

COMETS AND METEORITIC SHOWERS IN THE *ṚGVEDA* AND THEIR SIGNIFICANCE

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The possibility of some transient celestial object being described by the word *dhûmaketu* in the *Ṛgveda* is studied in this paper. It is found that the well known Vedic deities, *maruts* through their physical actions stand for meteoritic showers or storms. In some places the description reads like extra terrestrial objects hitting the earth. This goes against the traditional interpretation of *maruts* as thunderstorm and wind gods. It is demonstrated that *vibhâvasu* also stands for a transient object in the sky, which in one place in the *Ṛgveda* is said to be like a big rock. Importance of the above results for tracing the early history of Indian Astronomy is highlighted. Ancient Vedic people appear to have been preoccupied with celestial fires in the form of meteoritic swarms and comets which would have necessitated regular ritualistic observation of the sky, gradually leading to the calendar and later to the knowledge of the planets.

Key words: Comets, *Dhûmaketu*, *Marut*, Meteorites, *Ṛgveda*, Vedic deities, *Vibhâvasu*

INTRODUCTION

The *Ṛgveda Samhitâ* (*RV*) has attracted the attention of scholars in almost all branches of human knowledge for locating the most ancient references to topics of interest to them. The text of *RV* contains a cryptic statement *yâdṛgeva dadṛúe tâdṛgucyate* (V.44.6). This means the seers said what they saw. Hence identifying the physical background which could have led to special and strange description of the sky in the hymns of *RV* would be a worthwhile exercise. With this optimism, the present study attempts to retrieve a picture of the Indian sky

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the composers of *RV* or their immediate predecessors would have observed at an unknown period of time. The question raised here is whether some specific *RV* hymns that use the word *dhûmaketu* as an epithet for a fire that is essentially celestial could have been associated with or inspired by transient celestial objects such as comets and meteors. The *Atharvaṇa Veda* has a famous hymn¹ in which *dhûmaketu* is mentioned along with sun, moon and Râhu the eclipse causer, indicating that in Vedic parlance this word meant a celestial object. *Kauṣika Sûtra* of the *Atharvaṇa Veda* mentions the event of the Seven Sages (U.Major) veiled by *dhûmaketu*, which could have meant a comet only². One could counter this observation by pointing out that in Sanskrit a given word may denote different objects depending on the context. Acceptance of this does not rule out the possibility of a celestial object being treated as a deity for a ritual or as a hero for a legend. Thus it is natural to question what was the contextual significance of the Ṛgvedic word *dhûmaketu*, which occurs seven times in *RV*. Does it in any sense refer to a comet? This question is approached in the present paper in the following way. The word *dhûmaketu* which may mean smoke-banner or flag or insignia or comet is searched in *RV* text. In each place the contextual meaning of the corresponding verse (*mantra*) within the larger hymn (*sûkta*) is picked up to discuss whether a comet or a similar transient celestial object could have been implied by this characteristic word. Clearly, it was not necessary for the ancients to have used this word even when they wanted to describe a comet like figure. Hence, a few hymns where the description is rich with comet imagery are identified for some limited study. In the sequel it becomes necessary to discuss the physical nature of two other Vedic deities (celestial objects) namely, *maruts* and *vibhâvasu* that are closely connected with *dhûmaketu*. The evidences in the text, if taken in a matter-of-fact fashion indicate beyond reasonable doubt that *maruts* in the earliest layers of *RV* represent meteoritic showers and that *vibhâvasu* was a transient celestial object. In *RV* the nomenclature *dhûmaketu* seems to have been used in a generic sense, indicating bright transient objects with a dusty extension rather than denoting a specific comet.

TEXT OF *RV*

Any one approaching *RV* faces the daunting problem of extracting the meanings of the hymns. This difficulty is known since the time of Yâska (c 7th cent. BC) who notes 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, which is not the case with hymns containing rare words. To approach *RV* in this fashion, one has to follow the ancillary texts and traditional Sanskrit commentaries, instead of going by modern day translations. This way one can hope to find whether the origin of a later Vedic ritual can be traced to the sky pictures of *RV*. Among the various editions of *RV* available, the Mysore Palace edition of the *Ṛgveda* (abbr. *MPRV*) is versatile. This gives in thirty six volumes an exhaustive introduction, the text, traditional meaning, ritual application, grammatical explanation, and the complete Sanskrit commentary of Sâyaṇa (14th century AD) with a brief translation in Kannada³.

KETU IN *RV*

The word *ketu* and its derivatives occur eighty times in *RV*, with the following distribution among the ten books (*maṇḍala*):

[I.19; II.0; III.10; IV.3; V.8; VI.7; VII.8; VIII.4; IX.3; X.18]

What strikes here as significant is the absence of the word in the second book and its increased use in the first and the tenth books. The compound word *dhûmaketu* which means comet in the *Atharvaṇa Veda* is used three times (1.27.11, 1.44.3, 1.94.1) in the first book, twice (VIII.43.4, and VIII.44.10) in the eighth book and twice (X.4.5, X.12.2) in the tenth book. Yet another interesting feature is the occurrence, in the tenth book, of words *bhâsâketu* (10.20.3) and *vṛṣâketu* (X.92.1) which are particularizations of the word *ketu* to specific nameable objects. While there is no consensus on the absolute chronology of *RV*, it is generally accepted that among the seven family books the eighth book is the latest. The first and the tenth books containing collections of hymns from various composers are also considered to be relatively late. But these two books may refer to ancient events and practices, even if they were composed after the family books got fixed.

The specific word *dhûmaketu* meaning literally ‘smoke- or dust-banner’ occurs seven times but, only in the three late books. As per traditional interpretation this word qualifies *agni* the (sacrificial) fire. One wonders, if this were to be the unique meaning, why this epithet is absent in the other family books which also

profusely refer to *agni*. Is it possible the word *dhûmaketu* with two meanings, fire (*agni*) and anomalous event (*utpâta*), as listed in the *Amarakośa*⁴ could be traced to *RV*, when in ancient times a comet with a (dusty) smoky extension, like the earthly fire which has smoke for its insignia might have inspired the composers of some hymns. The word *utpâta* denoting anomalous natural events does not appear in *RV*. But the word *adbhuta* which stands for strange and unusual objects or events is used in *RV* as an epithet for *agni* the fire. Could this *adbhuta* in some sense point to strange fiery transient objects observed in the sky? The *Ṣaḍvimûa Brâhmana* of the Sâmaveda group has a chapter called *Adbhuta Brâhmana*. This deals with special rituals to be observed in case of occurrence of unusual events. Among these are *somadevatyâni adbhutâni* which, include shooting stars, meteorites and comets (*ketavaḥ*)⁵. It is notable that the *Nirukta* (1.6) interprets *adbhutam* as *abhûtam*, that is, unprecedented. Thus, *prima-facie* there is a case for *dhûmaketu* to be a comet or a fireball similar to a strange fire with a smoky extension.

DHÛMAKETU

Here, the seven hymns with the word *dhûmaketu* are considered in the order of the books in which they appear. Hymn (1.27) in praise of *agni* by Śunaḥśepa Ajigarti starts comparing *agni* to a horse with tail (*vâravantam*). In the next verse (1.27.2) this object is qualified as having wide motion (*pṛthupragâmâ*). In (1.27.6) *agni* is called *citrabhânu*, one having varied colors. This fire is qualified in (1.27.10) as *rudra*, one with ferocious form. This is followed by the prayer,

sa no mahân animâno dhûmaketuḥ puruścandraḥ | dhiye vâjâya hinvatu|
(1.27.11)

‘May the great, illimitable, smoke bannered and brilliant *agni*, be pleased with our rite and inspire us.’

The above is the literal meaning of the verse. Sâyaṇa explains *animânaḥ* as an object without any fixed size, shape or measure. *MPRV* correctly notes that there can be no special similarity between *agni* and a tailed horse even as a figure of speech. However, instead of taking this *agni* to be earthly fire, if it is understood to be a transient celestial object, its characterization as having a tail (*vâravantam*) would be natural. 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 (*mahân animâno*) and look like a big bright celestial

herald (*viśpatiḥ daivyaḥ ketuḥ bṛhadbhânuḥ*| I.27.12) it could as well have been a comet described aptly by the word *dhûmaketu*. The epithet *viśpatiḥ* signifies the object to be closely connected with *maruts*, who are also called *viś* in *RV*. This point is considered again later in the present study.

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

adyâ dûtam vṛṇimahe vasum agnim purupriyam |

dhûmaketum bhârjikam vyuṣṭiṣu yajñânâm adhvaraúriyam || (1.44.3)

‘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 (*dûtam*) is in the first person. This *agni* is qualified as *dhûmaketu* and *bhârjika*. The latter word is interpreted as shining. For this, Sâyaṇa cites the *Nirukta* (VI.4) of Yâska: *bhârjikaḥ prasiddha-bhâḥ| dhûmaketuḥ samidhâ bhârjikaḥ ityapi nigamo bhavati*. This may mean one who is shining or may mean one who is famous as *bhâ*. This *agni* is addressed in (I.44.4) as Guest (*atithi*), highlighting his transient nature. In (I.44.10) *agni* is referred also as *purohita* and as *vibhâvasu* who had shone previously at many dawns (*pûrvâ anu uṣaso vibhavasô didetha*). *MPRV* interprets *purohita* traditionally as, ‘one who is installed in the east of the sacrificial altar in the *âhavanîya pit*’. This hymn ends in (I.44.14) with a request to the fire-tongued *maruts* to be heard (*śṛṇvantu marutaḥ agnijihvâḥ*). This hymn appears to be closely related with hymns of the 8th book yet to be considered. The transient nature of the fire, probably named *vibhâvasu* or *bhâ* with links to *maruts*, hints at this object to be a comet. If the *MPRV* tradition is accepted it follows, this hymn is an invocation to the celestial *agni*, (the comet deity?) already deified from previous tradition.

Hymn (1.94) to *agni* is by Kutsa a member of the family of Aṅgîrasa. Every verse of this hymn ends with the refrain⁶ let us not suffer injury as we have friendship with you (*agne sakhye mâ riṣâmâ vayam tava*).’ This is a prayer to *agni* seeking protection particularly from the fiery *maruts*. The first verse refers to *agni* as *jâtavedas*. *MPRV* describes the technicalities of this word quoting the *Bṛhaddevatâ* (*BD*) an important ancient authority on preserving the tradition of *RV*⁶. As per this, *RV* seers call terrestrial fire *agni*, fire in the mid-space *jâtavedas* and fire in the sky *vaiúvânara*. There is a mystic meaning to the word *jâtavedas*,

but the localization of this fire is again mentioned in *BD* with the extra information that this fire is known to all (or seen by all) created again and again in mid-space⁷. This *agni* is thought about at every syzygy by offerings (I.94.4). The next verse (I.94.5) is interpreted differently by Sâyaṇa and Skandasvâmin. *MPRV* provides both the meanings, the one by Skandasvâmin being realistic. As per this, *agni* is seen all through the nights in different colours and is brighter than even the light at day break (*uṣaso mahân*). In (I.94.7) *agni* is praised as one who is seen to be similar from all places (*viśvataḥ sadṛñg asi*). Even though he is really at a distance (in the sky) he seems to be near. In (I.94.9), *agni* is requested to kill with his weapons the enemies of the devout. The next verse is

yad ayukthâ aruṣâ rohitâ rathe vâtajûtâ vṛṣabhasyeva te ravaḥ |
âdinvasi vanino dhûmaketuṅgne sakhye mâ riṣâmâ vayam tava ||
 (I.94.10)

‘When you have yoked the wind driven red (animals) to the chariot, your roar is like that of a bull. You cover forest trees by a banner of smoke. Let us not suffer injury as we have friendship with you.’

Here the word *dhûmaketu* seems to be used in the sense of a smoke cover. However the *agni* addressed in this hymn has for its background not any ordinary terrestrial fire but the one in mid-space significantly coloured red. The next verse (I.94.11) mentions that the drops of this *agni* eat grass (*drapshâḥ yavasâdah*). The word *yavasâdah* literally means one who eats (burns) *yavasa* which is taken to be grass by tradition. But this may as well refer to destruction of grain fields. Sâyaṇa likes to interpret *drapsâḥ* as flames, but in the context of a fire from above, dropping of fiery matter would be apt. This is followed by a request to *Mitra* and *Varuṇa* to protect the poet from the strange fury of *maruts* who live in mid-space. The description of *maruts* is picturesque as, *avayâtâm marutâm heḷa adbhutaḥ* (I.94.12). Sâyaṇa explains this as: the anger of the gods known as *maruts* moving below the heavens happens to be severe. However this can be directly translated as ‘the cry (rumbling sound) of the descending *maruts* is strange (unprecedented)’.

In the above hymn the word *dhûmaketu* is not used directly to refer a comet. But the hymn is about *agni* that is between the earth and the visible sky. The prayer is to ward off the danger posed directly by *maruts*, with ritualistic connotations linked to earthly fires ignited by atmospheric agents. The weapons of *agni* that could kill enemies, but from which protection is sought by the poet,

can be conjectured to have been showers of stony meteoritic debris. This interpretation would be consistent with the action of *maruts* at all places in *RV*.

The only family book using the word *dhûmaketu* is the 8th book of the Kaṇvas. The first verse of hymn (VIII.43) declares this to be a laudation to *agni* the uninterrupted doer of sacrifice. The third verse mentions *agni* to be burning the forests. The immediate next two verses are

harayo dhûmaketavaḥ vâtajûtâ upadyavi | yatante vr̥thagagnayaḥ ||
ete tye vr̥thagagnayaḥ iddhâsaḥ samadṛkṣata | uṣasâmiva ketavaḥ ||
 (VIII.43.4,5)

‘Individual forms of swift wind-impelled smoke-bannered fires move in the sky. These separated fires shining in the front appear like heralds of the dawns.’

In verse (VIII.43.6) the black dust raised by the feet of *jâtavedas* as he travels, when fire spreads on the earth, is described. The physical implication of the above verses would be that the composer is describing one or more celestial fiery objects with smoky or dusty extensions seen before dawn. These celestial fires are linked to fire on earth, which may indicate either a cause effect relation or just a poetic similarity. The objects are many and said to be emphatically separated (*vr̥thak=pr̥thak*) and moving. As a physical picture this fits the description of a meteor swarm encountered by earth while passing through the trail of a comet. Here *dhûmaketu* is used to indicate swiftly moving objects in the sky. Since the word dawn is used in plural, perhaps this spectacle was seen for several days before day break in the eastern sky. The next hymn (VIII.44) is also about *agni*. Here in (VIII.44.7) this *agni* is called ancient (*pratnam*) and invoker (*hotâram*) and the guest of honour in sacrifices (*adhvarânâṃ abhisriyam*). This ancient *agni* is named in the objective case as

vipram hotâram adruham dhûmaketum vibhâvasum | yajñânâṃ ketum
îmahe ||

(VIII.44.10)

Sâyaṇa interprets the word *vibhâvasu* as *one having light for wealth* (*dîptidhanam*) and identifies him with *agni*. If here also *dhûmaketu* meant the ordinary sacrificial fire, why once again the composer refers to *agni* as the banner of sacrifices? On the other hand the matter-of-fact meaning would be

We pray to the wise guileless (divine) invoker, the comet (smoke bannered) *vibhâvasu*, who is the banner of sacrifices.

There is nothing in the above hymn that would contradict the above direct meaning. The use of the word *ketu* in the second half would be appropriate in the sense of a herald.

It is seen that in the 8th book the word *dhûmaketu* refers to visible transient objects that might have included meteors and comets in a general sense. In the tenth book the hymn (X.4) by Tṛta Âptya is about *agni* the link between men and gods, who traverses in between (X.4.2). In the next verse (X.4.3) he is said to be eager to come to sacrifices on earth looking down from above with a desire to return. There appears considerable difficulty in interpreting the 5th verse with the word *dhûmaketu*. *MPRV* takes the first part as a question and constructs a meaning with which the commentator is not satisfied. The text and the interpretation are as follows.

kûcijjâyate sanayâsu navyo vane tasthau palito dhûmaketuḥ |
asnâtâpo vṛṣabho na praveti sacetaso yam praṇayanta martâḥ ||
 (X.4.5)

‘Where is the new *agni* born? He is present in the old plants, grey haired, smoke-bannered. Though not needing a bath, as he is pure, he rushes to water like a bull...’

This interpretation reads strained and forced. The simple meaning based on the context of the preceding and succeeding verses would be of a fire that is white in colour, seen above a forest. Its rush towards water may be a real event of a fireball entering a water body. This matches with *agni* being called *jâtavedaḥ* later in (X.7), the technical meaning of which is fire in mid-space. Even though the meaning of the word *dhûmaketu* in this hymn remains ambiguous, it is still linked to a fiery object that approaches a water body, from above. The last appearance of the word *dhûmaketu* is in

devo devân paribhûr ṛtena vahâ no havyam prathamâs cikitvân |
dhûmaketuḥ samidhâ bhârjikaḥ mandro hotâ nityo vâcâ yajîyân ||
 (X.12.2)

Here, the word is used in the sense of sacrificial fire with no direct celestial relation except for the qualification *bhârjikaḥ* as in (1.44.3). This completes a brief discussion on the seven occurrences of the word *dhûmaketu* in *RV*. It is noted that all the above hymns are addressed to *agni*, a prominent deity in *RV*.

Interestingly in the tenth book *agni* is called *bhâsâketu* that means light bannered, which is nearly the opposite of *dhûmaketu*, the smoke-bannered.

yamâsâ kṛpaniḷam bhâsâketum vardhayanti | bhrâjate śreṇidan ||

(X.20.3)

Sâyaṇa interprets the word *bhâsâketu*, as flame bannered fire or one who gives out light. It is not clear why this should not have been the name of a celestial object, for in the very next verse this fire is described as, ‘who when he moves up penetrates the ends of the sky, illumining the firmament’. Further the hymn lauds this fire as one that is standing above the sacrificial altar. Traditionally the phrase *sadma minvan puraḥ eti* in (X.20.5) is interpreted to mean that this fire ‘measures the fireplace by his movements’. This description would be more suitable for a bright celestial object that was stationary for some time and then started moving as though measuring the sky. Sâyaṇa’s understanding of this as representing the sacrificial fire amply indicates that the Vedic sacred fire on earth is a symbol or simulation of a visible bright celestial object ritualistically invoked through special hymns. In (X.20.5.9) this fire is described to ‘move straight in a big car showing colours, white, black, red and crimson’. A cosmological background is also indicated here, since the car of *bhâsâketu* was fashioned by the Creator. On the whole this hymn is consistent in describing a comet-like celestial object, out of which some aspects of the terrestrial (religious) fire, as described in the later *Yjurveda Saṃhita* and *Brâhmaṇa* texts, have been modelled. Similarly the word *vṛṣâketu* may be related to an object seen in the night sky. This name appears in the hymn *RV* (X.92) attributed to Úaryâta son of Manu.

yajñasya vo rathyam viśpatim viûâm hotâram aktoratithim vibhâvasum/

śocan śuṣkâsu hariṇîsu jarbhuradvṛṣâketuryajato dyâm aúâyata || (X.92.1)

This *ketu* has some connection with *vibhâvasu* who was described in the hymn (1.44) considered previously. Here also *vibhâvasu* is called the guest of the night similar to its description in (1.44). Sâyaṇa interprets the first half as a call to gods for worshipping *vibhâvasu*. His statement *paricarati iti śeṣaḥ* is an unnecessary assumption. The second half is independently taken to mean ‘the giver of desires (*vṛṣâ*), the banner (*ketuḥ*) reposes in heaven’. In line with Sâyaṇa, MPRV gives the meaning of the above verse as

‘You (gods, adore) the charioteer of the sacrifice, the lord of men, the invoker of the gods, the guest of night, the resplendent (*agni*). Blazing

amid the dry (bushes) preying upon the green, the showerer of desires,
the banner (of light), the adorable, reposes in heaven’.

Since *vibhâvasu* is a guest of night (*aktoḥ atithim*) with its location in the sky (*dyâm asâyata*), the name *vṛṣâketu* most probably signifies a transient object in the sky.

MARUTS

The brief review above brings out the major physical characters of *agni* called *dhûmaketu*, but only in relation with two other celestial objects namely *maruts* and *vibhâvasu*. *Maruts* are well known Vedic deities taken to represent ‘winds and thunderstorms inducing rain’ by traditionalists as well as by modern scholars. However, their explicit relation with *dhûmaketu* provides a clue to their correct decipherment as ‘meteoritic storms’. *Maruts* are a group of deities, usually known as sons of Rudra and occasionally directly as *Rudrâḥ*. The key discriminatory feature of *maruts* is that they are a collection of individuals who could be seen and hence countable in some sense. They are said to be separated among themselves. They increase by two and three and their count varies from twenty-one (I.133.6) to forty-nine (VIII.28.5) to sixty-three (VIII.96.8). They could even be seen in waves of thousands (I.168.4). If these properties were to be reconciled with a physically possible natural object, *maruts* have to be taken as a shower of meteorites. No doubt there are hymns associated with *maruts* that refer to lightning, rain, wind, thunderous sound and consequent shaking of trees, people and mountains. However, seen in the perspective of a celestial *agni* called *dhûmaketu* being a comet, the above actions of *maruts* are more valid for a swarm of meteors than for the monsoon thunderstorm.

Maruts are closely associated with Indra in many hymns and these read like recollection of past events for a ritual. There is palpable spontaneity in the hymns to *maruts* with the figures of speech and epithets picturesquely describing a rare spectacle. In all thirty-three hymns are devoted exclusively to *maruts* in *RV*. Since these deities are mentioned more than five hundred times by name, spread over the ten books of *RV*, it is not possible here to discuss all the occurrences of this word used always in the plural. Interest here will be limited to descriptions of *maruts* that are graphic and hence appear like direct observations or recollections of some past episodes.

Maruts come (to earth) along with *agni* from above. They are brilliant with terrible forms and kill people. *Maruts* sit as deities in heaven, above the luminous vault. They move the mountains and disturb the oceans (I.19.6, 7). Here following Sâyaṇa, *MPRV* argues that however strong a wind may be it can not possibly shake hills, and hence the word *parvatân* should be taken as clouds and not as mountains. But if *maruts* are taken naturally for what they are, namely extra terrestrial objects, they could have shaken mountains by their impacts. In the next verse *maruts* are described as widening with their light (*raśmibhiḥ tanvanti* I.19.8) and storming the oceans with their power. The earliest Angiras was *agni*, to support whom *maruts* were born with their glittering spears (I.31.1). Here traditionalists take *maruts* to be winds with the further unnecessary assumption that the word *raśmibhiḥ* above means *sûrya-raûmibhiḥ*. That this is an uneasy explanation is clear when we note that *MPRV* mentions that *vâyû* and *maruts* are distinctly different not only in the text of *RV* but also in the practice of Vedic rituals.

Hymns (I.37.39) by Kaṇva son of Ghora are dedicated to *maruts*. These hymns highlight the meteoritic nature of *maruts*, personified as deities, as being self luminous and spotted. The poet says in first person that he can hear from where he is the roaring sound of *maruts* (I.37.1, 5). In the next verse the poet wonders, who could be the strongest among the *maruts*, since they shake heaven and earth like mere trees. The common man is said to be protecting his dwellings from the (impact of) *maruts*.

nivo yâmâya mânuṣo dadhra ugrâya manyave | jihîta parvato giriḥ||
(I.37.7)

‘To withstand your ferocious journey man has strengthened his dwelling with columns. Even rugged hills get crushed (at your approach)’.

Maruts have mowed down men on earth and have made mountains fall. Wherever the group of *maruts* goes, everyone is sure to hear their roaring sound (I.37.12, 13). *Maruts* come from the sky to the earth, but not the other way round (I.38.2). That *maruts* could not go back from earth is ingeniously expressed as

yadyûyam pṛûnimâtaro martâsaḥ syâtana | stotâ vo amṛtaḥ syât|| (I.38.3)

‘Children of Pṛṣṇi! You may become mortals, but let those who laud you remain not dead’.

Maruts are sure to bring airless showers to deserts (I.38.7). *MPRV* wonders why the word airless (*avâtâm*) has been used to describe showers (*mīham*). This doubt arises if *mīham* is taken as ordinary rain. An intense meteoritic shower can make the target region airless for some time, which fact was known to the pre-siddhântic astronomer Vṛddha-Garga⁸. It is repeatedly said that people were afraid of *maruts*. If these deities were really harbingers of monsoon rainfall, the following descriptions read out of place.

adha svanât marutâm viúvam â sadma pârthivam | arejanta pra mânuṣâḥ
// (I.38.10)

‘At the roar of the *maruts*, every house on the earth shook. The people also trembled’.

parâha yatsthiram hatha naro vartayathâ guru|
vi yâtana vaninaḥ pṛthivyâ vyâúâḥ parvatânâm // (I.39.3)

‘When you overthrow what is stable and whirl away what is heavy, your course is through the forests and the mountains’.

â vo makṣû tanâya kam rudrâ avo vṛṇivahe |
gantâ nûnam no’vasâ yathâ purethâ kaṇvâya bibhyuṣe // (I.39.7)

‘Sons of *Rudra*! We pray to you for the quick protection of our progeny. Like you came once previously, come for the sake of frightened *Kaṇva*.

Nodhâ Gautama describes *maruts* in (I.64) as having fearful forms. They are drop like (falling objects) and shining like suns (*asurâḥ ghoravarpasaḥ drapsinaḥ sûryâ iva úucayaḥ* / I.64.2). It is indicated that *maruts* induced winds and rains before their arrival. This seems to have been the reason for the traditional interpretation of *maruts* as storm deities before rainfall. In the hymns (I.86, I.87 & I.88) Gotama Râhugaṇa mentions that *maruts* were worshipped by people since many years seeking protection. *Maruts* are described as having wheels of gold and rushing like boars with tusks of iron (*ayodamṣṭrân vidhâvato varâhûn*). The epithet *asurâḥ* does not indicate any ethnic group but just that *maruts* as deities threw stones and other objects towards earth. The word *asura* is derived traditionally, as held by Sâyaṇa, from the root *asu kṣepaṇe* (to throw).

Hymns (I.166) onwards by Agastya further reveal the physical side of *maruts*. All creatures on earth along with their dwellings shake in fear that they might get hit by the weapons of *maruts*. The tearing weapons of *maruts* hit animals like well aimed darts. *Maruts* are visible at a distance shining like stars

(*dûre dṛúo ye divyâ iva stṛbhiḥ*/ I.66.11). The visible hair-like extension of the *maruts* is figuratively described as *rodasî*, their companion with dishevelled hairs (*viṣita stukâ*; I.167.5). *Maruts*, although formless, seemingly have a form. They are self born and always tremble in their path. They come in thousands like waves on water (I.168.4). They came down to earth together effortless, with burning looks and shook the mountains (*svayuktaḥ divaḥ vṛthâ ava âyayuh...bhrâjadṛṣṭayaḥ dṛḥhâni cit acucyuvuh* || I.168.5). The next verse, indirectly mentions that they enter the sea. *Maruts* on their approach gleam like serpents (*ahi bhânavaḥ*). The material of the weapons of *maruts* is made clear by Agastya in,

Far be from us, your impetuous shaft. Far from us be the stone you hurl
(I.172.2)

In the second book, Gr̥tsamada prays to *Rudra*: ‘O, father of *maruts*, do not exclude us from seeing the sunlight’ (*mâ naḥ sūryasya sandṛúo yuyothâḥ*). Let not *Rudra*’s quoits have us as targets. Let his frightening anger avoid us (*pariṇo heti rudrasya vṛjyâḥ paritvesasya durmatirmahî gât*) (II.33.1 & 14).

Even though *maruts* poured in, the material they rained is not said to be ordinary water. It is described as *soma*, *ghee*, milk, honey or a liquid coloured like honey. *Maruts* showered medicines which were accepted by *Manu* the ancestor of the poet (II.33.13).

If one agrees with the principle of internal consistency as the approach to understand *RV*, one can not assign different meanings to the same word used in similar contexts. Doubts arise about the words *parvata* and *giri* occurring in connection with *maruts*. Traditionalists take this to be mountains in some verses but as clouds in other places. A typical example of this confusion is in hymn (III.26) attributed to *Viúvâmitra*. *Sâyaṇa* assumes *maruts* produce a rain of water and hence takes the word *parvatân* to mean clouds, where as there is nothing in the three verses (III.26.4-6) to indicate ordinary rainfall. The statement *marutaḥ pravepayanti parvatân* should normally mean *maruts* shake the mountains. This remains consistent in all places if *maruts* are understood to be representing meteorites or fragments of extra terrestrial objects falling on earth.

Ten of the thirty-three hymns devoted to *maruts* are found in the 5th book. These are important since tradition holds hymns (V.52) to (V.61) to be inspired compositions of seer *Úyâvâúva*. Hymn (V.52) is a laudation in which

maruts are said to be capable of exceeding the nights in their travel, which means they were visible in day light also. In (V.52.7) they are praised in the sky, on earth and in the rivers. Specifically they are found in the River Paruṣṇî (V.52.9). *Maruts* dug a well for Gotama (V.52.12), as in *RV* (1.85.10-11) which in physical terms would mean creation of an impact crater. This hymn ends in (V.52.17) referring to River Yamunâ. The next hymn starts wondering ‘who knows the origin of maruts?’ They release their treasury for their devotee (V.52.6) and help release *parjanya* (rain water?). Further, in (V.52.9) six more rivers Rasâ, Anitabhâ, Kubhâ, Krumu, Sindhu and Sarayû are linked with *maruts*. The prayer in (V.52.13, 14) is for the material showered by *maruts* namely, seeds (*bîjam*) and water (*âpaḥ*). Hymn (V.54) is a laudation to the force or power behind the group of *maruts*, who with stony weapons (*aśma didyavaḥ*) disturb mountains. They, children of Rudra, shake everything like a boat on water, day and night, and disturb forts difficult to enter (*durgâni*). Hymn (V.55) is a prayer in which *maruts* are described to make a shower out of sea (*samudrataḥ*). The material carried by them is called *purîṣa*, which is not rain water, but assumed to be so by Sâyaṇa. Hymn (V.56) is an invocation to *maruts* to come down to earth from above. Effortlessly, *maruts* bring down the rocks of the mountains. In (V.57) they are called *vâûimantah*, as in (I.87.6). As per Yâska this refers to weapons made of stones or to voice⁹. Clearly, the epithet refers to stony meteorites making rumbling sound as they approached earth at high speed. *Maruts* are in the form of large drops (*purudrapshâḥ*) and carry the name *amṛtam*. Hymn (V.58) contains verses in which *maruts* are associated with water (*udavâhâsaḥ* V.58.3; *âpaḥ kṣodante* V.58.6). But in (V.59.5) *maruts* are described to be of equal measure like spokes (in wheels) and (length of) days. Traditionalists take (V.59.1) to describe rainfall, by stretching the word *arṇava* to mean clouds. However, direct reading of the verse only indicates a shower of bright materials getting into the seas. The next verse (V.59.2) does not refer to rainfall, but to the trembling earth compared to a shaking boat. Hymn (V.60) is similar to others in highlighting the power of *maruts* to disturb the mountains.

parvatûcinmahi vṛddho bibhâya divaûcitsânu rejate svane vaḥ |

yatkṛîlatha maruta ṛṣṭimanta âpa iva sadhryaṅco dhavadhve || (V.60.3)

‘Hey *maruts*! When you start playing, even the ancient big mountain fears your sound. The lofty regions of the sky tremble. Carrying spears you rush together like a stream of water.’

The comparison *âpa iva* in the above verse, should put to rest doubts about *maruts* being agents of rainfall. Their stormy shower was only *like* a water stream. Bhâradwâja Bârhaspatya in hymn (V.66) describes *maruts* as *samânam* in the first verse. Sâyaṇa comments, *maruts* are always of the same form (*marutaḥ sadâ samânarûpâh*) and quotes *RV* (V.60.5) to emphasize that there are no elders and youngsters among them (*ajyeṣṭhâso akaniṣṭhâsa ete*). The next verse mentions that *maruts* shine like fires and increase by two and three. They are dustless and created with gold, wealth and power. The *MPRV* meaning for the word *girayaḥ* in (VI.66.11) as clouds unnecessarily negates the above realistic description of *maruts*.

The lauds to *maruts* in the seventh book by Vasiṣṭha are similar to the hymns by other seers. ‘May your weapons be far from us’, is the constant prayer (VII.57.4). The birth of *maruts* was with great commotion. They were fast, fierce and wrathful. The whole world was afraid to look at them during their brightened travel (VII.58.2).

In the eighth book there is some further interesting information about *maruts*. The seventh hymn describes *maruts* in the same way as in other books, but is emphatic on the hills and peaks getting physically affected. Like hills control themselves (bend) at the arrival of *maruts*, even rivers control their flows (8.7.5). This meaning is acceptable to Sâyaṇa also. If *maruts* brought in the yearly seasonal rainfall, a river being controlled reads anomalous. The last three verses of this hymn show that *maruts* should have been extra terrestrial objects hitting hill peaks. These were thought to be connected with a celestial object, referred by the generic name *agni*.

girayûcinni jihate parûânâso manyamânâḥ | parvatâûcinni yemire ||
âkṣṇayâvâno vahantyantarikṣeṇa patataḥ | dhâtârah stuvate vayah||
agnirhi jâni pûrvyaûcchando na sûro arciṣâ | te bhânubhirvitasthira ||
 (VIII.7.34-36)

‘(As the *maruts* arrive) hills get hit and disturbed from their position. Even mountains are controlled. Speedy carriers bear the flying *maruts* through space. They are givers of riches to the worshipper. *Agni* was born previously (among gods) bright like the sun. Then the *maruts* stood surrounding him with their lights’.

The above rendering closely follows Sâyaṇa, with the word *girayaḥ* here being taken as hills by him also. The word *âkṣṇayâvâno* is explained by Sâyaṇa

as traveling faster than the eyes. There is one more hymn lauding *maruts* in the eighth book by Sobhari Kânva. In this we find a reference to *maruts* disturbing islands and deserts (VIII.20.4). Further (VIII.20.13) informs that even though *maruts* are many and extend widely like a sea, they are known by only one name as per ancestral tradition. In (VIII.20.17), *maruts* are qualified as sons of Rudra (*rudrasya sūnavah*) and as *asurasya vedhasah*. The word *asurah* is explained by Sâyaṇa at many places as ‘one who throws’, derived from the root *asu kṣepaṇe* (to throw). However in the present verse he interprets *asurah* as creator of clouds, which hardly fits the context. The direct meaning of one who throws (stones/missiles) is appropriate for *maruts*, since the falling objects would have been like stones.

In the tenth book hymns (X.77 & 78) are devoted to *maruts*. These appear to have been composed after the status and position of *maruts* in the sacrifices had been finalized. Oblation to *maruts* is mentioned in (X.77.7), which is not so conspicuous in the other books of *RV*. An interesting technical simile describes the motion of *maruts* as, ‘like the nave of a wheel with spokes’ (*rathânâma na ye arâḥ sanâbhayah* / X.78.4). Sâyaṇa explains this clearly as; even though *maruts* are several, they move equally spaced like spokes connected at the center of a wheel¹⁰. The descriptions of *maruts* in the various hymns are broadly similar, with minor differences which indicate repetition of the same natural event with variation in the details. Inducing rain is not the main function of *maruts*, as assumed by Sâyaṇa. Relation with water is a minor detail mentioned in the 5th book, but otherwise the majority of the hymns uniformly describe *maruts* as a collection of bright objects moving in swarms, appearing even in day times. They made a characteristic sound inducing fear in men. They were known to bring stones hitting the hills and the ground. At least once they created a crater with water for Gotama. This poetic but nevertheless realistic description can not possibly be valid for any event other than a cluster of meteorites or fragments of an asteroid hitting the earth.

VIBHÂVASU

Our study of the word *dhûmaketu* shows that this fire in the sky was closely related with *maruts* and *vibhâvasu*. From a detailed discussion of *RV* text it is seen that *maruts*, beyond reasonable doubt, would have been showers of meteorites. Since comets and meteor showers can have causal connections, it appears that *vibhâvasu* in some places of *RV* can refer to a comet. This word

is interpreted in the tradition of Sâyaṇa as *fire* qualified ‘as wealth of the night’, which is the literal meaning obtained by breaking the word into its two components *vibhâ* and *vasu*. Even in this sense it retains in its name a significant comet image. The word *vibhâvasu* occurs in the first (I.44.10), third (III.2.2) and the fifth (V.25.2,7) books. Next it is used five times in the eighth book (VIII.43.32; VIII.44.6, 10, 24; VIII.93.25). It appears twice in the ninth (IX.72.7; IX.86.10) and thrice in the tenth (X.92.1; X.118.4; X.140.1) books.

In the second verse of the *agni-vaiúvânara nivid* (III.2) by Viúvâmitra, the birth of *agni* is described. As per Bṛhaddevatâ, *nivids* indicate the qualities of the deities addressed in such hymns. *Agni* is here described as brightening heaven and earth at his birth. He is qualified also as *viúâm atithiḥ vibhâvasuḥ*. This is taken as ‘guest of men, affluent in radiance’. Since the word *vis* means *maruts* in several other places, here also the *agni* referred must be related with *maruts*. According to *BD*, *vaiśvânara* is fire in the sky, *jâtavedas* fire in the mid-space and *agni* the fire on earth. In the 14th verse, the prayer is to the fire seen ‘at daybreak, emblem of the sky, a big horse’ (*uṣarbudham divaḥ ketum mûrdhânânam vâjinam brhat*). The implied meaning of the hymn is that, *vibhâvasu* was a horse-like fire seen in the eastern sky early in the morning (*rochanasthâm*). This leads to the inference that the word here stands for a comet.

In (V.25.2) the reference is to the fire praised as *vibhâvasu* who was kindled in the past by gods and seers. In (V.25.7), *agni* is again addressed as *vibhâvaso*, because from him riches come out. In (V.25.8), this fire is lauded as self effulgent in the sky, making thundering sound and ‘is said to be like a huge rock’ (*brhat grâveva ucyate*).

The next use of *vibhâvasu* is in the eighth book. The two hymns VIII.43 and VIII.44 on *agni* by Virûpa Âṅgiras, were previously discussed while investigating the word *dhûmaketu*. This fire is described as famous *vibhâvasu*, destroying darkness with increasing brightness like the sun (VIII.43.32). In the hymn VIII.44 the word is used three times, one of which *dhûmaketum vibhâvasum* (VIII.44.10) was discussed already. *Agni* is referred as multi-coloured *vibhâvasu* (*citrabhânûm vibhâvasum* VIII.44.6). In (VIII.44.24) *agni* is praised to be the abode of riches and called *vibhâvasu*, which can mean ‘lord of light’. The first use of the word in the 10th book (X.92.1) in association with *agni* called *vṛṣâketu* was discussed already above. The use of the word *vibhâvasu* in *RV* (X.118.4 & X.140.1) qualifies the sacrificial fire in a prayer. There is no direct celestial connection for the fire invoked in these hymns.

FURTHER COMET IMAGES

The present study started tracing the object *dhûmaketu* and it was found that this was closely connected with *maruts* and *vibhâvasu*. This necessitated a study of these two deities to find that there is a strong case for correlating *maruts* with recurring meteoritic showers rather than with the traditional rainstorm gods. A new question arises out of this identification of *maruts* as meteors. This is about *Indra*, the premier Vedic deity, described as being intimately connected with *maruts*. Some acts of *Indra* are very similar to those of *maruts*. However, it is possible *Indra*'s power as a celestial entity is more in the sense of an unseen and hence great divine force and comparatively less as a visible physical object. Nevertheless, *Indra* appears like a visible celestial figure (zodiacal light?) in many places of *RV*. *Indra*'s position is known to have got reduced to that of a rain-god in later Sanskrit literature. Perhaps this made *maruts*, the constant companions of *Indra* to be equated with winds. We side step these issues, since our present focus is on comets, one of which, the fire called *dhûmaketu*, appears only in the later books of *RV* (I, VIII & X). However, there are distinct references in the other books to an ancient fire in the sky related with *agni*, *vaiûvânara*, *mâtariûvan*, *arvan*, *ajaiikapât*, *ahirbudhnya*, *pûsan* and other deities. Hence, in the earlier layers of *RV* transient celestial objects seem to have been described using other nomenclatures. The only way to address this issue is to see how likely such celestial fires match with known modern comet and/or meteor images. To keep the discussion brief, only three such hymns are considered here.

The famous hymns (I.162 & I.163) on *Aśva* by Aucathya are traditionally taken to refer to the Horse-sacrifice (*Aśvamedha*). But these hymns primarily describe a bright horse-like moving object in the sky¹¹. In hymn (I.162), the celestial horse, a replica of which is sacrificed in the *Aśvamedha* is described. This is the *medhyâûva* (sacrificial horse) born out of *tvastâ* (I.162.19). This particular verse has two meanings referring to both the divine horse which was killed by gods and the terrestrial animal which is to be similarly sacrificed by men. *MPRV* quotes the *Taittiriya Saṃhitâ*¹² to clarify the close relation ship between *tvastâ* and *arvan*.

The above deity called *arvan* was the first born in the sky, making sound, with wings of falcon and ankles of deer (I.163.1). This horse given by *Yama* was harnessed by *Trita* for *Indra* to ride. Here the word *Yama* is interpreted in the *Nirukta* as *agni*, which as per *Sâyaṇa* would indicate the simultaneous birth of *agni* and *Indra*. In (I.163.3) this *arvan* is said to be threefold with three bonds

in the sky (*trîṇi divi bandhanâni*). Sâyaṇa likes to take these three bonds to be similar to the three ropes with which an earthly horse is held¹³. Further, the *RV* poet describes the sequence in which he saw the horse. In (I.163.5) he says; ‘I saw your reins’ (*te bhadrâ raúanâ apaśyam*). Next the poet saw the head of this horse. MPRV reports two types of arranging the words of (I.163.6), to yield meanings applicable to the earthly horse and the heavenly horse respectively. In the derived meaning, the horse is said to be going from the earth by way of heavens to the sun. The primary meaning is; the poet in first person says that ‘he saw the head of the horse in the sky flying down towards the earth’ (*divâ avalḥ patayantam patatri. sírahḥ apaśyam* || 1.163.6). This is continued in the next verse to inform: ‘I beheld your best form at the cow’s foot’ (*te rūpam uttamam apaśyam. â pade goḥ*). Sâyaṇa takes the word *goḥ pade* to mean the sacrificial place on earth, which is the secondary meaning of the hymn as per the sacrificial tradition. However, primarily for an object seen in the sky it should have been natural to mention its location with respect to the stars and hence one should take ‘cow’s-foot’ as the *nakṣatra* with that meaning which is *proṣṭha-pada* (Pegasi). Reference to this location appears again in *RV* (III.39.5 & IX.71.5). The hymn which so far described a single object, refers to multiple celestial horses in the next verse (I.163.10) comparing their flight to that of a line of swans (*hamsâ iva úreṇiśo yatante*). This picture is a plain indication of bright meteorites flying like birds in a line. This simile is again used in (III.8.9) to describe the arrival of *yûpâḥ*, the sacrificial columns of gods in the sky, which has an inbuilt comet image.

The 48th hymn in the 6th book is about *agni* and *maruts*. The sixth verse in this hymn describes the sight of ‘*agni* moving in the night sky along with smoke. He with attractive colours becomes visible pushing aside the darkness and stays through the night (*dhûmena divi dhâvate... úyâvâsu úrmyâsu tamaḥ tiraḥ â dadṛúe*). From (VI.48.11) onwards *maruts* are praised to bring riches from above. In (VI.48.21) the poet mentions that *maruts* cover the sky with their brightness like the sun and are the cause of killing *Vṛtra*. The last verse mentions that the earth and the sky got created only once. Similarly the milk of *prśni*, namely *maruts*, showered only once. *Prśni* is the night sky dotted with stars, compared to a spotted cow. This hymn is inspired by a special sky event to sing a prayer to *agni* and *maruts*.

The hymn to *Kesîns* (X.136) embeds definite comet imagery. This is about bright, long hairy objects in the sky. However, the hymn also reflects deeper

mystical and philosophical thoughts. This hymn has the earliest reference to the concept of *vâtaraiçanâh*, which in later *siddhântic* astronomy became the invisible air-strings of force holding the planets in their position. This hymn perhaps indicates a cosmic view emerging out of traditional knowledge and new observations. Further discussion on this hymn is beyond the scope of the present study.

SUN COVER

The above analysis, even though limited in extent, makes a case for the ancient seers to have witnessed some spectacular events in the sky. Some of the *RV* hymns are inspired from direct observations and some others contain legendary information transferred from previous generations. The hymns considered here, taken together, may be said to represent a disturbed sky, unlike the present day calm skies. But, the description of the purported effects of the transient sky objects on earth is quite intriguing. Furthermore when the hymns express distress it would appear that the community had to face some unexpected adverse climatic conditions due to the disturbed sky. This is not a far fetched inference when it is noted that in several hymns the physical sun is said to be covered by some type of dust, so much so there was no day break for considerable length of time. There are too many hymns and legends about this event for one to ignore the absence of sunlight as a poetic license to describe the dark night of the human soul or as the prolonged winter at northern latitudes.

In *RV* (1.51.4) Indra is said to have established sun after destroying *Vṛtra*. In *RV* (1.86) *maruts* are prayed to remove the darkness and create the light for which people were longing. Hymn (I.175) is about Indra stealing Sun's wheel, which is a euphemism for the absence of normally expected rise, movement and setting of the sun. Hymns (1.183 & 184) refer to the ending of a period of darkness. In the second book hymn (II.15) is about Indra crushing the vehicle of *uṣas*, which is a metaphor for a continuous dawn like condition without a visible sun. Indra had to be supplicated by men who struggled to get sunlight (II.19). Indra found the sun dissolving in darkness near the cow's-foot (*sûryam viveda tamasi kṣayantam* / III.39.5). In (IV.16.9) Indra is implored in the battle for sunlight. Indra is said to have hurt *uṣas*, daughter of the sky, near River *Vipâûa* (IV.30.9-11), which refers to absence of day break. This event is recounted in a slightly different form in the tenth book in hymn (X.138). In hymn (V.31.11) when the night was ending, sun's wheel is said to have gone backwards. This is again

a reference to absence of day break and nonexistence of observable sun's movement across the sky. Even though the temporal ordering of the various events is left in doubt, the metaphoric texts lead one to perceive anomalous climatic conditions preceded by uniquely spectacular celestial events. *Maruts* should have had an important role to play in these natural events, since they are said to reduce heat and conduct a sacrifice in the heavens (V.54.1). In (V.59.5) the poet says that *maruts* are capable of blocking the sun by their showers (*sūryasya cakṣuḥ pra minanti vṛṣṭibhiḥ*).

This has been routinely taken, by many translators, to be a cloud cover during a rainy day. However, this interpretation does not match with the immediate next verse, which refers to a special event in the sky.

'Like line of birds they flew in lengthened lines from heaven's ridges to the borders of the sky. *Rudra's* children are all similar with none younger or older'. (V.59. 6, 7)

The above could have been a wide meteoritic ring or trail of a comet obstructing the sun's orb being seen from the earth. In (VI.7.5) *vaiúvânara* is praised to have freed and set the sun in the sky for all to see. A similar statement occurs in (X.156.4) mentioning that *agni* has made sun mount the sky. Several hymns to Indra are prayers for sunlight or laudation after sunlight was restored. In (VI.17.5) Indra gives splendour to sun, which had been lost. In *RV* (VI.39) the reference is to a light called *indu* which brightened the worlds that were not shining. Reference to the widespread abnormal darkness appears in one form or other in several places of *RV*, with its all pervasive cosmological, philosophical, mystical and religious influence spread all through the later Vedic texts¹⁴. Some hymns of *RV* praise Indra for having given light to sun as in (VIII.3.6). A few others (VIII.12.30, VIII.89.7) laud Indra for having fixed sun in the sky. In the hymn (X.37) dedicated to sun, the general prayer is; 'May we never suffer from want of sun's presence', which is similar to the verse (II.33.1) from an earlier strata of *RV*. One of the most cryptic descriptions of the sun being covered up is in the seventh book,

*tânîdahâni bahulânyâsan yâ prâcînamuditâ sūryasya /
yataḥ pari jâra ivâcarantyuṣo dadṛkṣe na punaryatîva ||* (VII.76.3)

'Many days were over before the old sun rose again. In this period Uṣas was seen behaving like a maiden with her lover'.

The above is a plain statement that once, there was a long gap between dawn and sun rise. It also implies that the Vedic seers considered this period to be *uṣas* or dawn only. Since nothing is said about the nights, it is conjectured that they could recognize the passage of time as implied in the key phrase *ahâni bahulâni* (many days). The immediate next verse (VII.76.4) mentions about the ancestors of the poet rejoicing after discovering the hidden light of sun. This incident and the above verse are the basis for all later legends associating *Prajâpati* (Creator) with *Uṣas* (his own creation figuratively called daughter) as in the Vedic *Brâhmaṇa* literature¹⁵.

GEOGRAPHICAL MARKERS

There are several geographical locations mentioned in *RV* correlated with *maruts*. In the first book hymn (1.186) mentions *maruts* to be flying over *Iriṇa* with their sparkling missiles. *Iriṇa*, a place or a region named six times in *RV*, is traditionally translated as desert. Later Vedic texts identify *Iriṇa* with disaster. Recently it has been shown that this region, during the time of *RV*, should have been spatially contiguous with the present day Rann-of-kutch¹⁶. The spatial extent of the spread of *maruts*, even if these were to be at different periods of time, appears quite wide. In (V.52.9) *maruts* are described to crush the hills near River *Paruṣṇî*, which is identified with River Ravi in Punjab. In book eight we read

suṣome úaryañâvatyârjike pastyâvati | yayuḥ nicakrayâ narah || (VIII.7.29)

Maruts went downwards to *Suṣoma*, *Rjika*, *śaryañâvati*, full of dwellings.

This verse has clear geographical information about where *maruts* were supposed to have gone prior to the composition of this hymn. Sâyaṇa takes this to be the *Rjika* country, full of *Soma* (plants), where *Úaryañâvatî* was a lake. This is in line with Vedic tradition where the Horse's head was hit by *vajra*, the weapon of Indra¹⁷. *Maruts* are addressed in the past tense and one gets the impression that the poet is referring to past events in this laudation. In *RV* (X.75.5) *Ârjikâ* and *Suṣomâ* are listed along with a river named after *maruts* as *Marudvṛdhâ*. These rivers are generally identified to be in Punjab. In *RV* (V.52.17) *maruts* are connected with river *Yamunâ*, which almost surely would not have been following the course of the present day river of the same name. *Maruts* are also mentioned linked with rivers *Sindhu* (Indus), *Krumu*, *Kûbhâ*, *Sarayû* further north-west of greater India. A wide region is covered if the connection between the *maruts* as showers of meteoritic objects and the river names are taken

together in a physical sense. Precise delineation of the region is difficult without some logical basis for organizing the *RV* hymns chronologically. An interesting reference in this regard is to the famed River Sarasvatī. In *RV* (II.30.8) this river is said to have been followed by *maruts*. In the famous prayer to Sarasvatī by Vasiṣṭha, first the river is addressed *asuryâ* and in the next verse her friends are said to be *maruts* (VII.96.1, 2). The word *asuryâ* has been rendered in several translations as *divine*, but the connection with *maruts* indicates the epithet to be a physical description of the flowing river affected by *maruts* who were always called *asurâḥ* or throwers (of stones). Significantly, in the tenth book (X.17.8-9) goddess Sarasvatī is invoked seated in the same chariot as the ancestor deities. This certainly means the river was treated as dead, which, in the language of *RV* should have been after frequent sightings of *maruts* in the visible sky above the River Sarasvatī.

CHRONOLOGICAL FOOTPRINTS

The late usage of the word *dhûmaketu* has chronological significance for understanding the development of astronomy in ancient India. The word *dhûmaketu* for a transient celestial object in the *Ṛgveda* and the *Atharvaṇa-veda* is in harmony with the use of the word to indicate a specific comet by Parâûara as quoted by Utpala (10th century AD) in his commentary on the *Bṛhat Saṃhitâ*. This acquires significance since, names of some of the Vedic deities (*devatâ*) coincide with the names of comets and other non-planetary objects described by Parâûara, Vṛddha-Garga, Nârada and Varâha-mihira who have left records of scientific literature prior to the development of mathematical (*siddhântic*) astronomy in India¹⁸. Parâûara knew twenty-six comets (*Ketu*) long before Varâha-mihira stated them in the wrong order in his *Bṛhat Saṃhitâ*¹⁹. The last comet of this list was called *dhûmaketu*. The text of Parâûara preserves a tradition originating around 1400 BC, but records a list of twenty-six comets with names and year numbers going back in time for nearly 1300 years. The most conservative dates for *RV* agree that the canons were closed, including the late 8th and the 10th books, by 1500 BC. 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 *RV*. Parâûara and subsequently Vṛddha-Garga had more things to say about comets. These conspicuously included their specific names, year number, position in the sky, movement, colour, visibility, duration, and effect on earth. They also

classified meteors (*ulkâ*) into five types. They proposed the existence of a dark object called Râhu as the cause of both solar and lunar eclipses, already known to the *Atharvaṇa Veda*. They were aware of some periodicity in the occurrence of eclipses, even though their values lacked clarity. However their writings about planets were comparatively elementary and incomplete. Parâúara, Vṛddha-Garga mention that a *graha* (grasper) called Tvaṣṭâ can darken sun and moon at odd times²⁰. Varâhamihira, a votary of mathematics for predicting eclipses, severely criticized Parâúara for his eclipse divination methods, but was obliged to retain the above legend in the *Bṛhat Samhitâ*. We conjecture that strong belief in the possibility of such a strange event should have been in the collective memory of the community since the start of the *Ṛgveda*. This pattern has a parallel in the Vedic literature also. In all the ten books, direct and indirect references to the battle between Indra and Vṛtra, son of Tvaṣṭâ for reestablishing the light of sun can be found. The release of waters of *RV* is most probably the *samplava* (Flood) of Parâúara, from which his tradition counts sequentially the years for the appearance of twenty-six comets. In *RV* there are a group of hymns which relate meteoritic showers, celestial fires and at least a few comets with names. Interestingly, *maruts* and correlated sky objects do not refer to the moon directly. References to the moon, months, intercalation and the lunar number 3339 probably belong to another strata of *RV* coming after the havoc caused by *maruts* and the consequent climate alteration effects subsided. It is demonstrated elsewhere that the above number 3339 is the 18-year eclipse period associated in *RV* with the moon and a total lunar eclipse²¹. 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 and later the *Vedâṅga Jyotiṣa* which is an algorithmic calendar. Planets, called *târâ-graha* (star-grasper) were known, but had not yet attracted great deal of attention. The *Atharva-veda pariśiṣṭa* a late book compiled in the last centuries of the first millennium BC names them. This indirectly shows the Vedic people were more intrigued by the infrequent occultation of stars, by the moon and the planets which in course of time would have lead to a qualitative picture of the movement of planets. The tradition of Parâúara running parallel to the Vedic compositions had visibility knowledge with numbers about Venus, Jupiter, Saturn and Mercury, but only verbal description for Mars. This topic is a subject for further investigations.

DISCUSSION

It is well known that *Agni* and *Indra* are the most important deities of *RV*. This is true, not only in a statistical sense, but also in terms of the importance they have carried through in the Vedic rituals and literature devoted to the elucidation of *RV*. Even though the original *agni* of *RV* was clearly celestial, the sacrificial *agni* which is terrestrial assumed greater significance in the traditional (*yājñika*) interpretation of *RV* by Sâyaṇa and others. The reasons for this are not difficult to find. The Vedic religion of *yajña* on earth is a replica of what the gods did once upon a time. This *yajña* of the gods was of celestial origin with its effects reaching the earth. Hence it was of profound cosmological import to the founders of the Vedic religion and philosophy culminating in the *Vedânta* or the *Upaniṣads*. There are several instances in the *Vedas* where this point is stated either metaphorically or directly. In the second book (II.21.5), Usîjs (Añgirasas) are said to have found the path by means of *yajña*. The allegorical reference is to the overthrow of Vala to get the waters released. *RV* hymn (VIII.89) by Nṛmedha and Purumedha (Añgirasas) is about Indra supported by *maruts* as a group. In (VIII.89.5, 6) the principle of *yajña* is said to have originated when Indra spread between the earth and the sky for killing Vṛtra. This *yajña* of gods had a corresponding sacrifice on earth also, which in modern parlance could perhaps be called a natural disaster. *Maitrâyaṇî Saṃhitâ* mentions that gods did a sacrifice at Kurukṣetra²². This is confirmed with further elaborations in the *Taittirîya Âraṇyaka*²³. *Taittirîya Brâhmaṇa* categorically states, *maruts* killed Prajapati's creatures because they (*maruts*) were not initially worshipped by the people. Prajâpati (Progenitor of people) had to behold a particular offering and present it to *maruts* in order to save his creation²⁴. A similar statement occurs in the same text about *maruts* disturbing the work of Prajâpati²⁵. Since *RV* is the earliest among the *Vedas*, other texts derive inspiration from *RV* for their contents and practices. Thus Vedic literature has sufficient evidences for us to infer that sacrifice by the gods through the agency of meteoritic storms called *maruts* in *RV* should have depleted the population in the northern parts of ancient India. *Nirukta* (XI.13) explains the word *marut* derived variously from the roots *mi* & *ru* as measured sound, or from *mi* & *ruc* as measured brilliance or from *mahad* & *dru* as having great movement²⁶. However, the main action of *maruts* had been to kill. Hence derivation from the root *mṛ* (to smash, to pound, to die) as pointed out by Max Mueller would be appropriate²⁷.

The present study started by tracing the word *dhûmaketu*. In the sequel *maruts* and *vibhâvasu* were found to be intimately connected with the fiery *dhûmaketu*. *Vibhâvasu* 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, *vibhâvasu* 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 stone throwing demons (*asurâ*), 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 cluster or group (*gaṇa*), unlike undifferentiated masses of clouds or sheets of water. The *Śatapatha Brâhmaṇa* explains that *maruts* are *viś* the groups (or clans) and clans means abundance^{28, 29}. The perception of the *RV* composers (e.g. 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 *Taittiriya Brâhmaṇa* declares this more explicitly; ‘*maruts* are the most numerous among the deities’³⁰.

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 that the shower of stones may avoid the worshippers of *maruts*. The third layer contains hymns wherein *maruts* are invoked to arrive at a 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 (*sanâddhi vo ratnadheyâni 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 the meaning of *maruts* as wind deities in later literature. We guess, 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 *vâyû* are the independent rain and wind deities in *RV*. One reason for this mismatch should be the absence of recognizable Indra and *maruts* in the skies. Evidence for the evolution of the concept of Indra from the concrete to the abstract is found in *RV* itself. In the hymn (VI.21.4) the poet wonders

Where the famous Indra is now located? Where he travels, among what people? Indra! What *yajña* satisfies you? Which hymn helps to attain you and who is the person capable of invoking you?

In (X.54.2) the composer says that Indra's battle was an illusion and he had no foes either in the past or at present. Similarly in hymn (V.74) the poet sings, 'where are *aśvins* to be seen in the sky today', indirectly suggesting the invisibility of another celestial object closely connected with *agni*, Indra and *maruts*.

The later Vedic texts corroborate the above points, since they essentially describe invocations and offerings to *maruts*. The *Taittirīya Brâhmaṇa* which, as already pointed out 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 remembered³¹. It also associates a season with *maruts*, namely the *hemanta ṛtu* the dewy season which is the two month period ending with the winter solstice³². It is most likely; *maruts* were thought to originate from a particular object or constellation in the sky, called *Rudra*. It is tempting to speculate that this *Rudra* may refer to the planet Mars. Mars is not only red but has for its regent deity *Skanda*, son of *Rudra* in later Hindu tradition. In many hymns of *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 Âraṇyaka* differentiates *rudra-gaṇa* from *marut-gaṇa* and mentions that the first appear in the *grīśma-ṛtu*, the two month season ending with the summer solstice before the rainy season starts. The latter appear in the *hemanta-ṛtu*, as in the *Taittirīya Brâhmaṇa*. The commentators mention that both are sky deities appearing in the respective seasons. *Rudra-gaṇa* is described as being white robed and recurring with the summer season³³. The second group appears red with anger as though ready for battle in the dewy season³⁴. It is easily recognized that both should be 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 easily observed meteor showers, which once caused destruction on land.

This raises the question whether *marut* was a generic word for all types of meteoritic activity or it referred to particular types. This can not be answered definitively at present. *Ulkâ* the popular word for meteorite in classical Sanskrit

is already in use in *RV*. This word in plural occurs in (IV.4.2) where *agni* is asked to cast his firebrands (meteors) around. Again *ulkâ* significantly appears in the singular in (X.68.4) where a meteor is said to be cast down from sun. The group nature that is special to *maruts* is absent in the occasional meteor called *ulkâ*. 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 *Ṣaḍvimûa Brâhmaṇa* further brings in new events *târâvarṣa* or star-showers, and *dig-dâha* meaning blaze of the cardinal directions or zodiacal light in addition to *ulkâ* and *ketu*.

Even as early as Yâska (*c* 700 BC) it was accepted that *RV* text is intended to be interpreted in three different levels of perception. This was the tradition inherited by Yâska and this is how we have to proceed to understand the influence of *RV* on later religious, cultural and intellectual developments including the origins of Hindu astronomy. The three types of meanings arising out of the above perception are denoted as *adhiyajña*, *adhidaiva* and *adhyâtma*. The first is the sacrificial interpretation, the second refers to the gods or deities (*devatâ*) of the sky or the cosmos and the third is the mystical meaning. Thus when a particular *RV* hymn is prescribed for use in a major sacrificial ritual, it would be futile to ask why the hymn does not describe the performance of that sacrifice by humans. What has to be wondered is whether the *RV* hymn contains mention of sacrifice (*adhiyajña*) by the celestial deities (*adhidaiva*) with mystical meanings (*adhyâtma*). Over centuries the rituals have attained a steady state as seen in the *Brâhmaṇa* and the *Sûtra* texts with the background sky observations rarely mentioned or assumed to be known to the priests. It is the *adhidaiva* interpretation that provides some clues to understand the Vedic sky.

MODERN PERSPECTIVE

Only a small sample of *RV* hymns is 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 calamitous natural events attributable to meteoritic showers, comets, dust veils and possible climate alteration for an extended length of time. Evidence for a severe natural disaster to have occurred in ancient India is available also in the *Mahâbhârata* and the *Skânda Purâṇa*³⁵. Memories of an ancient calamity, most probably overlapping with the Vedic narration, are strongly preserved in the above texts. The Vedic literature also carries some indication of the distressed

state, but not in the same way as it preserves the celestial spectacles. In the Vâlahilyam hymns of *RV* two significant verses (VIII.66.14-15) hint at distress in the community³⁶. The negative famine deities, *Śuṣṇa*, *Uraṇa* and their defeat at the hands of Indra also seem to have hidden climatic significance. The *Chândogya Upaniṣad* remembers that the people of Kuru land were once killed by a shower of stones and due to non-availability of food Uṣasti Cākṛâyaṇa had to stay in the village of elephant trainers³⁷.

In recent years scientific evidence for near earth objects to have impacted earth in the past has been growing. It is known that the path of the Taurid group of extra terrestrial objects consisting of meteors, meteoroids, asteroids and Comet Encke intersects the orbit of the earth making earth vulnerable for impacts from extra terrestrial 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 has split severally to disintegrate and leave a trail of debris causing dust veils that could have temporarily blocked sunlight reaching earth^{38,39}. Thus, the Ṛgvedic descriptions of *maruts* killing people on earth, birth of *agni* and the Horse in the sky, *Vṛtrâ* covering the sun, Indra restoring sunlight, breaking down of Viúvarûpâ son of *Tvaṣṭâ* 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 3-4 millennium BC or earlier.

SUMMARY AND CONCLUSION

The possibility of the *Ṛgveda* describing observations of comets and meteor showers is studied in this paper. This presents a novel approach for deciphering the Vedic sky. First, the seven hymns mentioning the word *dhûmaketu* are analyzed to find that in all except one place this word figuratively stands for a transient celestial object. This is followed by studying two other important Vedic deities namely, *maruts* and *vibhâvasu* with which *dhûmaketu* is closely connected in the hymns of *RV*. A fairly detailed study of hymns devoted to *maruts* brings out the fact that these are group (*gaṇa*) deities representing meteors. *RV* describes picturesquely swarms of meteors and meteorites approaching earth making rumbling sound and shaking the mountains. At one place significantly *vibhâvasu* is described to be a huge rock. In several places *maruts* are described as hurling stones. Ritualistic Yajurveda texts mention *hemanta ṛtu* (autumn) as the season for the

appearance of *maruts*. The *Taittirîya Âraṇyaka* prescribes observations for identifying the six seasons. Prominent among these are the sky deities *rudragāṇa* appearing in summer and the *marudgāṇa* appearing six months later in autumn. This hints that the Taurid complex was the most likely causative agent in the *Yajurveda* period since even now the two branches of the Taurid meteor shower appear in May-June and November-December. The later Vedic texts also declare that once upon a time people got killed by *maruts*. These points reinforce the conclusion that *maruts* in *RV* represent meteoritic showers and not thunder storms of the rainy season.

The origin and development of Indian astronomy before the *siddhânta* period is not well explored and much less understood. Some historians of astronomy like Pingree⁴⁰ have expressed their personal conclusion that the subject originated outside India. Such erroneous conclusions are drawn by ignoring archaic astronomical observations and evidences in the Vedic literature starting with the *R̥gveda*.

ACKNOWLEDGMENT

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NOTES AND REFERENCES

1. *Atharvaṇa Veda* (XIX.9.7-10): *Úam no bhûmirvepyamânaḥ úamulkâhatanca yat/ ...úamno grahâhcândramasâh úamâdityaúca râhuṇâ/ úamno mrt'yurdhûmaketuḥ úam rudrâh tigmatejasah ||*
2. *Kausîka Sûtra* (127.1): *atha yatraitaddhûmaketuḥ saptarṣîṇupadhûpayati tadayogakṣemâúankamityuktam ||*
3. *R̥gveda Samhitâ*; edited by a group of ten scholars, published by the Mysore Palace, 1950. This thirty-six volume series in Kannada script is complete with *Samhitâ* and Pada Pâtha, Khila, Anukramani, R̥gvidhâna and other ancillary texts to follow *RV*. MPRV includes the texts and commentaries on the Aitareya Brâhmaṇa, the Bṛhaddevatâ and the Nirukta which are indispensable in understanding the tradition of *RV*. The editorial board included traditional and modern scholars. The editors indicate where Sâyaṇa's commentary is vague and not accurate enough. Similarly they point out several serious mistakes in the interpretation of a few well known western writers.
4. *Amara Kośa* (3rd Book, *Tânta Varga*): *agniyutpâtau dhûmaketû ||*
5. *Ṣaḍvimûa Brâhmaṇa* (VI.9.2): *atha yadâsya târâvarṣâṇi colkaḥ patanti nipatatnti dhûmâyanti/ diúo dahyant, ketavṣcottiṣṭhanti.....ityevamâdini tânyetâni sarvâṇi somadevatyânyadbhutâni....||*

6. *Bṛhaddevatâ* (1.67): *ihâgnibhûstastu ṛṣibhirloke stutibhirîli?taḥ | jâtavedâ stutomadhye stuto vaiûvânaro divi||*
7. *Bṛhaddevatâ* (II.31): *vidyate sarvabhûstairhi yadvâ jâtaḥ punaḥ punaḥ| tenaiṣa madhyabhâgendro jâtavedâ itistutaḥ ||*
8. Vṛddha Garga quoted in the *Adbhuta Sâgara* of Ballâla-sena: *patanti gagane colkaḥ sanirvâtâ diûo daûa| sajavâlângâradhûmâdyâḥ sûryasyâbhimukhâ iva ||*
9. *Nirukta* (IV.19): *vâsibhi aûma mayibhiḥ iti vâ| vâgbhiriti vâ||*
10. Sâyaṇa's commentary on *RV* (X.88.4): *rathânâm na rathacakrânâmivârâḥ te yathâ bahavo'pi sanâbhayaḥ samânanâbhayo bhavanti tadvadye sanâbhayaḥ samânabandhanâ ekasminnevantarikṣe vartamânâḥ ||*
11. Birth of the celestial Horse in the *Mahâbhârata* (Âdi Parvan 66.36 & 180.22):
tvâṣṭrî tu saviturbhâryâ vaḍavârûpadhârinî | asûyata mahâbhâgâ sâ'ntarikṣe aûvinâvubhau ||
mahat hayasiro bhûtvâ yattad vedavido viduh | tamagnim udgiran vaktrât pibatyâpo mahodadhau||
12. *Taittiriya Saṃhitâ* (V.1.11): *tvâṣṭâ vîram devakâmam jajâna tvâṣṭurarvâ jâyata aûuraûvaḥ||*
13. *Taittiriya Saṃhitâ* (IV.6.7): *âhuste trîṇi divi bandhanânî |*
14. *Tai.Saṃh.* (1.5.7): *citrâvaso svasti te pâramûyetyâha râtrirvai citrâvasuravyus?tyai vâ etasyai purâ brâhmaṇâ abhâiṣurvyuṣṭimevâvarundhe ||* This is about the Citrâvasu hymn. It is said that in ancient times the sages feared that they may not see the dawn again (sun may not rise at all). By the Citrâvasu hymn they won the dawn.
15. *Úatapatha Brâhmaṇa* (I.7.4.1-4): *prajâpatirha svâm duhitaramabhidadhyau | divam voṣasam vâ mithunyena yâsyâmiti tâm sambabhûva ||*
16. R. N. Iyengar, B.P. Radhakrishna and S.S. Mishra (2009), *Vedic Iriṇa and the Rann-of-kutch*. Purâtattva, (Indian J of Archaeology) 38, pp. 170-180.
17. *Bṛhaddevatâ* (III.23): *dadhîcaûca úiraûcâûvyam kṛttam vajreṇa vajriṇâ | papâta saraso madhye parvate úaryaṇâvati ||*
18. R.N.Iyengar (2008) *Archaic Astronomy of Paraśara nd Vṛddha-Garga*, *IJHS* 43, 1, pp. 1-27.
19. *Bṛhat Saṃhitâ* of Varâhamihira, Text with Commentary of Utpala, K.C. Dvivedi (Ed.) Sampurnananda Sanskrit Uni., Varanasi, 1996.
20. Parâûara as quoted by Utpala and Ballâla Sena: *aparvaṇI úaûânkârkau tvâṣṭânâma mahâgrahaḥ| âvṛṇoti tamaûûyâmaḥ sarvalokavipattaye||*
21. R.N. Iyengar, 'Eclipse Period Number 3339 in the Ṛgveda', *IJHS* 40.2 (2005) 139-152.

22. *Maitrâyaṇî Saṃhitâ*. (IV.5.9): *devâ vai satramâsata kurukṣetre*||
23. *Tai. Âraṇ*. (V.1.1): *devâ vai satramâsata...teṣâm kurukṣetram vedirâsît| tasyai khândavo dakṣiṇârdhamâsît| tûrghnamuttarârdhaḥ| pariṇajjaghanârdhaḥ| marava utkaraḥ* ||
24. *Tai. Br*. (I.6.2.2 -3-4) : *samvatsaro vai prajapatih| samvatsareṇaivasmai prajaḥ prajanayat| tah. praja jata maruto'ghnan asmanapi na prayukṣateti| sa etam prajapatirmarutam saptakapalamapasyat| | yah purvaḥ prajaḥ asr?kṣi| marutasta avadhisuḥ* ||
25. *Tai. Br*. (1.3.4.4) : *maruto yajṇamajighânsan prajâpateḥ* |
26. *Nir*. (11.14): *maruto mitarâviṇo vâ mitarocino vâ mahadravanîti vâ* ||
27. Max Mueller, *Vedic Hymns, Sacred books of the East Vol.XXXII*. p.24
28. *Úatapatha Brâ*. (III, 9.1.17) *viúo vai maruto bhûmo vai viṭ* ||
29. *Kausitaki Br*. (VII.9.16): *maruto hi vai devavisah antarikṣa bhajanaḥ* ||
30. *Tai. Brâ*. (II.7.10.1): *maruto hi devânâm bhûyistâḥ* ||
31. *Tai. Âraṇ* (I.12.1): *ya eko rudra ucyate| asnkyâtâḥ sahasrâṇi smaryate na ca dñyate*||
32. *Tai. Br*. (II.6.19.2): *hemantaṭunâ devâḥ marutastrinave stutam* ||
33. *Tai. Âraṇ* (I.3.3) *viúeṣaṇamtu vaksyâmah| ṛtûnâm tannibodhata| suklavâsâ rudraganaḥ| | grîṣmeṇâvartate saha | nijahan prthivîm sarvâm* ||
34. *Tai. Âraṇ* (1.4.2) *abhidhûnvanto abhighnanta iva| vâtavanto marudganaḥ| amuto jetumiṣumukhamiva| sannaddhâḥ saha dadrûte ha| apadhvastairvastivarṇairiva| viúikhâsah? kapardinaḥ| akruddhasya yotsyamânasya| kruddhsyeva lohiniḥ| hematah cakṣuṣî vidyât| akṣṇayoh kṣipañoriva* ||
35. R.N.Iyengar, Profile of a natural disaster in ancient Sanskrit literature, *IJHS*, 39.1 (2004) 11-49.
36. *Tai. Âraṇ* (1.23.3): *ye vâlâh te vâlakhilyâḥ* | Also *Tai Saṃ*: (V.3.2.5) *sapta vâlakhilyâḥ purastâd upadadhâti sapta paúcât*. The literal meaning of the word *vâlakhilyâḥ* is: *those fallen from the tail(of Brahma)*. *Purâṇas* describe *Vâlakhilya* as a group of sages of the size of a thumb. They were sixty thousand in number produced from Brahmâ's body. They are said to be near the chariot of the sun.
37. *Chândogya Upaniṣat* (I.10.1) *maṭacî hateṣu kuruṣu âṭikyâsaha jâyayâ uṣastirha câkrâyaṇa ibhyagrâme pradrâṇaka uvâsa*||
38. Clube and Napier (1990). *The Cosmic Winter*. Basil Blackwell, U.K.
39. D.Steel (1995) *Rogue Asteroids and Doomsday Comets* J. Wiley & Sons, New York.
40. D.Pingree, "Indian Astronomy", *Proc. Am. Phil. Society*, 122.6 (1978), 361-364.