

## THE STRUCTURE OF THE RĠVEDA

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The paper announces the discovery of an astronomical code in the structure of the *Rġveda*. The main elements of this code are deciphered. It is argued that the *Rġvedic* poets knew that the sun and the moon were approximately 108 of their diameters from the earth, and that between an average rising and setting each inscribed 339 diameters across the sky. This implies considering the value of  $\pi$  to be approximately 3.1389.

### 1. INTRODUCTION

The *Rġveda* has come down to us in the *Sākala* recension and it consists of 1017 main hymns and an additional 11 *khila* hymns that are called the *Vālahkilya* hymns. Several indexes or *Anukramaṇīs* to the *Rġveda* were written quite early. Śaunaka in his *Anuvāka Anukramaṇī* describes the number of words in *Rġveda* to be 153,286, but this does not include the *khilas*, and this suggests that the 1017 hymns formed the main book, and the rest served as an appendix. The *Bāṣkala* recension, according to Śaunaka, consisted of 8 more hymns, but this recension has not survived.

The hymns are divided into 10 *maṇḍalas* (books) of varying lengths. The question that we raise in this paper is whether there is a definite design to the organization of the hymns. In fact, this is an old question and an answer is implicit in the statement in *Śataṛuṭha Brāhmaṇa* 10.4.2.23 that describes the number of syllables in *Rġveda* to be 432,000, which equals the number of *muhūrtas* (1 day = 30 *muhūrtas*) in 40 years. The number of *muhūrtas* in a year is 10,800. This suggests that the organization of the *Rġveda* reflects some astronomical facts. This also raises questions about the significance of the number 108 that occurs often in Vedic texts.

Antiquated theories of recent decades about the structure and the internal chronology of the *Rġveda* will not be reviewed in this paper. We will show that several astronomical numbers underlie the structure of the book. This should also put to rest the theory about a gradual accretion of the hymns. This theory has been popular for some time in spite of contrary internal evidence. This is not to deny that there are hymns of varying antiquity, but our analysis will show that the whole framework has a unity.

As is well known, the Vedic synthesis of knowledge was based on the postulation of a correspondence between the cosmic, the terrestrial and the

physiological. This equivalence may be seen as the common thread that permeates all the Vedic literature. For examples of equations between the cosmic and the physiological one may see ŚB 8.1.1.6-2-6, AA 3.2.2.2-7, BU 2.2.4. One might ask what cosmic facts would be most apparent to the Vedic ṛṣis. The evidence for the knowledge of a year which is between 365 and 366 days is strong. This is reflected in the 371 or 372 *tithis* (lunar days), where there is a specific mention of 371 *tithis* in terms of the 3339 *bhāṃśas* (Kak 1993). The nominal division of the year into 360 days is widely encountered. The *Samhitās* and the *Brāhmaṇas* speak of ceremonies that depend on precise knowledge (Sengupta 1938) of the solstice days (e.g. AB 18.18, TS 4.4.10, KB 19.3, KB 5.1, PB 5.9, SB 2.6.4.11). Clearly, there existed a careful observation of the celestial phenomena.

This paper must be read as a companion paper to Kak (1993), where several related issues regarding Vedic astronomy are described.

## 2. TWO FUNDAMENTAL NUMBERS: 108 AND 339

In the context of the other information it is reasonable to assume that the Vedic ṛṣis had found the fundamental astronomical numbers 108 and 339. That this was so is corroborated by the *Rgveda* itself.

The number 108 is roughly the average distance that the sun is in terms of its own diameter from the earth; likewise, it is also the average distance that the moon is in terms of its own diameter from the earth. (The true averages obtained using modern instruments are 107.6 and 110.6 respectively, but 108 should be considered an excellent early approximation.) It is owing to this marvellous coincidence that the angular size of the sun and the moon, viewed from the earth, is almost identical.

It is easy to compute this number. The angular measurement of the sun can be obtained quite easily during an eclipse. The angular measurement of the moon can be made on any clear full moon night. An easy check on this measurement would be to make a person hold a pole at a distance that is exactly 108 times its length and confirm that the angular measurement is the same. Nevertheless, the computation of this number would require careful observations. Furthermore, 108 is an average and due to the ellipticity of the orbits of the earth and the moon the distances vary with the seasons.

It may be noted that the sky was divided into 180 degrees, a division that is at the basis of the nominal representation of the year by 360 days. It turns out that the angular measurement of the sun or the moon is about 0.54 degree. That this number is 1/200 of 108 invests both the numbers with enhanced significance. Furthermore, 108 is  $27 \times 4$ , where the mapping of the sky into 27 *nakṣatras* goes back to at least TS 4.4.10.1-3.

The second number, 339, is simply the number of disks of the sun or the moon to measure the path across the sky:

$$\pi \times 108 = 339$$

This represents the earliest approximation to  $\pi$  that takes it equal to 3.1389. Another way one might obtain the number 339 is:

$$0.54 \times 339 = 183$$

The actual product is more than 180, since 0.54 degree is slightly larger than the true angular size of the sun or the moon. Nevertheless, 183 is also of significance, since it represents half the number of days in the year.

Once 108 was arrived at, 339 could be easily calculated. These estimates must have been refined through mutually related measurements. For example, one could count the number of disks of the sun or the moon that would go into an arc of a specified extent.

With 339 being the number of what one might call sun steps during the day, the *ṛṣis* would have liked to relate it to the 183 days of the half-year. This has an excess of 156 units, which when divided into the 2 *sandhyās* of the dawn and the dusk apportion 78 to each.

The question might be asked as to what evidence supports such an astronomical interpretation for the numbers 108, 339, and 78 in the Vedic literature itself. There are two kinds of evidence: first, in the organization of the Vedic texts; second, in parallel with the details of *agnicayana*, or representation of time by a fire altar (Kak 1993). These will be described in the following sections.

### 3. TOTAL NUMBER OF THE HYMNS

Note that in *agnicayana* (Tripāthī 1990, Kak 1993) 21 bricks go into the formation of the *gārhapatya* altar. At the same time, 21 enclosing stones go around the *gārhapatya*, whereas the number of such stones around the *dhiṣṇya* and the *āhavanīya* is 78 and 261 respectively, making a total of 360. The *gārhapatya* represents the earth, whereas the *dhiṣṇya* and the *āhavanīya* represent the space and the sky respectively. In analogy, 21 days of the year may be called *gārhapatya* days: the remaining 339 days of the year represent the 78 days of the space and the 261 days of the sky. This provides a corroboration of our interpretation of the number 339.

Many hymns are very brief, whereas others are much longer. This suggests that when the compilation of the hymns into the *Rġveda* was made, the total number must have played a role. Now  $1017 = 3 \times 339$ . Also note that  $339 + 21 = 360$ . The

1017 hymns then symbolize the  $339 \times 3$  divine (space and sky) days of the three worlds.

Recall again the theory of the Vedic knowledge based on a similarity between the cosmic, the terrestrial and the spiritual. This is why the geography of the *R̥gveda* counts just three sevens or 21 rivers in RV 10.75.

Also note that a lunar day, called a *tithi*, was considered equal to 9 *bhāmsās*. An explained in Kak (1991), the RV 3.9.9 and RV 10.52.6 reference to 3339 gods in a year, personified as *Agni*, represents the 371 *tithis* in the year. It is also quite possible that this 3339 is coded doubly into the  $339 \times 3$  for the total number of hymns.

#### 4. ORGANIZATION OF THE BOOKS

The *Anukramaṇīs* ascribe books 2 to 7 to the *ṛṣis* Gr̥tsamada, Viśvāmitra, Vāmādeva, Atri, Bharadvāja, and Vasiṣṭha or their families. Book 9 is a collection of hymns by several *ṛṣis* to *Soma Pavamāna* or *Soma* poured through the filter. Book 1, which consists of 191 hymns, is classed into 15 groups of hymns by different seers. Book 10 also consists of 191 hymns and its first 84 hymns are classed into 25 groups based on *ṛṣis* and its remaining 107 hymns are counted singly.

The classification of the family books 2 to 7 is based on hymns to different gods and these groups are 5, 4, 11, 7, 5, 12 respectively. Book 8 hymns are grouped according to the particular seers of the Kaṇva family. Including the *Vāḷakhilya* hymns these constitute 19 groups. The hymns of Book 9 are grouped into 7 according to the metre. These metres are *Gāyatrī*, *Jagatī*, *Triṣṭubh*, *Anuṣṭubh*, *Uṣṇih*, *Pragātha* and miscellaneous. These hymns are by a host of *ṛṣis*, including Bhṛgu, Kaśyapa and Kavi Uśanas. This information is summarized in Table 1.

Table 1: Hymns and groups

<i>Mandalas</i>	1	2	3	4	5	6	7	8	9	10
Hymns	191	43	62	58	87	75	104	92+11	114	191
Groups	15	5	4	11	7	5	12	18+1	7	25+107

One would expect that if the *R̥gveda* is considered akin to the five-layered altar described in the *Brāhmaṇas* (Kak 1993), then the first two books should correspond to the space intermediate to the earth and the sky. Now the number that represents space is 78. When used with the multiplier of 3 for the three worlds, this yields a total of 234 hymns. We find that is indeed the number of hymns in these two books. One may represent the *R̥gvedic* books as a five-

layered altar of *mantras*, as shown in Table 2.

Table 2. The altar of books

Book 10	Book 9
Book 7	Book 8
Book 5	Book 6
Book 3	Book 4
Book 2	Book 1

Note that the structure of this representation has considerable regularity. In particular, Books  $(4 + 6 + 8 + 9) = 339$ . Other relationships are apparent from Table 3.

Table 3. Hymns in the altar of books

191	114
104	92
87	75
62	58
43	191

We see also that the number of hymns in the different books (*maṇḍalas*) satisfies the following relationships:

$$\text{Books } (1 + 2 + 3 + 4) = 354 \text{ (Lunar year)}$$

$$\text{Books } (4 + 7) = \text{Books } (5 + 6) = 162 \text{ (1/2 } \textit{Nakṣatra} \text{ year)}$$

$$\text{Books } (4 + 5 + 6 + 7) = 324 \text{ } \textit{Nakṣatra} \text{ year}$$

$$\text{Books } (6 + 7) = \text{Books } (5 + 8) = 179 = 1/2 \text{ Books } (1 + 6 + 8) = 1/2 \text{ Books } (5 + 6 + 7 + 8)$$

$$\text{Books } (5 + 7) = \text{Book } (1) = \text{Book } (10)$$

Note further,

$$1/2 \text{ } \textit{nakṣatra} \text{ year} + 21 = 1/2 \text{ year of 366 days.}$$

The number of hymns in Books 1 and 10 is 191. This number also satisfies the interesting equality:

$$191 = 113 + 78$$

where the significance of 113 and 78 has already been explained.

## 5. MORE ON THE ASTRONOMICAL BASIS

The total number of groups, excluding the *Vālakhilya* hymns, is 216. This is twice the 108 diameters of the sun that describe the distance from the sun to the earth. This is 1/2000 the fundamental great *yuga* number of 432,000, which according to the *Satapatha Brāhmaṇa* equals the number of syllables in the *Rgveda*.

PB 16.8.6, PB 21.1.9 speak of the sun being at a distance of a thousand earths from the earth. This statement is not factually correct, since the correct distance is more than 10 times greater than this figure. But the number of 432,000 may now be seen as a product of the total units of the sun and the earth diameters that are assumed to be separating the two.

## 6. GEOGRAPHY OF THE ṚGVEDA AND THE SARASVATĪ SCRIPT

The geography of the *Rgveda* is of enormous help in determining a chronology of the hymns (e.g. Frawley 1991).

RV 7.95 and RV 6.61 speak of Sarasvatī being the pre-eminent river of that age, flowing from mountains to the sea. RV 2.41.16 calls it *nadītamā*, the best of rivers. RV 6.61.14 indicates that region around the river was the centre of the Vedic people. An allusion to building a fire altar on the banks of Sarasvatī and Dṛṣadvatī to represent time is in RV 3.23.4. *Mānava Dharma Sāstra* MDS 2.17.19 defines *Brahmāvarta*, the land between Sarasvatī and Dṛṣadvatī, as being the most sacred.

After the *Rgvedic* age, the *Brāhmaṇas* speak of the disappearance of the Sarasvatī in the desert. PB 25.10.16 speaks of the source of Sarasvatī in the mountains 40 days horseback from where it is lost in the desert. The source is called Plakṣa Prāsravaṇa, which is apparently a lake.

Archaeological research has established (Kenoyer 1991) that the Sarasvatī river dried up around 1900 B.C.E., when as a result of tectonic shifts its tributaries Sutudrī and Yamunā were captured by Sindhu and Gaṅgā. Note also that most of the settlements of the Harappan phase (2600-1900 B.C.E.) of the Indus tradition were on the banks of the Sarasvatī river (Fig.1). This tradition goes back to at least 6500 B.C.E. (Kenoyer 1991, Kak 1992). With the settlements of *ṛṣīs* on the banks of the Sarasvatī river it is not surprising that the later tradition represents Sarasvatī as the goddess of learning. It appears that this tradition alludes to the development of writing in the Sarasvatī region. This suggests that perhaps the earliest script of India was called the *Sarasvatī* script; this is the script that is now popularly known as the Indus script. Recent analysis has shown (Kak 1988, Kak 1989, Kak 1990) that this script and the later *Brāhmī* script are related. This squares with the tradition that the *Brāhmī* script represents a renewal of a tradition of learning that had been interrupted.

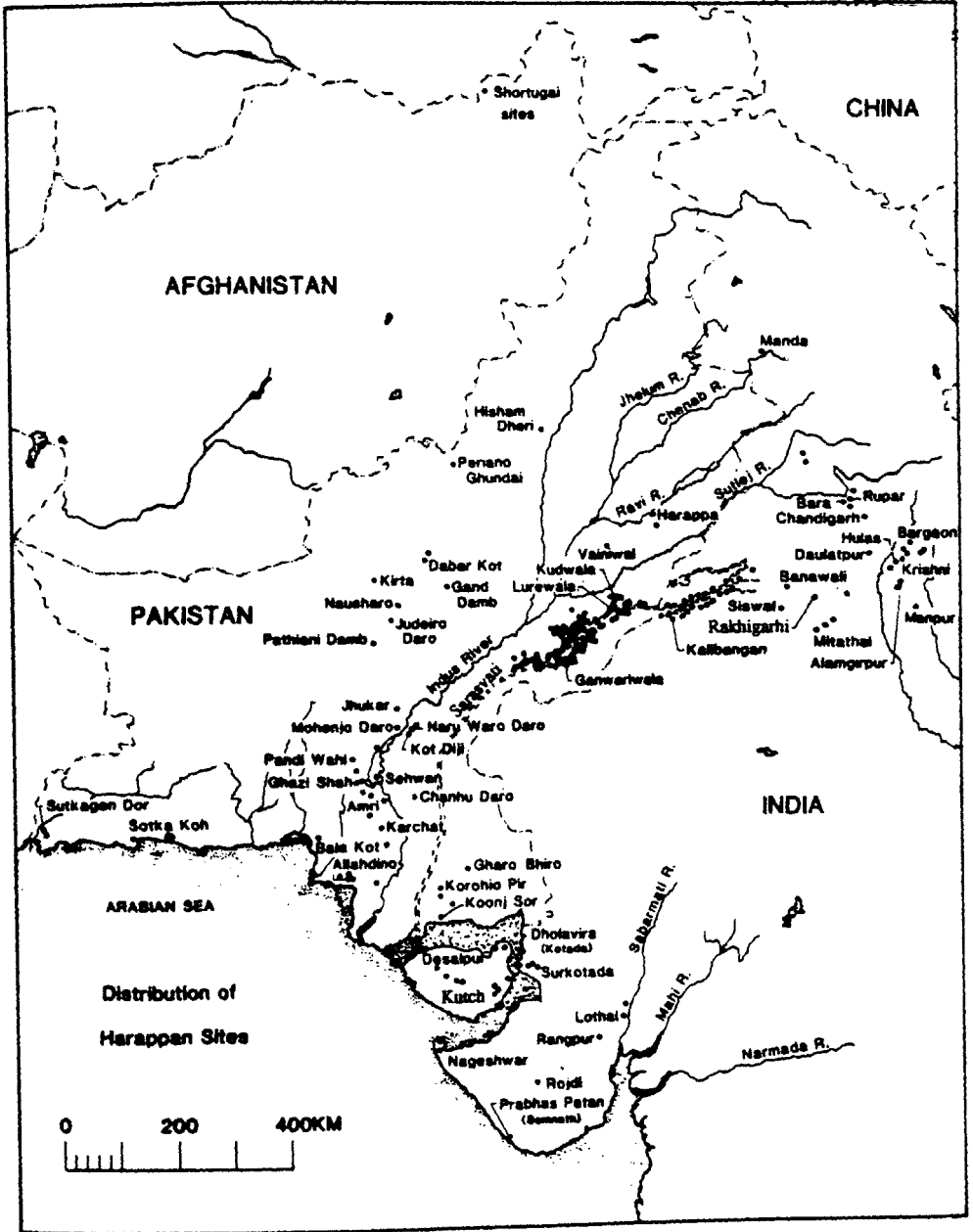


Fig. 1. Harappan sites of the 3rd millennium B.C.E.

## 7. DISCUSSION

One might assume that the compilation of the hymns was made based on a large number of available hymns. Just as the total number of 1017 was deliberately chosen, it is also likely that the number of hymns in the individual books had astronomical significance. This may also have been true of the manner in which the hymns were grouped.

The *Vāḷakhilya* hymns appear to have the significance of the 11 extra days that need to be added to the lunar year to obtain the solar year (Kak 1993). At one level the entire *Ṛgveda* appears to be a representation in *mantras* of the *agnicayana* rite.

One reason why the syllables of the *Ṛgveda* were preserved with incredible fidelity is that the total represented measurements of natural processes. We do not yet know the significance of all the books of the *Ṛgveda*, but other details are emerging that will be discussed elsewhere.

**Abbreviations for Vedic Texts**

AA	<i>Aitreyā Aranyaka</i>
AB	<i>Aitreyā Brāhmaṇa</i>
AV	<i>Atharvaveda</i>
BU	<i>Bṛhadāranyaka Upaniṣad</i>
KB	<i>Kauṣītaki Brāhmaṇa</i>
MDS	<i>Mānava Dharma Sāstra</i>
PB	<i>Pañcaviṃśa Brāhmaṇa</i>
RV	<i>Ṛgveda</i>
SB	<i>Śatapatha Brāhmaṇa</i>
TB	<i>Taittirīya Brāhmaṇa</i>
TS	<i>Taittirīya Saṃhitā</i>

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