

SHORT COMMUNICATION

On Some Comet Observations in Ancient India

R.N. IYENGAR

Department of Civil Engineering, Indian Institute of Science, Bangalore – 560 012

Email: rni@civil.iisc.ernet.in

Abstract: A brief review of the ancient prose text of Parāśara, referring to comets, as transmitted by later non-religious Sanskrit literature is presented. The information passed on appears to belong to 2nd millennium BC or earlier. A sequence of 26 comets with names and purported effects are given. The form of each comet sometimes with its position in the sky is presented vividly. A year number, mentioned as the time interval between each appearance, is also given. The total period covered adds to about 1300 years. The first comet is said to have appeared in the era of the Floods. This would date the Floods to about 2500-2700 BC. Whether this has any historical importance needs to be further investigated. The names of many comets correspond with names of Vedic deities. This raises the possibility of comet sightings being alluded to in the Rig Veda.

Keywords: Comets, Flood, Disasters, Anomalous phenomena, Sanskrit Literature, Ancient India.

INTRODUCTION

A brief note on the tradition of comet observations in ancient India has been presented previously (Iyengar, 2005). Sanskrit literature contains large number of references to comets. These are spread over Vedas, Purāṇas, religious, semi-religious and secular texts. The oldest literary composition namely, R̄gveda seems to contain references to comets, in an archaic mystical style. Mahābhārata and Purāṇas contain graphic and highly personified descriptions of comets. But, the secular writings of Varāha-mihira (5-6 century AD) in Br̄hat-samhita (*abbr:* BS) and of Ballāla-sena (11-12 century AD) in Adbhuta-sāgara (*abbr:* AS) are objective and organized (Bhat, 1981; Jha, 1905). Both the above writers present the knowledge passed on by ancient scholars Parāśara, Vrddha-Garga, Garga, Asita-Devala, and a few others. Surprisingly, no contemporary comet sighting is presented in BS, whereas AS appears to have left one record. The above period saw the peak of mathematical astronomy (*siddhānta*) in the country, when many sky observations were also carried out. However, *siddhāntic* astronomers have largely kept silent about comets. Varāha-mihira is categorical in stating that the orbits of comets are beyond mathematics. But, he had no hesitation in listing the names, forms and effects of comets as prevalent before his time. Ballāla-sena was a king ruling at Mithilā, but his origins were in Karnātaka (Sinha, 1979). He seems to have had a penchant for collecting information on anomalous happenings from all sources available to him. He named

his book aptly Adbhuta-sāgara (Ocean of Wonders). His writing covers all of BS on natural phenomena and much more. His intention was to bring in one place comet-lore prevalent during his time. What could have been the reason for interest in comets by writers such as Parāśara and Vr. Garga who should have lived several centuries before Varāha-mihira? It is this aspect, which makes one wonder why interest in comets waned to such an extent that the word *Ketu*, in later days, meant the descending lunar node. Unfortunately we do not have the texts of Parāśara, and Vr. Garga available in their original form. The identity of these authors is also not clear, since several persons are cited by the same name. Notwithstanding these shortcomings, the information about comets provided in BS and AS should be of interest to historians, scientists and lay people interested in Indian culture. Since the material available is too large, here only AS the work of Ballāla-sena, is considered. This will not be a limitation, since AS covers all of what Varāha-mihira has written in BS.

Adbhuta-sāgara (AS)

Muralidhar Jha (1905), brought out a critical edition of this book a century ago, after consulting several available manuscripts. This edition published in 1905 is followed here for further work. *Ketu-adbhuta* (Comet-wonder) is the 8th chapter (pp.148-202) in AS. It is not the intention here to translate the complete text about comets, which will be too long. AS repeats the statements of Varāha-mihira, Garga,

Asita-Devala, Atharva-muni and towards the end of the chapter gives the writings of Parāśara and Vr. Garga. Parāśara is the most interesting among the above authors for two reasons. Firstly, his composition is in prose. AS in a few places cites a Parāśara in verse also. It is possible these two persons are different, but with same family name. Prose style in Sanskrit is rare and ancient, going back to the Brāhmaṇa period of Vedic literature. It is also noteworthy that sentences in PS end with the word ‘*iti*’ similar to the prose style of Brāhmaṇa texts. Parāśara’s *samhita* text (*abbr:* PS) should contain the earliest information about comets seen in India, in a non-religious context. Further AS quotes PS in other chapters also, giving a clue to when Parāśara might have lived or the era of the tradition reported by him. In the 2nd chapter on Sun’s transit, the position of solstices, as given by Varāha-mihira is recorded. This corresponded to summer solstice being at the third quarter of star *punarvasu* (觜-geminorum). This is followed by the position as observed during Ballāla-sena’s time, when summer solstice was at the beginning of *punarvasu*. This amounts to a precession of about 7° amounting to time difference of approximately 500 years (72 years per degree) between Varāha-mihira and Ballāla-sena, which is quite realistic. Next the relation of seasons with stars as per Parāśara is quoted:

tathā ca svakālikam ḥtu-kramam āha parāśarah /
 tasya śraviṣṭādyāt pauṣṇāntam carataḥ śiśirah /
 vasantah pauṣṇārdhāt rohinyantam/
 soumyāt sārpārdham griṣmaḥ /
 prāvṛt sārpārdhāt hastāntam /
 citrādyāt iindrārdham śarat /
 hemanto jyeṣṭārdhāt vaisṇavāntam iti //

Parāśara said (the following) order of the seasons during his time:

Sīśira, the cold season is when he (Sun) transits from beginning of Dhaniṣṭhā till middle of Revati. Spring is from middle of Revati till end of Rohini. Summer is from beginning of Mṛgaśirā till middle of Aśleśā. Rainy season is from middle of Aśleśā to end of Hastā. Sarat season is from Citrā to middle of Jyeṣṭhā. Hemanta, the dewy season is from middle of Jyeṣṭhā to end of Śravaṇa.

There is a scribal mistake in the first sentence, which should read *pauṣṇārdham*, as seen from the next statement, which is correct. The above is a description of the *nakṣatra* (stars along the ecliptic providing a background for observation) system of astronomy, with the year beginning at winter solstice coinciding with the first point of star

Dhaniṣṭhā (觜-delphini). This is same as the tradition of *vedāṅga jyotiṣa*, which has been well discussed in recent years (Shastri, 1984). Briefly, Varāha-mihira whose time may be taken as 530 AD, provides the position of winter solstice as the first quarter of star *Uttarāṣāḍha* (♀-sagittari). For this to have been at the beginning of star *Dhaniṣṭhā*, the precession amounts to 23°20'. From this information the era of *vedāṅga jyotiṣa* is assigned to 1150-1370 BC. This hints that the information contained in PS also belongs to a tradition originating at a period around 1400 BC. It is noteworthy that PS does not indicate the seasons in terms of the twelve zodiacal signs or *rāśi*, as done by later astronomers Varāha-mihira and Brahmagupta.

Comets as per Parāśara Samhita (PS)

PS classifies comets into eleven groups making a total of 101 comets. PS mentions that 16 are born out of Death (*mṛtyu* group), 12 are from solar deities (*ādityā* group), 10 are due to anger of Rudra (Rudra group), 6 belong to Pitāmaha group, 15 are from Uddālaka group, 5 are from Prajāpati, 17 are from the forehead of Mārci and Kaśyapa (stars of U. Major), 3 are from Vibhāvasu, 14 are coeval with Moon when the ocean was churned (Moon group), one is born of smoke or dust (Dhūma) and one is from the anger of Brahma or Creator. This list adds up to 100 only. Vr. Garga gives the comets of Rudra group as eleven, in which case the figure of 101 will be correct. The basis for the grouping is not mentioned but the names appear to be distinctly linked with Vedic deities, a point to be discussed later. Twenty-six among the 101 comets were purportedly seen. Hence Parāśara has described their name, form and the time interval between successive sightings of these comets. All the 26 observations are reproduced here briefly, with their names and associated year number. *Ketu* is the standard word for comet, hence only the meaning of the first part is given against a few names in parentheses. The text is given in two cases to highlight the archaic style, which is nevertheless, objective and realistic.

tatra vasā-ketuḥ snigdho mahān udagāyata-śikhāḥ
 trimśat-varṣa-sātam proṣya samplaveṣu paścimenoditāḥ
 sa sadyo maraka-phalaḥ (a)saubhikṣa-karaḥ / rūkṣo asthi-
 ketuḥ asaubhikṣa-karaḥ tulya-pravāsa-kāla-phalaḥ /
 pūrveṇa snigdha eva śastra-ketuḥśastra-vṛta-rāja-virodhā-
 maraka-phalaḥ samo rūkṣaḥ- iti // (AS. p.171)

There, big Vasā-ketu, (Flesh or Marrow) with its crown bent towards north, elapsing 130 years in the floods, having risen in the west, causes immediate destruction. Harsh asthi-

ketu appears in the same period causing misery. Sastra-ketu rising sharply in the east causes destruction...

The alternate reading for *samplaveṣu* is *samplave yuge*. This would mean in the *era of floods*. *Asthi-ketu* (Bone) and *Sastra-ketu* (Weapon) have the same transit period, with the latter rising in the east. This may be the same comet seen once in the west and then in the east. Since three comets are listed as being contemporaries, perhaps at least two comets were seen together. At the end of the transits of the above comets, *Kumuda-ketu* (Night Lily) is seen for one night in the west like a bright spray of cow's milk, with its head bent towards east. This does good to people for a period of ten years. *Kapāla-ketu* (Skull) rises in the east on a new moon evening, travels half the sky with a smoky crown. Seen 125 years, after *Kumuda-ketu*, it induces drought and famine. For years equal to the months of visibility, it reduces grain yield by half and also uses away (destroys) half the population. At the end of this transit, *Maṇi-ketu* (Crystal) is seen in the west for a night, subtle like the star Arundhati (Alcor in U.Major), with its crown bent towards east. Among the Rudra group comets, *Kali-ketu* arises 300 years and 9 months after *Maṇi-ketu*. From the east, along the ecliptic, with a head like the tip of a spear, it travels one-third of the sky to be seen at the horizon. For that many years, equal to the number of months seen, the comet having reduced the population to one-third, leaves only one-eighth of the grain yield. *Cala-ketu* (Moving) rises 115 years after *Kali-ketu*, in the west with a crown of the size of a finger joint, bent southwards. Following one-third of the sky, as it moves north, it exhibits a head like the tip of a spear (*śūlāg rākārām śikhām darśayan*). Moving close to Abhijit (near star Aquila), it touches U.Major and the Pole Star, to return half the sky and sets in the south. It does horrible deeds (*dāruṇam karma*) in the sky, shakes the earth and destroys a populous province in central India (*madhyadeśa*) for a period ten months. In other places also for 18 months it creates fear of drought, disease and death. The next comet *Jala-ketu* (Water) raises in the west with its head bent to the west, with a well-formed star (*sujāta-tārah*). It helps people for nine months with good health and agriculture. Comets *ūrmi* (Wave) and others of Moon group appear at intervals of 13, 14 and 18 years to produce good effects on earth. After the work of eight of these, *Bhava-ketu* is seen in the east for a night. It is of the size of the north star of the *Kṛttikā* cluster (Pleiades) with the crown bent clockwise.

*atha udd̄sliki-śveta-ketuḥ daśottarm varṣa-śatam
proṣya bhavaketohcārānte pūrvasyām diśi dakṣinābhinata-*

*śikho ardha-rātra-kāle dṛśyah/ tenaiva saha dvitiyah
prajāpati-sutah paścimena ka-nāma grahah ketuh yuga-
samsthāyi yugapadeva dṛśyate / tāvubhau sapta-rātra-
dṛśyau daśa-varṣāni prajāh piḍyatah/ kah prajāpati-putro
yadā dyadhikam dṛśyeta tadā dāruṇam prajānām śastra-
kopam kuryāt/ tāveva sneha-varṇa-yuktai kṣemārogya-
subhikṣadai bhavatah/* (AS. p. 184)

Then, Śveta-ketu (White) is seen, 110 years after Bhava-ketu, in the east at midnight, with its crown bowed southwards. At the same time is seen in the west a comet named Ka (second of the Prajāpati group). Both, visible for seven nights, trouble people for ten years. If Ka is seen for double the period (14 nights) it will cause horrible effects of weapon (?) on people. The two turning to oily colour bring good effects to people.

Reference to *Ka* as *yuga-samsthāyi*, (one who stays for a *yuga*) is not clear. We can only speculate that perhaps on previous occasions it had stayed for a long time, since one *yuga* is of the order of five years, in Vedic parlance. It is called both *graha* (seizer or planet) and as *ketuh* (comet). At the end of the effects of *Śveta-ketu* (that is after 10 years) *Padma-ketu* (Lotus) rises in the west with a crown of lotus colour, for a night and brings happiness for a period of seven years. After a lapse of 115 years *Svadhi-ketu* (Kāśyapa group) is seen, with star *jyesthā* (Antares). It is dark and harsh occupying one-third of the sky anti-clockwise, with a crown rotating clockwise above, like a lock of hairs (*ūrdhvaprakāśina-jatākāra-śikhah*). It will reduce population in the central region and north to one-third. *Āvarta-ketu* (Cyclic or Periodic) comes after the work of *Svadhi-ketu* with a conch-like trunk portending happiness to the world. *Raśmi-ketu* (Ray) comes 100 years after *Āvarta-ketu* in *kṛttikā* (Pleiades) with a smoky head. Its effects are similar to that of *Śveta-ketu*. After a lapse of 108 years *Samvartaka* is seen in the evening. It occupies one-third of the sky, with a dreadful head and ejecting a thin copper coloured spear-like jet of smoke. For years equal to the hours it stays, kings fight among themselves. The 26th comet in this list is *Dhūma-ketu* (Smoky). Earthquakes, dust veils and exchange of heat and cold (seasons), precede the rise of *Dhūma-ketu*. It appears at no fixed intervals of time.

The above descriptions presented by Parāśara are unambiguously of comets. The years mentioned are to be treated as approximate time intervals between two sightings, expressed as elapsed time. The first one is clear as to its connection with the Floods. However the number word poses a problem in interpretation. For example, *Vasā-ketu*'s year

number is given as *trimśat-varṣa-śatam*. Is this 3000 or 130? Here the latter is taken as the intended meaning for the following reason. Garga, who describes *Viśvarūpā* as celestial objects causing fire, gives their count as *vimśat-graha-śatam*. Ballāla-sena explains this as: *vimśat-graha-śatam vimśatyadhiham śatam ityarthah*/ It is seen that, in ancient India, *twenty-above-hundred* (not twenty-times-hundred) was the accepted meaning of this compound word. Varāha-mihira in BS also gives the number of *Viśvarūpā* as 120 without ambiguity. The number of years mentioned in the comet list adds to about 1300. This would mean that Parāśara the author of PS has passed on a record of 26 comets observed before his time in a particular sequence starting from the era of Floods.

Next to Parāśara, Vṛ. Garga writing in verse form is important for our discussion. He accepts the same grouping as in PS, but names all the 16 comets of the Mṛtyu group, naming one of them as *Parāśara*. This indicates that his writing belongs to a date later than PS. He does not state the initial era of the observations, but mentions that *Asthis-ketu* (2nd in the list of PS) as soon as it is sighted inundates earth with water. He adds here and there more details to the descriptions of PS. For example, the interval between Kali-ketu and Śankha is given as 18 years and 6 months. Similarly, *Agni-ketu* is seen three-and-a-half years after Āvarta-ketu with star *jyesthā*, remaining visible for one-and-a-half months. Vṛ. Garga mentions a comet *Gadā-ketu* (Mace) seen on *Mārgaśira amāvāsyā* (November-January) in the region of stars *ārdrā* (Betelgeuse), *punarvasu* (Pollux), *puṣya* (Asellus) and *āśleṣā* (Minhar) but gives no year number. Probably this was seen during his lifetime, after the close of the list of PS. He differs from PS, also about the last two comets *Samvartaka* and *Dhūma*. He boldly states:

nakṣatra-cakram ākāśe yathaiva parivartate/
ketu-cakram tathaivedam ākāśat parivartate//
tato varṣasahasrānte dr̥ṣyete coditau divi/
ketu-mālā-grahasyānte dhūma-samvartakau grahau//

Like the stellar wheel rotating (repeating) in the sky, the comet-wheel also repeats in the sky. At the end of 1000 years, at the end of the comet strand (ketu-mālā-graha?), two comets Dhūma and Samvartaka appear together.

Vṛ. Garga gives in detail, the tragedy that these two bring on earth. These lead to fall of meteorites with the ten directions becoming air-less. Earthquakes occur with oceans and mountains getting disturbed. He should have been a keen observer, as he says *Dhūma-ketu*, before setting, sends a jet of smoke away from Sun (*astamana-kāle tu raveḥ*

dhūmam vimuñcati). He seems to be wary of myths and folklore, when he states ‘those with ignorant eyes do not see the starry nature of this object’ (*nāsyā tārāmayam rūpam paśyanti ajñāna-cakṣuṣah*). He describes the other comet *Samvartaka* as the one famous for reducing the world (*samvartaka iti khyātāḥ kṣyāya jagatām iti*). But later Purāṇic literature has taken *Samvartaka* to mean a type of cloud that brings excessive rains, leading to a deluge.

The other authors quoted in Adbhuta-sāgara namely, Garga, Atharva-muni, Devala, Bhārgava and Varāha have nothing seriously original to add to the works of Parāśara and Vṛ.Garga. They increase the total numbers to 1000 and add new groups such as Jupiterian (65), Saturnian (60) etc. Association of comets with planets might have had an observational basis but the numbers appear to be arbitrary. Whether the mentioned objects were comets is also unclear. For example, *guru-sutāḥ* (Jupiter’s offspring) are described as white stars without hair (*vikacāḥ*) seen in the south. Similarly, the Venus group is a cluster of 84 white-stars called *visarpaka*, seen in the northeast direction. Arīgiras is a form seen on Sun, like a person sitting in a chariot. Comet Aruṇa is not starry, but dark red in colour and dust like, with diffused light. Karīka is a comet shining like moon but clustered like a clump of bamboos. None of these authors gives the time interval between any of the comets. Their main contribution is in preserving a tradition of celestial objects (other than nakṣatras and planets) being known as *aruṇa*, *ānigirasa*, *ka*, *karīka*, *kabandha*, *kiraṇa*, *viśvarūpā*, *brahma-danḍa*, *taskara*, *tvaṣṭā*, *triśiras*, *triśikha*, *vibhāvasu*.

Comets in the Rigveda?

Several of the comet names mentioned above synchronize with names of Vedic deities. This makes one wonder whether some hymns of the Rgveda (RV) could have been inspired by comet sightings. That, this is not just a speculation is borne out by a study of the ancient text harmonized with later traditional literature. Here, only a few points are highlighted to bring out the possibility of RV referring to comets. The word for comet in Sanskrit is *ketu* often referred as *dhūma-ketu*. Currently this word is used in almost all Indian languages in the sense of comet. *Ketu* originally meant a hairy flag like object, synonymous with words such as *sikhi* and *keśi*. Amara-kośa (3rd book; *tānta-varga*) a standard reference on ancient meanings provides two meanings for the word *dhūmaketu*; namely *agni* (fire) and *utpāta* (anomalous phenomenon). The first meaning is obtained by interpreting fire as smoke-bannered. It is obvious the latter meant a comet. The hymns RV 1.162, 1.163, read like an eye witness account of a celestial object:

'moving fast...in the sky like a line of swans...gold horned, metal footed.' The simile of the celestial Horse or Fire moving like a line of birds in V-formation appears again at RV 3.8, which could be the split tail of a comet. From Yajurveda (T.S.Br. 1.5.7) we learn that seers in ancient times feared that they might not see Sun raise again and in fact they won the dawn by the *citrāvasu* hymn. This read along with RV 1.35, where Sun is described as covered with dark dust, but getting cleared later, makes one wonder whether this could have been due to comet dust. RV 8.44 refers to *Vibhāvasu* specifically as *dhūmaketu* a comet. RV has also several references to objects falling from the sky (1.172, 8.55, 10.68). Atharvaṇa Veda (19.9) has a prayer for peace to the quaking earth hit by meteorites and to Death called *dhūma-ketu*.

DISCUSSION

A brief account of the most ancient comet lore of India as preserved in Adbhuta-sāgara has been presented here. AS repeats an ancient prose text of Parāśara, which perhaps forms the original Parāśara Samhita (PS). It may be mentioned here, that Utpala (9th century) also quotes the same text of PS in his commentary on Brhat-samhita (Bhat, 1981). Astronomical notions and some data about planets indicate that PS predates *siddhantic* astronomy by several centuries. For example, the period of Saturn is mentioned as 27 stars being traversed in 28 years, which was not the style in which later astronomers stated this period. As per internal evidence in the text, the tradition of PS belongs to *circa* 1400 BC. The interesting part of the text is the list of 26 comets purported to have been seen sequentially starting from the era of the Floods. The total number of years in the list adds to about 1300 years, which indicates that *Samplava* meaning the Flood (inundation or deluge) refers to a period about 2500-2700 BC. The story of the Flood appears for the first time in India, in Satapatha Brāhmaṇa (1.8.1), which is later than the R̄gveda but belongs properly to Vedic literature. The contents of this ritualistic text can be dated to 3rd millennium BC, based on a statement about Kṛttikā or Pleiades not moving from the east (Dikshit, 1969; Parpola, 1994; Kak, 1997). This text also contains reference to Agni (Fire) being stationed in the star group of Kṛttikā, which could as well be an oblique reference to a comet (Iyengar, 2004; Napier, 2004). The Flood story connected with the Fish form of Viṣṇu and a boat being tied to a peak in the Himalayas is recounted in Mahābhārata as belonging to a bygone era. The great epic has several references to comets but here it suffices to point out that *Brahma-danḍa* a comet

as per the discussed literature was held responsible for the inundation of the city of Dvāraka.

Further intriguing is the information preserved by the ancient authors that Tvaṣṭā (a personified celestial object extensively cited in the R̄gveda) can cause eclipses at times other than *parvan* (syzygy). Varāha-mihira criticizes superstitions about eclipses and upholds mathematics as sufficient to understand solar and lunar eclipses. Nevertheless, he does not hesitate to state that a planet called Tvaṣṭā is capable of darkening Sun at odd times (*satamaskam parva-vinā tvaṣṭā nāmārka-maṇḍalam kurute/ BS 3.6*). Earlier Indian tradition in Rāmāyaṇa and Mahābhārata identifies Rāhu as the sole cause of solar and lunar eclipses at syzygy. It is conjectured that the persistent tradition of a comet having caused an eclipse, could have influenced a school of later writers and astrologers to name the descending lunar node as *Ketu*.

As per PS not all past comets brought disaster but a few of them were responsible for decreasing the population by reducing agricultural yield. Some of them are said to have modified climatic conditions and caused earthquakes. This scenario perhaps pertains to India, but such events, if real, should have left their signatures at other places also. There are evidences to show that large parts of the earth went through climatic disturbances around 2300 BC, supposedly due to an intense encounter with the Taurid meteoroid stream (Mandelkehr, 2002). Clube and Napier (1984) have propounded the astronomical framework for the occurrence of such an event. The possibility of a comet-dust veil obscuring the sun and having caused climate alteration is of considerable scientific interest (Napier, 1998). Clube and Napier (1990) have correlated available ancient information with their theoretical results to demonstrate that the night sky around 3000 BC should have been much disturbed. Their most important conclusion is that bronze-age civilizations should have been severely affected by comet related events. Sanskrit texts investigated here uphold this conclusion about such a possibility in India. The text of Parāśara preserved in the ancient scientific literature of India contains an observational tradition of comets associated with destruction on earth.

Acknowledgements: This article was presented as a lecture at the Geological Society of India, Bangalore on 23 February 2005. Discussions on the lecture by Dr. B.P. Radhakrishna and Dr. K.S. Valdiya were useful in preparing this paper. Financial support from Indian National Academy of Engineering under the Indian Engineering (Civil) Heritage activity is acknowledged.

References

- BHAT, M.R. (1981) *Brihat Samhita of Varāha Mihira*, Sanskrit Text with Transl., Motilal Banarsi Dass, New Delhi, 1981.
- CLUBE, S.V.M. and NAPIER, W.M. (1984) The microstructure of terrestrial catastrophism. Monthly Notices Roy. Astron. Soc. v.211, pp.953-968.
- CLUBE, V. and NAPIER, W.M. (1990) The Cosmic Winter. Basil Blackwell Ltd., U.K.
- DIXIT, S.B. (1969) *Bharatiya Jyotisa Sastra*. Govt. of India Press, Calcutta.
- IYENGAR, R.N. (2004) Profile of a natural disaster in ancient Sanskrit literature. Ind. Jour. Hist. Sci., v.39(1) pp.11-49.
- IYENGAR, R.N. (2005) Cometary observations in ancient India. Jour. Geol. Soc. India, v.65(5), pp.663-665.
- JHA, MURALIDHARA. (1905) *Adbhuta Sāgara of Ballāla Sena*, (Ed.) Sanskrit Text, The Prabhakari & Co, Benares Cantt.
- KAK, S. (1997) Archaeoastronomy and literature. Curr. Sci., v.73(7) pp 624-627.
- MANDELKEHR, M. (2002) Commemoration of the 2300 BC event. Chronology and Catastrophism Review, v.2, pp.3-14.
- NAPIER, W.M. (1998) Cometary Catastrophes, Cosmic Dust and Ecological Disasters in Historical Times: the Astronomical Framework. In: Peiser, Palmer and Bailey (Eds.), Natural Catastrophes During Bronze Age Civilizations, Archaeopress, Oxford, England, pp.21-32.
- NAPIER, W.M. (2004) Personal communication.
- PARPOLA, A. (1994) Deciphering the Indus Script. Cambridge Univ. Press. Cambridge.
- SASTRI, T.S.K. (1984). *Vedāṅga Jyautiśa of Lagadha*, INSA, New Delhi.
- SINHA, C.P.N. (1979), *Mithila under the Karnatas*, Janaki Prakashan, Patna,

(Received: 24 August 2005; Revised form accepted: 21 November 2005)