Indian Journal of History of Science, 40.2 (2005) 139-152

ECLIPSE PERIOD NUMBER 3339 IN THE *ṚGVEDA*

R.NARAYANA IYENGAR

(Received 10 August 2004; revised 4 October 2004)

Among the various numbers, the number 3339 appearing in the *Ṛgveda* is perhaps the most intriguing. So far, this has been taken to be the number of Gods honouring Fire, but there is no further explanation on how this number arose. One wonders, how such a large but specific number would have been counted, if there were to be no physical significance behind it. With the help of *Brahmāṇḍa Purāṇa* it is shown that the above is an eclipse period number. *Purāṇa* describes this as the number of *tithis*, counted in the dark fortnights, from Full moon to *amāvāsyā*. This makes the total number of intervening *tithis* including the bright fortnights to be 6678, which equals 18 solar years as per the Vedic calendar of 371 *tithis* per year. There is indirect evidence in Vedic and Purāṇic literature to show that this was corrected by adding six or seven more *tithis*. Further, it is demonstrated that 3339 is a correlation number for the syllable counts of *RV* hymns, taken in the *aṣṭaka* format.

Introduction

Ancient Vedic and Purāṇic literature of India exhibits an intimate relationship with eclipses that is although mythological in many respects, is still pervasive in its cultural influence. Shama Shastry[1], the celebrated editor of *Arthaśāstra*, has made a detailed study of the subject, to find clues to knowledge about eclipses in Vedic literature. He emphatically points out '...the whole of our Indian culture is derived from the cycle of eclipses'. He makes a case for taking several numbers appearing in the *Ṛgveda* (*RV*) and elsewhere as somehow connected with eclipse periods. He points out a few hymns, which are remarkable in their poetical imagery and probable reference to eclipses. But the question whether or not the *Ṛgvedic* people knew an eclipse period remains unanswered, in the absence of numerical evidences. This can be attributed at

* *Professor, Dept. of Civil Engineering, Indian Institute of Science, Bangalore 560012;*
E-mail: rni@civil.iisc.ernet.in; aareni@yahoo.com

least partly to a strong tradition which explains every Vedic hymn as being related to either sacrificial practices or mysticism. At the other extreme, many modern scholars have tried to interpret *RV* hymns in the most mundane manner possible in terms of class conflicts, ethnic differences and migratory patterns. On the other hand, for example, there should be no difficulty in accepting *sūkta RV* (5.40) as referring to a solar eclipse. Hence, it would follow that the specific word *āsura* used in this hymn is celestial in purport, referring to the eclipse shadow figuratively. While this may not be the implied meaning of the word at all the places where it occurs, possibility of an eclipse being meant in a few hymns by this metaphor should not be overlooked. The present paper is motivated by the above points to investigate a few hymns of *RV* in the light of later Purāṇic explanations. It is demonstrated that, there is every reason to believe that the Vedic community was fully aware of a special eighteen-year period, which in all likelihood was the eclipse cycle.

Number 3339 in the *Ṛgveda*

RV mentions not only small numbers such as one, two, three but also large ones like 1000, 4000, 60,000. For our purpose here, the most intriguing number is 3339. This occurs twice in the *Ṛgveda*, first in the third *maṇḍala* and again later in the tenth *maṇḍala*. The text[2] and two translations are provided below to bring out the fact that numbers can not be interpreted differently even if their basis may not be understood.

trīṇi śatā trī sahasrāṇyagnim triṃśacca devā nava cāsarpayan|
aukṣan ghṛtairastṛṇan barhirasmā ādiddhotāram nyasādayanta||
(*RV* 3.9.9; 10.52.6)

"Three times a hundred Gods and thrice a thousand, and three times ten and nine have worshipped Agni/For him spread sacred grass, with oil bedewed him, and stablished him as Priest and Sacrificer"(Griffith[3]).

"Gods three thousand and three hundred and thirty and nine waited upon the Fire / They anointed him with many streams of the clarity, they spread for him the seat of sacrifice, and seated him within as Priest of the call" (Aurobindo[4]).

Sūkta RV (3.9) is by Gāthina Viśvāmitra, a legendary figure of immortal fame in Indian culture. This hymn has Agni as its deity, which from the overall

context of the hymn can be seen to be celestial. This of course does not preclude the interpretation or application of the hymn to terrestrial rituals, as indicated by the later Brāhmaṇa literature. *Sūkta* (10.52) is about Viśve-devās, by *Saucika Agni*. The context of this *Sūkta* is seen to be, some type of time measurement. This is implied from hymn 10.52.3, where the reference is to one 'who springs to life month by month and each day' (*aharaharjāyate māsi māsi*). The suspicion that this could be a reference to Moon is unavoidable. Agni being honoured by 3339 Gods is the theme of the last hymn (10.52.6) of this *sūkta*. An interesting feature of *sūktas* 51 to 56 of the 10th *maṇḍala* is their apparent homogeneity. The implied themes of these *sūktas* are similar and they appear linked even as inspired poetry. *Sūkta* 10.51 is a conversation between Agni and Gods, where in hymn (10.51.2), Agni wonders 'how many number of Gods have clearly beheld my form'. There is also an allusion to Agni hiding in secret places. *Sūktas* 53, 54, 55 and 56 contains the word *asura(s)*, or its derivatives, which could be an allusion to the eclipse shadow. In hymn (10.55.5) there is reference to *vidhu* that is, Moon, being 'woken up from his slumber, who runs his course with many around him'. The hymn further observes, 'he who died yesterday is living today' and goes on in its poetic language to note, 'the ancient red bird has had no nest to dwell in'. Mention of the red colour of Moon makes a strong case for taking this hymn to be describing a total lunar eclipse. Duncan Steel[5] in his monograph on eclipses provides the scientific explanation as to why Moon's orb turns blood red during a total lunar eclipse. However, meanings of many *RV* hymns and related practices have remained obscure due to break or differences in traditions. Nevertheless, one wonders why a specific number 3339 was enunciated by seers of *RV* to be preserved religiously over several millennia. Sāyaṇa the great commentator of 14th century AD, in his gloss on *Taittirīya Brāhmaṇa* (*TB*. II.7.12.2), where this number occurs, declares that over and above 33 the remaining Gods are supernumeraries. Shama Shastry[1] takes 3339 to be the number of year of Gods and looks for a link for this number with a 33-year cycle. K.V.Sarma[6] feels that this number 'apparently refers to a period of 30 years consisting of 371 lunar months.' Subhash Kak[7], thinks that 3339 is the total number of Gods in a year, personified as Agni. He breaks the number into its factors 9 and 371 to identify the first as the *bhāṃśās* in a *tithi* and the latter as the number of *tithis* in a solar year. While these authors have at least attempted to find a rationale for this peculiar number, others have presumed

this to be just a part of variable Vedic mythology, wherein the number of Gods increased from 33 to higher figures with time. For example, Wilson[8] a translator of RV, referring to the hymn (10.52.6), writes '... a solitary passage, and one of which the commentator has given no satisfactory explanation, raises the number of deities, which is wholly incompatible with the ordinary enumeration.' How invalid this understanding is, can be realized if only more weight is given to Purāṇas, preceding Sāyaṇa by more than 1500 years. These texts are the prime claimants for having preserved ancient traditions outside the canonical Vedic literature.

Purāṇic Interpretation

There are eighteen major and eighteen minor purāṇas, making up an enormous body of Sanskrit literature, not easy to read, much less to synthesize to see the common cultural thread linking them with *Ṛgveda*. Here, only *Brahmāṇḍa Purāṇa*[9] is considered briefly to show the possible rationale existing behind the specific number of Gods of *RV* (3.9.9) and *RV* (10.52.6). *Brahmāṇḍa*, considered as one of the earliest Purāṇas, explains this as

āpūrayan suṣumṇena bhāgam bhāgamahaḥ kramāt |
suṣumṇā āpyāyamānasya śuklā vardhanti vai kalāḥ || (*part I*, 23.61)

"Sun having filled up the phases by his *suṣumṇā* ray, in daily sequence, the bright parts (of Moon) increase in the *śuklā pakṣa*".

bhakṣārtham amṛtam somaḥ pourṇamāsyām upāsate |
ekām rātrīm suraiḥ sarvaiḥ pitṛbhiḥ sarṣibhiḥ saha ||
somasya kṛṣṇā-pakṣādau bhāskarābhimukhasya tu |
prakṣīyante pitṛ-devaiḥ pīyamānāḥ kalā-kramāt
trayaśca triṃśataścaiva trayaḥ-triṃśat tathaiva ca |
trayaśca tri-sahasrāśca devāḥ somam pibanti vai ||
ityetaiḥ pīyamānasya kṛṣṇā vardhanti vai kalāḥ |
kṣayanti tasmāt śukla-śca kṛṣṇā āpyāyayanti ca || (*part I*; 23.66-69)

"Moon is approached by all the gods, manes and *ṛṣis* for a night on Full moon, for partaking *amṛta*. From the beginning of the dark fortnight, phases of Moon facing Sun, decrease being drunk by *pitṛ-devatās* digit by digit. Three and three

hundred, then thirty-three and again three and three thousand (3339) Gods drink soma. Being drunk this way, the dark digits increase with corresponding decrease in the bright digits".

The above is a clear enunciation of the model behind the 3339 Gods of *Ṛgveda* and what their role could have been. The connotation pitṛ-devāḥ in verse 67 indicates that these were not the general Gods (33 or otherwise) but were special and that their count was sequential, in the order of the decreasing phases of Moon (*kalā-kramāt*) adding to 3339.

Eclipse Cycle of 18 Years

Gods drinking Soma is a recurring theme in *Ṛgveda*. That this was linked with Moon is more than apparent in several places. One example is the celestial marriage *sūkta* 10.85, where the 5th hymn reads

yatvā deva prapibanti tata āpyāyante punaḥ|
vāyuḥ somasya rakṣitā samānām māsa ākṛtiḥ ||

"The Gods drink you, but later you become bright again/ Vāyu is the protector of Soma, Moon is the maker of years"(S.B.Dikshit[10]).

Griffith[3] translates the first half of this verse as 'When they begin to drink thee then, O God, thou swellest out again.' This meaning is seen to be completely wrong in the light of Purāṇic evidence. It follows the symbolism of particular Gods drinking away the digits of Moon, which obviously refers to the dark fortnight and their total number being 3339 has its origin in *Ṛgveda*. For this characteristic number the above Purāṇic model has to be accepted as the most likely explanation. The count started on a Full moon to proceed till *amāvāsya* and stopped till the next Full moon, to repeat again in the same fashion with gaps in the bright fortnight. In other words, this number is clearly the number of tithis in the dark fortnights counted as 3339 sequentially for a special purpose. If both the fortnights were to be included, this number would have been 6678 *tithis*. Now, at the rate of thirty tithis per lunation, this number is equal to 222.6 lunations, which in round figures is the eclipse cycle of 223 lunations. It is known that the Vedic calendar was luni-solar. The months were

lunar but the year was solar. From *Vedāṅga Jyotiṣa*[11], it is known that one solar year was taken to have 371 *tithis*. Hence, the *RV* number 3339, which is half of 6678, stands for 18 solar years, with a fantastic imagery behind it. *RV* 10.52 after giving this number refers in subsequent *sūktas* to *asuras* and *sūkta* 10.55 is indeed a description of a total lunar eclipse with Moon turning red. Thus, this number was linked with eclipses. There are sufficient clues to infer that special ordinals were also associated with eclipses. For example, Atri got back the Sun engulfed in darkness by means of the fourth Brahma (*RV* 5.40.6). Atri alone could restore the Sun whom the asura Svarbhānu had engulfed with darkness (*RV* 5.40.9). Association of the ordinal fourth with this eclipse is here noteworthy. Another hymn, in the same *maṇḍala* belonging to Atri family reads,

pratiprayāṇam asurasya vidvān sūktairdevam savitāram duvasya |
upa bruvīta namasā vijānan jyeṣṭham ca ratnam vibhajantamāyoḥ || (5.49.2)

"Knowing full well the Asura's time of coming, worship God Savitar with hymns and praises/Let him who rightly knoweth speak with homage to him who dealeth out man's noblest treasure (Griffith[3]).

This beautiful hymn uses a technical word, *prati-prayanam*, which can only mean return journey or return period. Reference to *Savitar* (Sun), *asura* (eclipse shadow) and his return journey leaves one wondering, why this may not pertain to a predicted solar eclipse. Moreover, this *sūkta* has *Viśvedevāḥ* as its deities, in common with *sūkta* (10.52), which declares the special number 3339. *Sūkta* (10.56) to which reference has already been made is also related with *Viśvedevāḥ* and it contains reference to *asura* who finds light by the third act. Association of an ordinal number here, as in hymn 5.40.6, perhaps refers to the return journey or recurrence of an eclipse.

Further Corrections

Between two eclipses at a distance of 18.03 years, the number of lunations would have been obviously 223 without fractions. This fact would have indicated the inaccuracy of either the number 3339 or the round figure of 30 *tithis* in a lunation. There are hints in the texts indicating that attempts were made to correct the above number. The *Brahmāṇḍa Purāṇa* mentions that on 15th day, after the Gods, it is the turn of *pitṛs* to partake nectar for some time.

There is no clarity on whether this was for the time duration of two *kalās* or two *lavās*, but through a symbolism, the number of *pitṛs* is stated to be six or seven.

samvatsarāstu vai kāvyāḥpañcābdā yo dvijaiḥ smṛtāḥ|
saumyāstu ṛtavo jñeyāḥ māsāḥ barhiṣdaḥ smṛtāḥ ||
agniṣvāttārtavāḥ caiva pitṛ-sargā hi vai dvijāḥ |
ptiṛbhiḥ pīyamānasya pañcadaśyām kalā tu vai ||
yāvat prakṣīyate tasya bhāgaḥ pañcadaśastu yaḥ |
amāvāsyām tadā tasya tataḥ āpūryate paraḥ || (23.76-78)

"The five years, such as *samvatsara* are called *Kāvyās*. The seasons (*ṛtus*) are known as *Saumyās* and the months are called *Barhiṣadas*. *Agniṣvātta* and *ārtavās* constitute the *pitṛ-sarga*. When on the fifteenth day the fifteenth part vanishes, being consumed by the *pitṛs*, then *amāvāsya* takes place".

The above verses are in continuation to the verses explaining how the 3339 Gods are to be counted. These verses throw light on the intricacies involved in the classification and symbolism associated with pitṛs. It is known that Vedic calendar had a five-year cycle with names such as *Samvatsara*. Purāṇa says these were called *Kāvyās* (related with *kavya*). Similarly, the six seasons (*ṛtus*) were called *Saumyās* (related with *soma*). The months were called *Barhiṣadas*. For the present discussion, *pitṛs* named *Saumyās* who partake *soma* or nectar on the fifteenth day are of interest. Their number appears to have been seven as they consisted of one *agniṣvātta* and six others related to six seasons (*ārtavaḥ*). Perhaps they were thought to be in a sequence for two *kalās* (a time unit different from Moon's phase) ending with *amāvāsya*. This may be interpreted as an effort to accommodate six or seven extra *soumya-pitṛs* into a ritual. Nevertheless, implication of the above definitions, as culture specific artifices, to measure and quantify time cannot be overlooked. It may be surmised that like 3339 Gods representing that many *tithis*, *soumya-pitṛs* account for six or seven *tithis*. Thus, beyond reasonable doubt ancient Indians were aware of the so-called saros cycle. At the same time it is difficult to assert that the above addition of six/seven *tithis* to increase the characteristic number as 3345 was known in *Ṛgvedic* times. However, it may be asserted that the round figure of 18 years was retained for religious purposes, as it was convenient.

Yajurvedic Texts

The *Vājasaneya Saṃhitā* (33.7) and *Kāṇva Saṃhitā* (32.7) of Śukla Yajurveda repeat *RV* hymn (3.9.9; 10.52.6). The *Taittirīya Brāhmaṇa* (TB) records the same hymn at (II.7.12.2). Thus, the number 3339 was wide spread and its solar year equivalent 18 was well known in Vedic literature. Shama Shastry[1] claims that TB (III.11.3.25) mentions the number of Gods to be 3349. The present author has not been able to trace this in the currently available versions of TB. If the above claim were to be correct, this would be an evidence for efforts to fine-tune the number of *tithis* in the eclipse cycle, to a better figure. In any case, TB (I.3.10) describes the legend of Indra returning on an *amāvāsya* after having defeated *asuras*, which may be taken as a solar eclipse. It further refers to the arrival of *pitṛs* at that time and they being given a boon to drink soma on *amāvāsya*. Their number is said to be six as being related to six seasons (*ṣaṭ sampadyante| ṣaḍvā ṛtavaḥ |ṛtavaḥ khalu vai devāḥ pitaraḥ*). This is most probably a legendary reference to the shortage of six *tithis* in the previous count of 3339 for an observed eclipse. Further, TB (III.10.4.1) lists the names of years in a six-year cycle, using the imagery of a bird. This perhaps denotes an attempt to divide the 18-year cycle into three shorter cycles. TB (IX.1) on *Aśvamedha* in the very first hymn introduces eighteen as the prime symbolic cosmic number of the ritual. Several other descriptions of what look like eclipse related imagery are to be found in Yajurvedic texts as discussed by Shama Shastry[1].

Correlation of 3339 with *Ṛgveda*

Tradition in India holds that *RV* is about Sun, who is called Arka, literally one related to Ṛk. Naturally, one expects the contents of the *RV* text to have some information about eclipses. The discussion so far brings out, besides actual observations of a few eclipses, the periodicity of the node, called Rāhu in later literature, is mentioned in *Ṛgveda*. In the absence of physical records, it may be surmised that this discovery should have been based on long observations, as *Taittirīya Āraṇyaka* (1.4) says,

smṛtiḥ pratyakṣam aithihyam anumānaḥ catuṣṭayam |
etaiḥ āditya-maṇḍalam sarvaireva vidhāsyate ||

"Memory (of past records), direct observation, anecdotes and inference form the quartet. With these, Sun's circle is understood by all ".

Evidence available so far, points out that the number was discovered with the help of lunar eclipses. This is implied by the counting of the 3339 *tithis* starting from a Full Moon and carrying this count only during the dark fortnights, to end again on an *amāvāsya*. The expectation would have been that the subsequent Full Moon would be eclipsed. Steel[5] discussing how ancient civilizations could have arrived at the 18-year cycle mentions about observation of lunar rather than solar eclipses as the more natural possibility. This brings up the interesting question, whether *RV* contains more astronomical information than what meets the eye, in a codified manner. Kak[7] has investigated this question to some extent taking the *maṇḍala* division as the basis. It is generally held that *RV* was originally in the *aṣṭaka* (eight-book) format and for some reason not yet clear, was reorganized into ten *maṇḍalas*. *Aṣṭaka*, also has a technical meaning referring to the 8th day of specific dark fortnights in a year. This has a distinct flavour of time measurement, like *amāvāsya* and *pourṇimā*. What is intriguing in this context is the apparent correlation between the number 3339 and the number of syllables in the eight *aṣṭakas*. This is demonstrated in the accompanying table.

Table 1. Correlation between 3339 and the *Aṣṭakas*

Aṣṭakas	*Syllables (N)*	*N/3339*
1	48931	14.654
2	51718	15.489
3	47636	14.266
4	49762	14.903
5	48022	14.382
6	48412	14.499
7	47562	14.244
8	52178	15.627
average	49278	14.758

The *aṣṭakā* division is known to be approximately uniform with nearly equal number of syllables, in the eight books. Hence, divided by the same number the result also would be nearly equal. However, the internal structure

of *RV*, leading to the results of the last column in the above table, appears to be due to some plan and not due to chance. The results seem to vary around fifteen, but are not too close to that figure. If the compilers of *RV* wanted this to be precisely fifteen, given their attraction to count and record large numbers, they could have easily achieved the same. What is noteworthy is the syllable count hovering around an average value and hence its possible link with some type of time measurement. If this conjecture is correct, the number of syllables would represent a finer time measure of the period between two eclipses separated by eighteen years. In the present case, each *aṣṭaka* could be a measure for fifteen *muhūrtas* covering half-a-day (sunset to sunrise) or multiples thereof. It may also be a measure of *ardha-māsa* or half-synodic month, which is less than 15 solar days.

Discussion

Vedas are broadly divided into *Saṃhitā*, *Brāhmaṇa* and *Upaniṣads*. The *Ṛgveda Saṃhitā* is the most ancient among those belonging to 3rd - 4th millenium BC. *Saṃhitās* are organized as *sūktas*, made up of *mantras* or metrical verses endowed with knowledge, that was revealed to a *ṛṣi* (seer). What is interesting is that these contain special numbers, at least one of which, namely 3339 is connected with the 18-year eclipse cycle. *Brāhmaṇa*s are supposed to be explanatory texts for *Saṃhitās*. However, in their available format, the explanations are too convoluted with ritualistic jargon and hence not amenable always for establishing a one-to-one relation with the original hymns. In the present case, it is the *Brahmāṇḍa Purāṇa*, which preserves a simple explanation of the number. This also provides an insight into the symbolism involved in *RV*. This leads one to the conclusion that 3339 represents the *tithis*, in the dark fortnights, separating two eclipses of the same type. *Tithi* is a time unit well known to *Vedāṅga Jyotiṣa*[11], *Purāṇas* and Siddhāntic Astronomy[12] and continues to be used in India. The present study indicates, that this has come down to us from *RV* times. One may wonder, why the number is stated to be that there are many Gods and not *tithis*? The answer to this will be clear to any serious student of Vedic literature. Ancient Indians worshipped Time, notwithstanding its abstract nature. Hence, referring to time measures of *tithi, māsa, samvatsara* as Gods is the norm in the Vedas. Perhaps this helped them to deal with Time, inasmuch as they were able to formulate extremely

small and large measures of time. One may still question whether composers of *RV* were aware of the word *tithi*. The answer is in the affirmative, if the structure of Sanskrit language in which *RV* stands is any evidence. Sanskrit allows negation of almost any noun by the negative prefix (na ~ a). Use of such a prefixed negative word presupposes knowledge of the basic word, like a number with a minus sign presupposes the existence of the original positive number. *RV* uses the word *atithi*, meaning guest; one who comes without appointment, in profusion (e.g. *RV* 1.44.4, 1.127.8, 1.128.4, 1.186.3, 2.2.8, 2.4.1, 2.14.7, 3.2.2, 3.3.8, 3.26.2, 4.1.20, 4.2.7, 4.26.3, 4.40.5, 5.1.8, 5.1.9, 5.3.5, 5.8.2, 6.15.1, 6.15.6, 6.18.3, 6.26.3, 7.3.5, 7.8.4, 7.19.8, 7.42.4, 8.8.4, 8.9.3, 8.19.8, 8.21.16, 8.84.1, 8.103.12, 10.1.5, 10.48.8, 10.68.3, 10.122.1). The derivation and meaning of this word proves the prior knowledge of the word *tithi* in the sense of date. Now, turning our attention to *Purāṇas*, there is a view that in the remote past these were fewer in number. Since the present day versions contain same or similar texts in too many places, it is logical to imagine the origin of these books from a single source, which is not traceable now. *Itihāsa* and *Purāṇa* were known at least from Brāhmaṇa and Upaniṣadic times as evidenced in *TB* (III.12.8.2) and *Chāndogya Upaniṣad* (3.4.1). It is possible, like Brāhmaṇas explaining the ritualistic and *Upaniṣads* the philosophical aspects (e.g. *Bṛhadāraṇyaka Upaniṣad*, III.9), *Purāṇas* once explained the physical or worldly meaning of the Vedas. This view is upheld by the age-old adage,

itihāsa purāṇābhyām vedam samupabṛmhayet |

"Veda has to be understood (synthesized) with the help of itihāsa and puraṇa".

The anecdote of Gods and *Pitṛs* partaking nectar of Moon appears in several Puraṇas. However, the number of Gods mentioned in *Viṣṇu* and *Liṅga puraṇas* are different from 3339.

trayastriṃścat-śatāścaiva trayastriṃśat tathaiva ca |
trayastriṃścat-sahasrāṇi devāḥ somam pibanti vai ||
evam dinakramāt pīte vibudhaistu niśākare |
pītvārdha-māsam gacchanti amāvāsyam surottamāḥ || (*Liṅga P.* 56.11,12)

The number given here adds to 36333. *Viṣṇu puraṇa* gives the same number, with the text being slightly different. Now, this may be purely due to recording errors on the part of the scribe in copying previous versions, since

the above is not the Vedic number. However, it is plausible, there were efforts to formulate longer cycles based on the Vedic theory of counting only the *tithis* in the dark fortnight. The second verse above again upholds this way of counting. It was on daily basis (*dina-kramāt*) and only in the dark fortnight, since the Gods are said to go away on *amāvāsya*. Some of the further verses in *Liṅga Purāṇa* are same as the ones in *Brahmāṇḍa Purāṇa*. It is known that Jain astronomy, which did not follow the Vedic tenets, nevertheless influenced by it, had a 20,000-day eclipse cycle[13]. This harmonizes with reference to a period of 10,000 (days) in *Taittirīya Āraṇyaka* (1.18-19).

sa drapsaḥ | tasayiṣā bhavati | avadrapsom' śumatīmatiṣṭat | iyānaḥ kṛṣṇo daśabhiḥ sahasraiḥ |

"It is the Drapsa; the following is said about it. The Drapsa has taken its stand on the one shining Amśumatī. This Kṛṣṇa has come by ten thousand (days)" (Shama Shastry [1]).

This may be an obscure reference to an eclipse property, since Kṛṣṇa literally means dark-person, as conjectured by Shama Shastry[1]. The focus in the present study has been on the number 3339 of *RV*. It is found that this number is correlated well with the syllable count of the hymns of *RV* in the *aṣṭaka* (8-book) format. The strong relation of *RV* with the eclipse period number makes one to speculate that chanting of the hymns might have been used as a method to keep track of long periods of time. This is a possibility, when it is recognized that chanting of *RV*, which is still a live tradition, adopts time scaling. A given hymn with a fixed number of syllables can be chanted in different ways, each taking more time than the original. In each style the phrase order and the total number of syllables change in a defined fashion. Kashyap[14] shows that this ancient tradition has evolved an error correcting code for memorizing the orally transmitted hymns of *RV*. It is found that if a hymn in *anuṣṭup* meter with 32 syllables takes one unit of time in *pada-pāṭha*, the same hymn in *krama* takes nearly two units of time and in *daṇḍa* five units of time, where as in *śikhā* and *rekhā* it would cover more than six units of time. As was shown previously, the observation required was in the dark fortnight and would be met by counting the nights. Thus, it is conceivable the number of syllables in the *aṣṭakas* might have stood for the observed length of time from sunset to sunrise.

Since *RV* is shown to contain the period number of 18 years, was this used for making predictions? Apart from the significant terminology of the return journey of the eclipse shadow (*prati-prayāṇam asurasya*) in *RV* (6.49), no other clue has been yet found in Vedic literature, as to how this number could have been used. However, a multiple of 18 finds place in Mausala Parvan (2.19-20) of *Mahābhārata*. It is mentioned that when a solar eclipse occurred, Kṛṣṇa understood that the 36th year after the war had arrived, indicating his last days, as had been foretold by Gāndhārī. There is an assertion that this eclipse was similar to the one at the time of the war[15]. This is one occasion mentioned in ancient texts for possible application of the knowledge of the 18-year cycle. There is another claim for prediction, again associated with Kṛṣṇa in *Bhāgavata* (10th Book, Ch. 82.1-2). It is said that Kṛṣṇa along with others went from Dvārakā to Kurukṣetra for performing religious rites during a solar eclipse, which had been predicted by astronomers in advance.

Conclusion

An investigation of the *Ṛgvedic* number 3339, with the help of a few *RV* hymns and *Brahmāṇḍa Purāṇas* text has been presented in this study. It is found that this was the characteristic eclipse number of ancient India. This represents the number of *tithis* between two similar lunar eclipses separated by nearly eighteen solar years, counting only the dark fortnights. There are internal evidences in Purāṇas and Brāhmaṇa literature to the effect that efforts were made to add another six or seven *tithis* to the above number. It is found quite unexpectedly, that the structure of *RV* quantified in terms of the number of syllables in the *aṣṭaka* format is correlated with number 3339. With the help of the above new results, it may be possible to understand some parts of Vedic literature in a more rational and scientific manner, without discarding the esoteric and mystical contents, than has been so far possible.

Acknowledgements

Thanks are due to Prof.R.L.Kashyap for making available reference 1, and for useful discussions. Financial support by Indian National Academy of Engineering under its Engineering Heritage Program (Civil) is acknowledged.

References

1. R. Shama Shastry, *Drapsa: The Vedic Cycle of Eclipses*, Panchacharya Electric Press, Mysore 1938.
2. *Ṛgveda Saṃhitā*, Sanskrit Text with Anukramaṇī and Syllable Counts, Chowkhamba Samskrta Pratisthan N.Delhi, 2002.
3. R.T.H.Griffith, *Hymns of the Ṛgveda*, Munshiram Manoharlal Publn. N.Delhi 1999.
4. Sri Aurobindo, *Hymns to the Mystic Fire*, S.A.Ashram, Pondicherry, 1998.
5. D.Steel, *Eclipse- The celestial phenomenon that changed the course of history*, National Academy of Sciences, USA, 2003.(http://books.nap.edu/catalog/10123.html)
6. K.V. Sarma, "A Survey of Source Materials" *IJHS*, 20.1-4 (1985) 1-20.
7. S. Kak, *Astronomical Code of the Ṛgveda*, Munshiram Manoharlal Pubn. N.Delhi 2000.
8. H. H.Wilson, *Ṛgveda Saṃhitā*, English Translation, 1850, (www.archive.org/texts/)
9. *Brahmāṇḍa Purāṇa*, Sanskrit text (ed. A.N.Gangadhara Shastri) Sri Vidyā- Gāṇapati Trust, Bangalore 2002.
10. S.B.Dikshit, *Bharatiya Jyotish Sastra* (History of Indian Astronomy) English Transl. by R.V.Vaidya, Manager of Publns. Govt. of India, 1969.
11. *Vedāṅga Jyotiṣa*, Text with Transl. of T.S.K.Sastry, (ed.) K.V.Sarma, INSA, N.Delhi.
12. *History of Astronomy in India*, (eds) S.N.Sen and K.S.Shukla 2nd Revised Edition, INSA, N.Delhi, 2000.
13. S.D.Sharma, "Eclipses, Parallax and Precession of Equinoxes", *IJHS*, 20.1-4 (1985) 188-211.
14. R.L.Kashyap, "Essence of Veda", Article available at (http://www.vedah.com/org/literature/essence/toc.asp)
15. R.N.Iyengar, "Internal Consistency of Eclipses and Planetary positions in Mahābhārata" *IJHS*, 38.2(2003) 77-115.