenger (*dūtam*) is in the first person. This *agni* is qualified as *dhūmaketu* and *bhārjika*. The word *bhārjika* means 'shining' according to *Yāska*<sup>2</sup>. This may mean one who is shining or may mean one who is famous as *Bhā*. This *agni* is addressed in (v.4) as guest (*atīthi*), highlighting his transient nature. In (v.10) *agni* is referred also as *purohita*

<sup>2</sup> भाक्रजीकः प्रसिद्ध-भाः। धूमकेतुः समिधा भाक्रजीकः इत्यपि निगमो भवति॥ *Nirukta* (6.4)

and as *vibhāvasu* who had shone previously at many dawns (*pūrvā anu uśaso vibhāvaso didetha*). MPRV interprets *purohita* traditionally as,

one (the fire) who is installed in the east of the sacrificial altar in the *āhavanīya* pit.

This hymn ends in (v.14) with a request to the fire-tongued *maruts* to be heard (*śṛṇvantu marutaḥ agnijihvāḥ*). This hymn appears to be closely related with hymns of the 8th book of *RV*. The transient nature of the fire, named *vibhāvasu* or *bhā* with links to *maruts*, amply hints at this object to be a comet. As per the MPRV explanation, this hymn is an invocation to the celestial agni, the comet deity, already deified from previous tradition<sup>3</sup>.

## 2.2 Description of *Maruts* in the *Rgveda*

As is known Agni and Indra are the most important deities in the *RV*. This is true, not only in a statistical sense, but also in terms of the importance they have carried in the Vedic rituals and literature devoted to the elucidation of the *RV*. Even though the original agni of the *RV* was clearly celestial, the terrestrial sacrificial agni assumed greater significance in the traditional (*yājñika*) interpretation of the *RV* by Sāyaṇa and others before him. The reason for this is not difficult to find. The Vedic religion of *yājña* on earth is a replica of what the gods did once upon a time. This *yājña* of the gods was of celestial origin with its effects reaching the earth. Hence, this was of profound spiritual significance to the originators of Vedic religion and philosophy, to raise questions about the place of man in the universe culminating in the *Vedānta* and the *Upaniṣads*. There are several instances in the *Vedas* where this point is stated either metaphorically or even directly. In the second book (II. 21.5), *Uśījs* (*Āngiras*) are said to have found the path by means of *yājña*. The allegorical reference is to the overthrow of *vala* to get the waters released. The *RV* hymn (VIII. 89) by *Ṛmedha* and *Purumedha* (*Āngiras*) is about Indra supported by *maruts* as a group. In this hymn the principle of *yājña* is said to have originated when Indra spread between the earth and the sky for killing *Vṛtra*. This *yājña* of gods had a corresponding sacrifice on earth also, which in modern parlance could be called a natural disaster. *Maitrāyaṇī samhitā* mentions that gods did a sacrifice at Kurukṣetra.<sup>4</sup> This is confirmed with further elaborations in the *Taittirīya Āraṇyaka*.<sup>5</sup> *Taittirīya Brāhmaṇa* categorically states, *maruts* killed Prajāpati's creatures because they (*maruts*) were not initially worshipped by the people. Prajāpati (progenitor of people) had to behold a particular offering and present it to *maruts* in order to save his

<sup>3</sup> For other references in the *Rgveda* and more detailed discussion on *Dhūmaketu*, the reader is referred to Indian Journal of History of Science (IJHS) articles (2005, 2009, 2010, 2011 and 2012).

<sup>4</sup> देवा वै सत्रमासत कुरुक्षेत्रे॥ *Mai. Sam.* (IV. 5.9)

<sup>5</sup> देवा वै सत्रमासत...तेषां कुरुक्षेत्रं वेदिरासीत्। तस्यै खाण्डवो दक्षिणार्धमासीत्। तूर्धमुत्तरार्धः। परीणञ्जघनार्धः। मरव उत्करः॥ *Tai. Āra.* (5.1.1)

creation.<sup>6</sup> A similar statement occurs in the same text about *maruts* disturbing the work of Prajāpati.<sup>7</sup> Since the *RV* is the earliest among the *Vedas*, other texts derive inspiration from the *RV* for their contents and practices. Thus Vedic literature has evidence to infer the sacrifice by the gods through the agency of meteoritic storms, called *maruts* in the *RV*, which have depleted population in the northern parts of ancient India.

The present study started by tracing the word *dhūmaketu*.<sup>8</sup> In the sequel *maruts* and *vibhāvasu* were found to be intimately connected with the fiery *dhūmaketu*. *Vibhāvasu* could be the name of one or more comets but the evidence is equivocal. It is possible this word was used in some hymns as a qualification for Agni, which depending on its location was called by different names. In one place significantly, *vibhāvasu* is said to be like a big rock (v. 25.8) making one surmise, that the ancients had guessed the basic nature of these near earth objects, sometimes called deities but at other instances as demons, correctly. It is *maruts* that get more space than the other two objects considered here, almost competing with Indra and agni with whom they are any way closely related. The minimal commonality in the physical feature of *maruts*, is their countable membership to a group (*gaṇa*), unlike undifferentiated masses of clouds or sheets of water. The *Brāhmaṇa* texts explain that *maruts* are *viś*; the groups (or clans) and this means their abundance in the skies.<sup>9</sup> The perception of the *RV* composers (I. 27.12) was that as in their community traders and agricultural people (*viś*) were in abundance, so were *maruts* abundant in the sky. The *Taittirīya Brāhmaṇa* declares this explicitly; *maruts* are the most numerous among the gods.<sup>10</sup>

Three broad phases can be discerned in the description of *maruts*. The first, probably the earliest in time, are hymns which express awe at the approach of *maruts*. These also express a sense of fear that *maruts* are prone to kill people on earth. In the second group are prayers so that the shower of stones may avoid the worshippers of *maruts*. The third layer contains hymns wherein *maruts* are invoked to come to prayer or worship. It may not be wrong to conjecture that this trend should have been directly matching with the frequency of the storms of *maruts*. We also find hymns in which *maruts* are prayed to bring medicines and precious materials (*sanāddhi vo ratnadheyāni santi* | X. 88.8). This should be a later view of *maruts* after physical examination of the falling objects and a feel for their contents. A point to be reconciled is

<sup>6</sup> संवत्सरो वै प्रजापतिः। संवत्सरे एवास्मै प्रजाः प्राजनयत्। ताः प्रजा जाता मरुतोऽघ्नन् । अस्मान् अपि न प्रायुक्षतेति। स एतम् प्रजापतिर्मारुतं सप्तकपालम् अपश्यत्। याः पूर्वाः प्रजाः असृक्षि। मरुतस्ता अवधिषुः॥ *Tai. Brā.* (I. 6.2.2-3-4)

<sup>7</sup> मरुतो यज्ञमजिघान्सन् प्रजापतेः॥ *Tai. Brā.* (I. 3.4.4)

<sup>8</sup> The term literally means ‘the one who is smoke-bannered’ `` धूमः केतुः यस्य सः |”

<sup>9</sup> विशो वै मरुतो भूमो वै विट्॥ *ŚB.* (III. 9.1.17); मरुतो हि वै देवविशः अन्तरिक्ष भाजनाः॥ *Kauṣītaki Brā.* (7.9.16):

<sup>10</sup> मरुतो हि देवानाम् भूयिष्ठाः॥ *Tai. Brā.* (2.7.10.1)

the meaning of *maruts* as wind deities in later literature. We guess that with the status of Indra getting downgraded in time to a mere rain god, *maruts* always linked with Indra, were also brought down as wind deities. This has happened notwithstanding the fact *parjanya* and *vāyu* are the independent rain and wind deities in the *RV*.

The later Vedic texts corroborate the above points, since they essentially describe invocations and offerings to *maruts*. The *Taittirīya Āraṇyaka* which, states that *maruts* were in abundance and killed people, also states that there is only one Rudra and the innumerable thousands (Rudra's children) are not seen any more but only remembered.<sup>11</sup> It also associates a season with *maruts*, namely the *hemanta ṛtu* (the dewy season) which is the two month period ending with the winter solstice.<sup>12</sup> It is most likely that *maruts* were thought to originate from a particular object in the sky, called Rudra. In many hymns of the *RV* *maruts* are the children of Rudra, and their downward gliding motion is described by the unique word *skandanti* from which the proper name *Skanda* has originated. It is noted here, that not in all Vedic literature *maruts* are denoted as Rudra's children. The *Taittirīya Āraṇyaka* differentiates *rudragāṇa* from *marut-gāṇa* and mentions that the first appear in the *grīṣmartu*, the two month season ending with the summer solstice before the rainy season starts. The latter appear in the *hemantartu*, as in the *Taittirīya Brāhmaṇa*. The commentators mention that both are sky deities appearing in their respective seasons. *Rudragāṇa* is described as being white robed and recurring with the summer season.

विशेषणं तु वक्ष्यामः। ऋतूनां तन्निबोधत। शुक्लवासा रुद्रगणः।  
ग्रीष्मेणावर्तते सह। निजहन् पृथिवीं सर्वाम्॥

*Tai. Āra.* (1-3-3).

The second group appears red with anger as though ready for battle in the dewy season.<sup>13</sup> It is easily recognized that both are meteor groups separated by six months. This again makes a case for ancient sky observations and earthly rituals going hand in hand. It also hints at the development of observational astronomy starting with the identification of seasons, connected with the observable meteor showers, which once should have caused destruction on land. This raises the question whether *maruts* was a generic word for all types of meteoritic activity or it referred to particular types. This cannot be answered definitively at present. *Ulkā* the popular word for meteorite in

<sup>11</sup> य एको रुद्र उच्यते। असङ्ख्याताः सहस्राणि। स्मर्यते न च दृश्यते॥ *Tai. Āra.* (I. 12.1)

<sup>12</sup> हेमन्तर्तुना देवाः। मरुतस्त्रिणवे स्तुतम्॥ *Tai. Brā.* (II. 6.19.2)

<sup>13</sup>

अभिधून्वन्तो अभिघ्नन्त इव। वातवन्तो मरुद्गणाः।  
अमुतो जेतुमिषुमुखमिव। सन्नद्धाः सह ददृशे ह।  
अपध्वस्तैर्वस्तिवर्णैरिव। विशिखासः कपर्दिनः। अक्रुद्धस्य योत्स्यमानस्य। क्रुद्धस्येव लोहिनी।  
हेमतः चक्षुषी विद्यात्। अक्ष्णयोः क्षिपणोरिव॥ *Tai. Āra.* (I. 4.2)

classical Sanskrit is already in use in the *RV*. This word in plural occurs in IV. 4.2 where *agni* is asked to cast his firebrands (meteors) around. Again *ulkā* appears in the singular in X. 68.4 where a meteor is said to be cast down from the sun. The group nature that is special to *maruts* is absent in the occasional meteor called *ulkā*. It is not the case that the composers of the 4th and the 10th books were not aware of *maruts*. But they deliberately brought in a new word to discriminate *maruts* from other transient falling objects. The *Ṣaḍvīmśa Brāhmaṇa* further brings in new terminologies and events *tārā-varṣa* or star showers, and *dig-dāha* meaning blaze of the cardinal directions or zodiacal light in addition to *ulkā* and *ketu*.

### 2.3 Modern concepts

Only a small sample of the *RV* hymns are investigated in the present study. But, if the events described in these were descriptions of real events, either by direct experience or based on family tradition, the situation would indicate the occurrence of an ancient natural disaster attributable to meteoritic showers, comets, dust veils and climate alteration for an extended length of time. Evidence for such a severe natural disaster to have occurred in ancient India is available also in the *Mahābhārata* and the *Skandapurāṇa*.<sup>14</sup>

In recent years scientific evidence for near earth objects to have impacted earth in the past has been growing. The path of the Taurid group of extra terrestrial objects consisting of meteors, meteoroids, asteroids and Comet Encke intersect the orbit of the earth making earth vulnerable for impacts from these objects. Some of these objects instead of reaching the ground may vaporize in the atmosphere leading to air blasts and fires as it happened in Tunguska, Siberia in 1908. It is held by astronomers that in the last 10,000 years Comet Encke split and further disintegrated to leave a trail of debris which caused dust veils that would have temporarily blocked the sunlight reaching earth.<sup>15</sup> Thus, the Ṛgvedic descriptions of *maruts* killing people on earth, birth of *agni* and the Horse in the sky, *vṛtra* covering the sun, Indra restoring the sunlight, breaking down of *viśvarūpā* son of *tvaṣṭā* and celestial deities coming down to earth (India) to become important in cultural and religious practices, are to be taken as natural events of low probability but not impossible to have happened in the fourth millennium BCE or earlier.

### 2.4 Chronological footprint

The relatively late usage of the word *dhūmaketu* in the *RV* has chronological significance for understanding the development of astronomy in ancient India.

<sup>14</sup> *Profile of a natural disaster in ancient Sanskrit literature*. By R. N. Iyengar; Indian Journal History of Science, 2004; 39.1. pp. 11-49.

<sup>15</sup> The Cosmic Winter. By Clube and Napier; Basil Blackwell; U. K. 1990., Rogue Asteroids and Doomsday Comets. By D. Steel J. Wiley & Sons New York, 1995.

The word *dhūmaketu* for a transient celestial object in the *RV* and in the *AV* is in harmony with the use of the word to indicate a comet in later literature. This acquires significance since, names of some of the Vedic deities (*devatā*) coincide with the names of comets and other non-planetary objects described by Parāśara, Vṛddhagarga, Nārada and Devala who have left records of what may be called scientific literature prior to the development of mathematical astronomy in India.<sup>16</sup> Parāśara knew twenty six comets (*ketu*) long before Varāhamihira (6th cent. CE) stated them in the wrong order in his *Bṛhatsamhitā*. The last comet of this list was called the *dhūmaketu*.

The most conservative dates for the *RV* agree that the canons were closed, including the late 8th and the 10th books, by 1500 BCE. This, situation not only supports the deciphering of some *RV* deities as transient celestial objects, but also indicates the existence of a parallel tradition of sky observations contemporaneous with what is mentioned poetically in the *RV*. Parāśara and subsequently Vṛddhagarga had more things to say about comets. These conspicuously included their specific names, year number, and position in the sky, movement, color, visibility, duration, and effect on earth. They also classified meteors (*ulkā*) into five types. Parāśara and Vṛddhagarga mention that a *graha* (grasper) called *Tvaṣṭā* can darken the sun and the moon at odd times. Varāhamihira, a votary of mathematics for predicting eclipses, severely criticizes Parāśara for his eclipse divination methods, but retains the above legend in his writings. We conjecture that strong belief in the historical reality of such a rare event should have been in the collective memory of the community since the start of the *R̥gveda*, for Varāhamihira to accept its possibility and retain this event in the *Bṛhatsamhitā*.

Interestingly, *maruts* and correlated sky objects do not refer to the moon directly. References to the moon, months, intercalation, eclipses probably belong to another strata of the *RV* coming after the havoc caused by *maruts* and the consequent climate alteration effects subsided. It is as if the original group of people left their memories of a divine (celestial) catastrophe in poetic language upon which their successors added further observation of the sky leading to lunar and solar rituals. An algorithmic calendar attributed to Lagadha became a necessity for timing the rituals. The *R̥gveda* is well aware of eclipses and their recurrent nature. This is in contrast to the sun getting veiled due to atmospheric dust or a trail of comet debris. While the observation of a solar eclipse by Atri is easily recognized, lunar eclipses are metaphorical invoking agni to a *yajña* when the moon appears red in colour. The number 3339 mentioned twice in the *RV* is explained by the *Brahmāṇḍapurāṇa* unambiguously as a lunar number. This symbolic connection between the above R̥gvedic number and the eighteen year eclipse period is discussed in the following section.

<sup>16</sup> Iyengar R. N., *Archaic Astronomy of Parāśara and Vṛddhagarga*, IJHS 43.1, pp. 1-27, 2008.