

Vedic astronomers

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Abstract. The aim of this paper is to show that natural origin of Hindu astronomy in remote antiquity is the Indian environment of six seasons of monsoon climate. The deities and demons described in the Rigveda are either astronomical points or celestial constellations in the definite divisions of the zodiac as observed from the line of tropic of cancer in India. Hindus conducted researches in fundamental topics of astronomy i.e. art of inserting an intercalary month in a year : by Shunashshep, identification of the day of summer solstices by Ashvinikumars alias Nasatyas, identifying the four days pertaining to the solstices and equinoxes and fixing the corresponding celestial points of helical rising of four asterisms for this purpose by Ribhu Brothers.

The identification of the summer solstice by Ashvinikumars is proposed to be done by looking at the solar image in a well somewhere around the line of tropic of cancer in Central India.

The chief Rigvedic deity Indra is proposed to be a celestial point at 180° away from the Sun, the enemies of Indra i.e. Vritra, Shushna Ahi etc., are also identified as constellations and asterisms. The hypothesis for these identifications is discussed in depth.

The origin of Indian astronomy is traced back to the Rigvedic hymns leading to its independent development based on Indian sky observations.

1. Introduction

Different groups of stars in the sky, have played an important part in the evolution of human civilisations, even in remote pre-historic times. Many ancient civilisations were in close contact with Nature, especially the sky and the celestial bodies. Lapaas could count sidereal days at North Pole during long nights by counting the revolutions of the stars around the celestial North Pole. (See Tilak, 1925, p.175) Egyptians calculated the number of days in a year as 365 from the helical rising of Sirius, because of simultaneous rise of the level of water in the river Nile. From the

Egyptian name of the Star, the year came to be called as Sothic Year.

According to me, astronomy, astrology, and theology had a common origin in India. The pre-historic Indians could note the coincidence between rising of a particular constellation on the eastern horizon, immediately after the dusk, and the occurrence of a particular season, e.g., the rise of Orion on the eastern horizon, caused the first showers of the rainy season and the appearance of the constellation scorpio on the eastern horizon heralded the setting in of severe winter. Their feeling about the commencement of seasons, was akin to conditioned reflexes, rather conditioned responses.

Noting of such coincidences was the beginning of astronomy, because that made them identify different constellations. Their prediction of the commencement of the various seasons was the incipient stage of astrology. They felt that some supernatural powers or divinities were behind the constellations in the sky, and they caused the seasons. The belief in such divinities was the beginning of Divine worship in India.

I guess that the art of writing had not developed in those days. Vedic people expressed their feelings in the form of folk songs. It became a religious text for them, as such it was preserved subsequently for thousands of years. The contents were expressed in better language, subsequently, which were further used for the same purpose.

This Paper deals with the development of astronomy in India, in shady antiquity.

2. Nakshatra deities

In Vedang Jyotisha, a text for Vedic Almanac, we find that the ecliptic is divided into 27-28 divisions called 'Nakshatras' which are named according to the asterism comprising it. Every 'Nakshatra' has a corresponding deity. A list of their names is given in the text. Taittiriya Brahmana (4-4-10) Taittiriya Samhita (1-5-1) and Atharva Veda (1-9-5) which belong to an earlier period also give such a list. In early Vedic period the divisions of the ecliptic were only treated as six and their deities were called Adityas, as will be evident from what follows.

Aadityas : Two verses in Vedic literature give us a key to explaining the astronomical concept of the Vedic Aadityas. Both are addressed to the Moon.

यमादित्या अंशुमाप्यायन्ति यमक्षितमक्षितयः पिबन्ति

Tait. Sam 2-4-14

यत्त्वा देव प्रपिबन्ति तत आप्यायसे पुनः ।
वायुः सोमस्य रक्षिता समानां मास आकृतिः ॥

R@k. Sam. X-85-5

From these verses we find that the full moon was treated as a Round flask which gradually got filled in by 'Soma-Juice' and on full-moon day, it touched the lips of 'aadityas' and returned from

the other direction. The drinking of 'Soma-Juice' must then occur at 180° away from the Sun at the nearest point on the ecliptic i.e. at full-moon position. Let us find out who these Aadityas are. Rig (II-27-1) gives us the list of six Aadityas - (i) Mitra; (ii) Aryama; (iii) Bhaga; (iv) Varuna; (v) Daksha and (vi) Amsha. They are in a cyclic order. In India, the Monsoon climate has six seasons : (a) Shishira - Winter rains; (b) Vasant - Spring; (c) Grishma - Summer; (d) Varsha - Summer rainy season; (e) Sharada - Autumn; (f) Hemanta - Dry winter. Varuna is a deity of the rainy season, Varsha (See Figure 1)

We thus have a corresponding Aaditya for each season. This shows that the ecliptic (or Zodiac) was divided by the Vedic sages into six divisions one for each season, with its corresponding Aaditya. It is worthy to note that the Sanskrit word "Bhagah" means strength, power or prosperity. The Aaditya of the summer season gets that name. In this season, the Sun reaches the highest altitude and is most powerful. In RVJ. VII-41-2 Bhaga is addressed with an adjective "Ugra" (उग्र) which means fierce, terrific, intense, sharp, hot etc (Apte's Sanskrit English Dictionary). In Rig I=136-2 it is said that "Bhaga's path is more widely laid. The path of holy law (nature causing seasons) been maintained with rays. Visualise it with Bhagas Rays". The word 'Amsha' means a fraction or a part. The divinity of Winter is 'Amsha' because in this season, the power of the Sun gets diminished and it climbs the sky only partially. The names 'Mitra' and 'Varuna' correspond to the seasons of winter rains, and summer rains. They are the divinities of rains. Several hymns in Chapter V of the Rigveda, especially Hymns 62 (3-4) 63 (2 and 4) and 68(5), 69(2) of 5th Mandala state this fact in unmistakable words. They are praised for sending forth rains. Sanskrit words "Varsha" and "Parjanya" which occur in these verses mean downpour of rains.

Autumn follows winter rains. If Aaditya is "Dhaataa". The word "Dhaataa" means creator of the Universe. Its meaning in the relevant place is creator of nascent corn on food plants.

In India there is a traditional belief that the Spring season inspires attraction in young boys and girls, towards each other. The great Sanskrit poet Kalidasa has described this in his poetry "Ritusamhaar" verse 24 and 27 of Sarga VI. Let us now turn to Rig. V-3-2, it reads.

"Aryama (lord) art thou as regardeth maidens; mysterious is thy name, O self sustainer. As a kind friend, with streams of milk they balm thee, what time thou makest wife and lord one minded".

Rig. V-3-2, (Trans. by Griffith)

Aryaman is described as a deity of fertility. He is praised for giving progeny and cattle (Rig.III-54-18 and X-31-4).

Every Aaditya occupied a division of 60° of the zodiac. Tait. Br. 1-5-2-2 states that Daksha Prajapati occupies 5 Nakshatras of the Hindu zodiac. They are from 'Hasta' (Corvus) to Anuradha (Deschouba). They cover about 60° of an arc. Aditi is the mother of the whole ecliptic or zodiac. The mystic verse x - 72 - 4 can be explained best from this point of view. It says Daksha was born of 'Aditi' and Aditi was Daksha's child. In the Vedic period some people started their year with the beginning of Sharad Ritu, i.e., Autumn, i.e. with the rising of Daksha sign on the Eastern horizon, after dusk. The ecliptic began with that point and ended with the point.

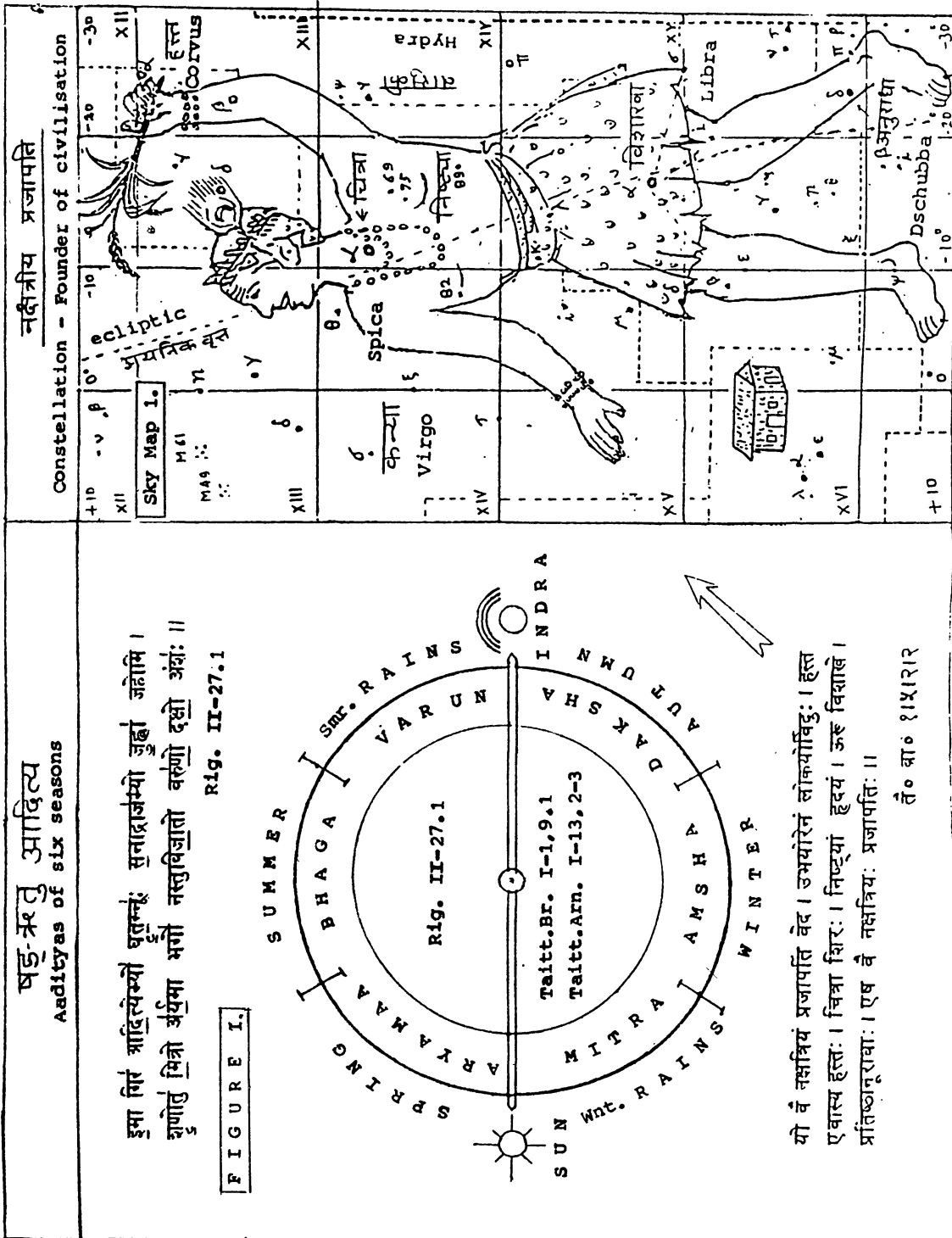


Figure 1. Left : The six seasonal Adityas Right : Nakshatriya Prajapati.

Eight Aaditya Indra : In the Rigveda, we also find mention of eight Aadityas. From Rig. X-72-8 we learn that Aditi had only eight sons. Nighantu gives a list of twelve Adityas, but that is a post-vedic list. We are at present concerned with original number of Aadityas in the Rigveda. One of the names of the Sun is Aaditya. In Rig. IV-18-4, Indra is the son of Aaditi, and in Rig. VIII-52-7 (Vaalaakhilya hymn No.4) he is called the fourth Aaditya. Perhaps the sage composing the verse counted three major seasons 'Sharada' 'Hemanta' and 'Grishma' with these divinities for them, as Aadityas. Therefore, Indra was counted as the fourth. But there is no mistaking the fact that he was regarded as one of the Aadityas. Taittiriya Brahmana (I-1,9,1 (F) and Taittiriya Aranyak (I-13, 2-3) give a list of eight Aadityas. They are grouped in four pairs - Dhatri-Aryama, Mitra-Varuna, Amsha-Bhaga and Indra-Vivaswata, (See Tilak, 1925). In the first three pairs, Aadityas on diametrically opposite sides are grouped together. In the fourth pair, Vivaswata means the Sun, Indra should therefore, be presumed as a point diametrically opposite to the Sun by harmonious construction.

Vedic bards situated in tropical belt presumed that Indra remains close to zenith at mid night. They therefore describe his position as vertically up in the sky (in the direction pointed by vertical bamboo ब्रह्माणस्त्वा उद्वंश येमिटे Rig. I-10-1), at the top of the celestial dome (यत्सानो सानो मारुढ Rig. I-10-2). Indra is called as "Sapta rashmi Vrishabha" i.e. bull emitting seven Rays in Rig. II-12-12. It appears to me that he is so addressed because he occupies the centre of a rainbow which is always at 180° away from the Sun. A beautiful sight of rainbow is described in Rig. VI-44-23 and 24. Verse 23 describes morning with its crimson goddess "Usha" followed with the rising of the Sun in the east. While verse 24 describes the chariot of Indra on western horizon emitting seven rays (of rainbow). This again fixes the position of Indra in the sky as diametrically opposite to the Sun (that is at the centre of the rainbow).

Sayana touched the subject of pairs of Aadityas while explaining Rig. I-164-15. However he took the meaning of the word Aaditya as "the Sun". He explained verse on the presumption that there are 12 Suns in the sky, one for each lunar month. Each pair of such months formed a season. The seventh partly born son of Aditee is a deity of the intercalary month. However, he did not read this verse with RV. X-72-8, RV II-27-1 and Tait Br. I-5-2-2, as given in Figure 1. From Rig. I-136-2 we also get that Mitra, Aryaman and Varuna had separate houses (i.e. allotted area) in the sky, which are similar to those which are presumed by the astrologers for each of the twelve signs of zodiac. Which strengthens our proposition in respect of nature of Aadityas. There were six constellations for six seasons occupying 60° each from the zodiac, for six Aadityas. The partly born Aaditya in RV X-72 was Indra.

3. The concept about 'Indra'

Griffith (1976) in his commentary on Rig. I-2-4 sums up the general impression about Indra, thus - - "Indra" was favourite national deity of Aryan Indians in the vedic age. He is the God who reigns over the immediate region of atmosphere, he fights against and conquers with thunderbolt the demons of drought and darkness, and is in general, the type of noble heroism." It is necessary to find out the root cause that made the Vedic civilisation feel the existence of the divinity called Indra, and the material circumstances for the invitation of such a deity. Indra is described as a

traveller moving in his Chariot which was pulled by horses (Rig. III-55-18). He drinks 'Soma-Juice' with the seasonal Aadityas on Full-Moon Day (Rig. I.-15-I). Full Moon is always seen at 180° away from the Sun. That is the point, which rises on the Eastern horizon immediately after dusk, or remains at the top of the Sky at midnight in tropical belt. It appears that Indra takes two months to cover the journey through the region of one Aaditya. His vehicle (chariot) moves above the air. In Rig. II-30-3 the Vedic sage says that :

"Aloft he stood above the airy region and against Vritra. He shot his deadly missile enveloped in cloud, he rushed upon him (Griffith)."

If we find out the position of the demon Vritra, it will be clear what vedic sages meant by 'Indra'. In Rig. I-80-7 the demon Vritra appears in the guise of an antelope (Mriga). In Rig. V-34-2 Indra is said to have lifted a mighty weapon with thousand points to kill the demon antelope. It is mentioned in Rig. VIII - 69 - 15 that Indra killed a huge antelope for his mother. Hindus call the constellation Orion as an antelope (Mriga). From the very beginning, it is in the list of 'Nakshatrics'. We can say that the constellation Orion used to rise on an Eastern horizon, immediately after dusk with the commencement of the rainy season. The traffic sound of thunder gives an impression that Indra is killing the demon Vritra, i.e. Orion. It is stated by the Vedic bards that Vritra was encompassing the water of a celestial river and on his death, the water began to flow. Griffith has translated the relevant verse as follows :-

"There it lies as like a bank-brushing river, the waters taking courage flow above him.

The dragon lies beneath the feet of torrents, which Vritra with greatness had encompassed."

Rig. I-32-8.

The same fact is told in different words in Rigveda, I-54-10.

The constellation Orion lies on the Western bank of the milky way. The river referred to in the aforementioned verse is obviously the milky way. The Milky way is traditionally called the celestial Ganges, (Aakash Ganga) by Hindus. It appears that it was called the celestial Rassaa in Vedic period (Rig. X-108-1-2). There is an additional evidence to show that Indra was hypothetical point moving at a distance of 180° away from the Sun, on the ecliptic, the existence of which was felt by the VEDIC Bards, out of conditioned response. He is described to have been swallowed by a female demon Kushava, and thereafter he escapes, and rises unhurt with conquering vigour (Rig. IV-18-8). This is a clear description of Lunar Eclipse which occurs at a point 180° away from the Sun. We will go through the nature of conditioned responses in the subsequent paragraphs. What is relevant for us at this stage, is the hypothetical nature of Indira. His existence was felt by inference, though he was not visible. So his existence was challenged.

"Striving for strength bring forth a loud to Indra a truthful hymn if he is in truth existeth. . . one, and another say, there is no Indra, who has seen him who has beheld him? What then shall we honour?"

Rig. VIII - 100 - 3

It is pertinent to mention here that similar pairs of hypothetical points i.e. the nodes in Moon's

Orbit are regarded as demons who cause solar and lunar eclipses. They are called 'Rahu' and 'Ketu'. Their existence is felt by inference. They complete their revolution around the earth in 18.6 years, though they are invisible. The Sun (visible) and Indra (invisible) form a similar type of pair of Aadityas.

Exploits of Indra : It appears that Indra was conceived by the Vedic stages, as a divinity, who helps the season Gods (Aadityas) in their function of forming the seasons. We have, therefore, hymns on the combined efforts of (i) Indra, and Varuna in causing rainfall (Rig. I-17, III-62, IV-42, VI-68, VII-82-85, VIII-59) (ii) Vishnu appears to be a divinity of Winter-rains. In this sense, it is another name of Aaditya Mitra. There are hymns on the combined efforts of Indra and Vishnu for fighting against demons Shambara. (iii) Indra kills another demon by name Shushana, Griffith (Rig I-2-7) gives the meaning of the word as "the excessive heat and drought before rains" Shushana is described as having horns (Rig. I-33-12). This description is applicable to the "V-shaped" Constellation, "Hydes" which include the bright star Aldeberon. "Rohina" is described to have been slaughtered by Indra. Griffith (Rig I-102-2) says that he is a demon causing drought. 'Indra's conflict with him is mentioned in Rig. I-102-2, and Rig. II-12-12.

"Who with seven guiding rains (ऋषी) the bull, the Mighty set free the seven great floods to flow at pressure? Who thunder armed rent Rohina in pieces, when scaling Heaven?
He O ye men, in INDRA." (Rig. II-12-12)

We can therefore, conclude that demon Shushana Rohina is the "V"-shaped constellation of "Aldeberon". He is a demon of summer season with two horns. His scorching heat is removed by Indra by starting rainy season.

Another demon in Rigveda is called as "Ahi" which means a dragon or a serpent. He can be identified with the constellation 'Aaslesha' (Hydra) The Lord of the Constellation 'Aaslesha' as described in Taittiriya Samhita (V-9-4-10) and Vedanga Jyotisha (verse 6) is a serpent. His name occurs at 21 places in the Rigveda. He is slaughtered by Indra for obstructing rains. The celestial river starts flowing when he is slaughtered. It appears that the demons who were withholding water in the rainy-season, were destroyed by the joint efforts of Indra and Varuna. Indra destroys the demon encompassing the water of the celestial river to make it flow freely and Varuna serves the people in distributing it in the form of rain. (Rig. VII-82-6, and Rig. VIII-85-3).

There are about 30 demons in the Rigveda who are destroyed by Indra. Scholars of the 19th Century and Lokmanya Tilak (1925, ch IX, Para 8) felt that they are different names of one or two demons. See also Griffith (Rig. 1-4-8). With the concept of seasonal demons in the form of asterisms on the path of the Sun, the Moon, and the Planets (Zodiac) we can make a spectrum analysis of these demons in relation to their shape or season at the time of their rising and fix their celestial positions.

Rohini is described in Taitt. Br.-I-1-10-6 thus :-
"She climbed up. Therefore, she became Rohini....."

Imagine Orion (Mriga) as midnight constellation on the day of summer solstice and then it is being replaced by Aldeberon रोहिणी to occupy the topmost position in the sky, at midnight, due to precession of four seasonal points on the ecliptic. We then see Aldeberon, as climbing the Sky from the Western direction.

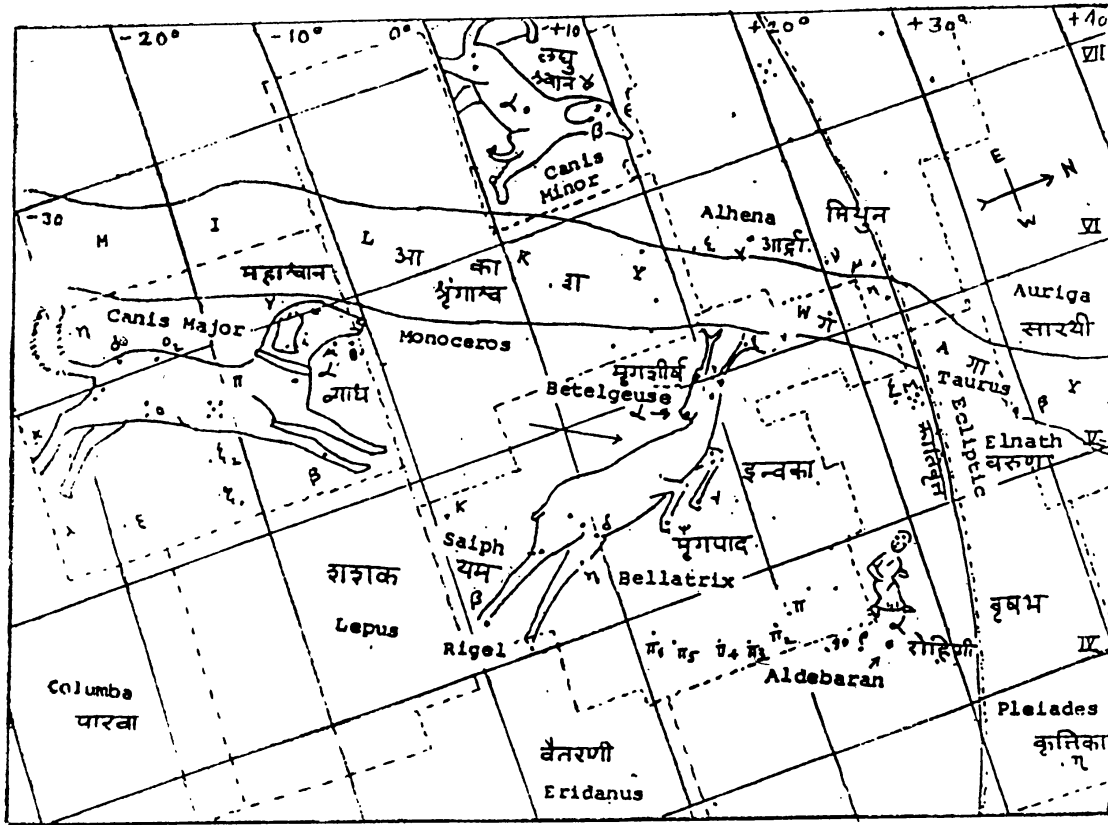
4. Vedic astronomy

a) *Angirasis*: Indian agriculturists during the Vedic period must have awaited the beginning of summer rains at the expected time. While early sowing of seeds could spoil the crop due to rains at the end of the rainy season, late sowing would spoil the crop at the end of the season for want of rains. The priests who performed the sacrifices were called 'Navagva' and 'Dashgva' Angirasas because they performed sacrifices for nine or ten months, see Tilak, 1925, P 132 and (Rig.V-45-7). According to me, they began the sacrifices on the first clear full-Moon day in Autumn so that they could complete them at the commencement of summer rains. The arrival of rains at the expected time must have been thought of as a mark of their success.

The functions of sacrifices: Oblations (Food) offered to the holy fire of sacrifice were burnt and their vapours rose to the heavens. According to me, they were supposed to reach Indra near the zenith at every midnight (Tar-Sam.II-4-14, Rig.X-85-5). Indra and the associated Aaditya were imagined to have accepted the pleasing smell of the vapours. They were supposed to be delighted by the smell and as a reward they were supposed to commence the seasons regularly. In addition to this, the full-moon which was imagined to be a pot of Somajuce was supposed to reach the lips of Indra occasionally. Offering of oblation and prayers to Gods through fire can be possible only in tropical belt. No poet in polar region, Europe or Babylonia can have a concept of full Moon as a round flask ascending the heaven with Somajuce. The Moon moves above the southern horizon in these regions with a vertical arc indicating that the Somajuce would fall on the ground.

Midnight astronomy and sacrifices: For visualising the description of the moon as given in the verses Taitt.Sam.2-4-14 and RikSam.X-85-5 quoted in para 6 above, the observer must look at it every mid-night from its eighth day (Sk 8th) to 23rd day of age (Kr.8th) so that the poetic moon-pot should get completely filled on the full-moon day to touch the lips of Indra and the relevant Aaditya of the season. We are also required to imagine at such a time the position of Indra at zenith as described in Rig I-10-1 and 2 as quoted in para 12 above. We are also required to mark the asterism of season i.e. dasyu (demon) being shot by Indra as described in para 18 above, which explains us the way in which mid-night astronomy as well as mid-night worship began in India in shady antiquity.

b) *Shunanshep the astronomer* : Almost all the early civilizations of the world called a lunation as a month and the tropical cycle as a year. Most of the civilisations failed to link these two units of time. (See Encyclopaedia Britannia XV Edn. Vol.3 on Calendars). The art of inserting 'Adhik-Maas' (intercalary month) was difficult to achieve. A young boy of Vedic civilisation solved the problem. He was tied to a pole in preparation to be offered in a sacrifice. He asked for some time to offer prayers to some deities. (See Aait Dr. 3rd Chap. 7th Panh). Verse Rig.I-25-8 was composed by him in the praise of Varuna :



Shunahshepa method of detecting inter calary month (अधिक मास) Star Varuna is on the ecliptic. Observer at point E marks full moon to follow Varuna's minimum distance in the year on the East; counts it as first full-moon and first month. After 12 months full-moon is on the western side of Varuna. If 13th full-moon does not cross Varuna, count it as of an Inter-calary month; if it crosses Varuna, it is the 1st month of the next year.

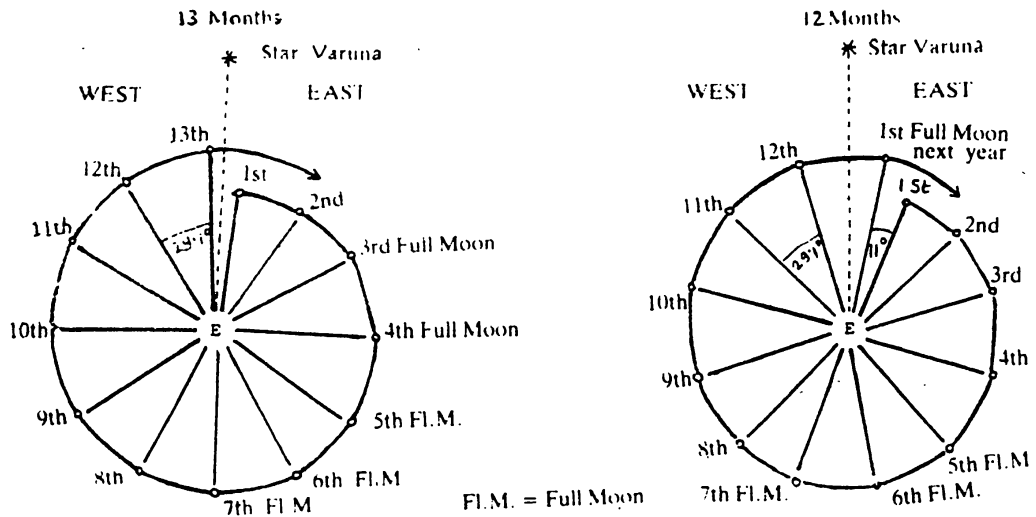


Figure 2. Top : Identification of Varuna.
Bottom : Shunahshepa's criterion for adhika masa (intercalary month).

"He who accepting the rites (dedicated to him knows the twelve months and their productions, and that which is supplementarily engendered." Rig. I-25-8 (Wilson)

We have seen that Varuna was an Aaditya for rainy season. We can get his location in Rig.X-14 (Yama Anteyshthi Hymn). The departed soul is given direction to start its journey towards heaven at the point where the Milky Way touches the southern horizon near Orion. He is directed to pass by two kingdoms of YAMA and VARUNA (Rig.X-14-7) and Rig. (X-14-10)

"Depart, depart by the former path by which our fore-fathers have departed, there shall thou behold the two monarchs YAMA and the divine VARUNA." Rig.X-14-7 (Wilson)

"Pass by secured path beyond the two spotted four eyed dogs the progeny of SARMA and join the wise Pitris who rejoice joyfully with YAMA." Rig. X 14-10 (Wilson)

Varuna is thus traced out as a star or group of stars on the cross-lines of the Milky Way and the ecliptic. It is either Alhena or the "Gate of the heaven" formed by Procyon and Pollux". It is obvious that stars cannot speak and count twelve lunations in the year and add the intercalary month. Men can make their use and devise a method to do so. The simplest method for the purpose, to my mind, is to count the first full-Moon at the nearest point on the eastern side of Varuna as the full-Moon of the first month, the subsequent full-Moon on the eastern side as the second month. The circle will have been traversed usually after twelve months in a year. Occasionally, we shall have the thirteenth month. See Figure 2.

c) Effect of precession of equinox

In the Vedic history, there was a period that witnessed the rainy season commencing on the days when Mriga (Orion) appeared on the eastern horizon after the dusk. Mriga had, therefore, acquired a religious significance. After the lapse of 960 years, Aldeberan shifted to the place previously occupied by Orion; and Orion to the place of Alhena and likewise on the belt of seasons. This change was noticed by Vedic bards. They, therefore, wrote the hymn Rig.X-86 commonly known as "Indra-Indrani, Vrishaakapi dialogue".

d) Indirect or circumstantial evidence

Most of the direct evidence provided by Vedic history is lost by the destruction of libraries of alien invaders. Two such libraries were the libraries of 'Taksha-Sheela' and of 'Naalandaa'. Fortunately, we have preserved it in the form of poetry, i.e. Vedic literature. In the pursuit of knowledge about very small objects like atoms and molecules, or very big objects like the stars, nebulae, galaxies or the universe, circumstantial evidence is accepted as one of the modes of search for truth. It may be called inductive method. While studying the history of remote antiquity, the same method is to be followed. It goes without saying that all rules of interpretation of circumstantial evidence have to be strictly followed when we are required to resort to such a method of interpretation. Turning to

our subject, my proposition is that "Naasatyas", who were also called the Ashwinikumaar and Ribhu-brothers, were great astronomers of Vedic times. The Vedic bards have used a figurative language to record history. Their words have assumed technical meaning because they are consistent in the use of words, e.g. 1. Ashwinikumar's car or chariot means the calendar designed by Ashwinikumar for the performance of sacrifices based on the rotation of the celestial vault. 2. Twastri's Chamas or ladle means the celestial vault. For having such definitions, we either get direct evidence or we have to use the rules of consistent reading. I would like to give a modern example of such technical words. Allegorical or symbolical terms and narrations are occasionally used in science and technology. Early instruments for measurements of electrical resistance were called "meter bridge" and "post office box". The word "lines" is used in three establishments : (i) aviation, (ii) railways and (iii) tele-communication. We gather the meaning from the context. The rules for interpreting these terms are (i) context and (ii) consistency. Hymns in the Rig. Veda were composed in remote antiquity. We must, therefore, use these rules for its interpretation. The wheel of a car is defined in Rig. I-164-48 thus :

"Twelve are the fellies, and the wheel is single; Three are the naves what man has understood it; There in are set together spokes, three hundred and sixty, which in nowise can be loosened."
Griffith Rig. I-164-48.

Here the wheel represents the twelve months, three seasons and 360 days of the year. The word wheel or car therefore, means a time scale or a calendar.

6. Ashvinikumars as astronomers

Two brothers, known as Ashvinikumars, Nasatyas or Dasaras, were astronomers of the Vedic period. In Rig-I-119-7 the poet tells us that Ashvinikumars repaired a worn-out car by taking out VANDANA out of a well. Similarly in Rig. I-20-3 the Vedic poet, while speaking about Ribhus, says -

"They constructed for NASATYAS (Ashvins) a Universally moving easy car, and a cow-yielding milk."
Rig.I-20-3 (Wilson)

The car referred to in these verses is the sidereal calendar based on the yearly motion of the celestial vault. The calendar was used for yearly sacrifices. Let us first investigate what were the exploits of Ashvinis. One of the important exploits of Ashvinis was to take out "Vandana" from a well.

"You extricated DASARA (Ashvins) the sage VANDANA, cast into well, like handsome and splendid ornaments designed for embellishment laying ASHWINS, like one sleeping on the lap of the Earth, or like the Sun disappearing in the darkness (you recovered VANDANA.)"
Rig. I-117-5 (Wilson)

As I think, the bright thing "VANDANA" mentioned in the verse is the image of the Sun in the well water. They observed the image of the Sun a few days before and after the day of Summer

solstice in the deep level of water in a well. The poet compares the bright thing with an ornament and the Sun, which is praiseworthy. In the next part of the sentence he compares it with an animal or a man sleeping on earth. Such a thing can only be the God SUN.

The incident of Ashvins taking out Vandana and Rebha from a well is given in Rig.I-112-5, Rig.I-116-11, Rig.117-5, Rig.I-118-6, Rig.I-119-6, Rig. 119-7, Rig.116-24 and Rig.117-4. Of these eight verses, I-117-7 is most important, for it stresses the achievement made by Ashvins through these exploits.

"Skilful DASRAS (Ashwins) you restored Vandana, when debilitated by old age, as a (Wheelwright) repairs a worn-out car; (VAMDEVA) from the womb; may your (glorious) deeds be (displayed) for him who in this place offers worhsip." Rig.I-119-7 (Wilson)

In this verse "worn-out car" means a solar calendar which for some astronomical reasons, has become useless.

It is interesting to note that at this stage the type of well Ashwinkumars were using :

"NASATYAS you raised up the well and made the base, which had been turned upwards, the curved mouth, so that water issued for beverage of the thirsty Gautama the offerer." Rig. I-116-9 (Wilson)

It is worthwhile to quote here Griffith's translation of the above verses :

"Ye lifted up the well, O ye Nasatyas and set the base on high to open downwards streams flowed for folk of Gautama and thirsted, like rain to bring forth thousandfold abundance." Rig. I-116-9 (Griffith)

Needless to say, it is impossible to uproot a well containing water and base it in the sky with mouth downwards. A man can see the image of the sky in the well having water at deep levels and use it as a reflector telescope. The poet says that after placing the well in this manner the earth got plenty of rains. Such rains are summer rains. The last line of the verse says that they brought "thousandfold abundance." Considering the antiquity of the verse, it should mean a "Good crop".

All the verses which we have considered so far make us conclude that Ashwinikumars saw the image of the Sun in the well water, just before the commencement of rainy season. Rig.I-119-7 (cited supra) states that Ashwinikumar's object for extrication of the image of the Sun was for the purpose of repairing a worn-out car (i.e. for replacing the old calendar by a new one.) Further details of Ashvinikumars's experiment are in Rig.I-116-24.

"Ashwini you raised up Rebha like soma in a ladle who for ten nights and nine days lain (in well) bound with tight bonds, wounded immersed in water suffering in distress." Rig.I-116-24 (Wilson)

From this verse we learn that Ashwinikumars conducted their experiment in well-water for 10

days before rainy season. A person having an elementary knowledge of astronomy can guess what Ashwins must have done. They watched the image of the Sun at Zenith at mid-Moon. The Sun thereafter moved towards the North and again came back to the Zenith in 10 days. The fifth day of its journey towards the North was a day of Summer-solstice. Till the day of Ashwinikumars' research, the image of the Sun, as seen in the well-water, had no importance. It remained uncared for, and without any respect. The poet, therefore, calls it as Rebha in distress. It gained importance and respect after the day of research. It was, therefore, renamed as "Vandan", which means a matter that calls for respect and praise.

The place where Ashwins conducted their observations in the well must be located about ten kilometers on the Southern side of the ecliptic, because the sun required only 10 days for its journey from the Zenith to the Northern point and back to the Zenith. The well was in the kingdom of a King-Mandhatri :

"With these aids by which you (Ashwina) encompassed the Sun after off : by which ye defended Mandhatri in discharge of his sovereign functions and by which you protected the sage Bharadwaj, with them came willingly neither." Rig.I-112-13 (Wilson)

(Griffith uses the words "in his task of lords of lands" in place of words "Sovereign functions". The original Sanskrit words are "Kshetrapati" which, according to Chitrava Shastri, mean work of an agriculturist.)

We cannot find a link between the position of the Sun in the sky and the agricultural functions unless we presume the theory given by me about the object of the research made by Ashwinikumars. There is a place known as Onkar Mandhata on the bank of the river Narmada in the district of Khandwa on the southern side of the Tropic of Cancer in India. The place is full of hills a thinly populated shrine. It is matter of research whether Vedic Mandhatri ruled there.

There is additional evidence to show that the Vedic bards noticed the position of the Sun on the day of Summer solstice.

"The Sun unyoked his chariot in the midst of the sky (when) the Arya (Indra) encountered the Dasa. Associated with RIJISHWAN, INDRA destroyed the strong hold of the guileful. PIPRU." Rig. X-138-3 (Wilson)

This is a clear description of the Sun as observed from one of the boundaries of the tropical belt. In the present context it is the tropic of cancer.

7. The calendar of Ashwins

The car of Ashwins had three wheels, three rods and three seats : Rig.I-47-2, Rig.I-118-2, Rig.I-139-4, Rig.I-157-3, Rig.I-183-1, Rig.VII-69-2.

Rig.VII-22-5 and Rig.X-85-13 give the description of such a car. However, only two wheels of such a car are visible at a time. One wheel is seen on the horizon and the other in the sky. (Rig.I-30-19) and (Rig.I-73-3). It appears to me that Ashvins had not only found the day of summer solstice but had also selected three asterisms on the ecliptic which marked the beginning of three major seasons : (a) Rainy season, (b) Winter season and (c) Summer season.

Most probably, the asterisms were (i) Krittikas (Pleides), (ii) Uttaraa Falguni (Denebola) and (iii) Uttarashada, the angular distance between these asterisms being roughly 120°. Only two asterisms are visible at a time. Perhaps in the days of Ashwins Indra used to be at Krittikas at the beginning of the rainy season. Ashwin brothers did not know the law of precession. They made a mistake of tagging the position of the asterisms on the ecliptic with seasons though they found out the day of summer solstice. After a lapse of about 2000 years, their calendar of seasons should be found wrong due to precessions of equinoxes. The verses of Ashvins and the technique of finding out the day of the summer solstice were preserved because of their religious importance Ribhu-brothers introduced their calendar in such days.

Ribhu brothers : Ribhus counted the difference in the number of days between the Solar year and the Lunar year (of twelve lunations). For this work they must have made use of Ashvini's method of finding out the day of the summer solstice. Their object was to design a calendar, to retune it with seasons :

"When Ribhu reposing for twelve days remained in hospitality of the uncouncealable (Sun), they rendered the field fertile, the led forth the rivers, plant spring upon the waste and waters (spread over) the low places." Rig.IV-33-7 (Wilson)

This verse clearly explains the object of Ribhu in designing a new calendar.

Twastri's chamas (ladle) : The word 'Chamas' originally means a wooden ladle meant for offering oblations. The following verses make it clear that the word "Twastri's Ladle" meant celestial vault and it was divided into four equal parts by Ribhu :

"A ladle with mouth inclined downwards and bottom upwards is said to hold within it, the universe and seven Rishis who have been the mighty one's protectors." Ath. Ved.X-8-9.

Seven Rishis in Vedic astronomy means the constellation Great Bear.

The division of such a chamas, made by Ribhus, into four parts is given in the following verses :

"Ribhus have divided unto four the new ladle, the work of divine Twashtri." Rig. I-20-6 (Wilson)

"The men (Ribhus) spoke the truth for such ladle they made, and thereupon the Ribhus partook of that libation Twastri beholding the four ladles brilliant as day, was content." (Rig.IV-33-6 (Wilson))

The division of the Ladle had a relevance for marking the seasons :

"Waters (rains) are the most excellent, said one of them. Agni (Summer season) is the most excellent (at appropriate time) said another, the third declared to many the earth (crops) to be the most excellent and thus speaking true things the Ribhus divided the ladle."

Rig. I-161-9. (Wilson)

When we read the four verses X-8-9, Rig.I-20-6, Rig.IV-33-6 and Rig.I-161-9 of the Ath. Ved. together, we come to the conclusion that Ribhus divided the celestial vault into four divisions in conformity with the time of the commencement of different seasons. These four points are well known to the astronomers. They are : i) Summer solstice, ii) Autumnal Equinox, iii) Winter solstice and iv) The Vernal equinox. The four divisions must have been made by counting equal number of days for each part of the year. Let us read the following passage :

"They (Ribhus) constructed for Nasatyas (Ashwins) a universally moving easy car, and cow-yielding milk."

Rig. I-20-3 (Wilson)

It is obvious that the car of Ashvins means a solar calendar in which summer solstice is the first day. It appears that during the period of Ribhus the highest point on the ecliptic at Midnight was near Alpha-Arietis and Beta Arietis. It is probably for these reasons that these stars were named as "Ashwinis" by Ribhus.

At present some verses in the Rig Veda appear to be mystical. In my opinion, most of the hymns and verses in Rig Veda can be explained on the assumption that they relate to the astronomical points constellations and some of these are compared to narrate the history of development of calendars to predict commencement of seasons in India. Mahamuni Lagadha (see Holay 1994) has rightly said (Rig Jyotish 36) : "The Vedas are revealed (to the sages) for the purpose of performing sacrifices. They are to be performed according to a pre-determined time-table. It is the knowledge of these (Scientific) rules of time which a sacrificer must possess."

Conclusion

We started our work of investigation in this paper about the nature of the deities Aadityas as described in the hymn Rig X-72. Lokmanya Tilak finds that this hymn refers to earliest glimpses of Vedic sages about the Vedic deities. He gives much stress on the words (पूर्वे युगे) : "in earlier yuga" occurring in Rvj. X-72-2 and (प्रथमे युगे) "in first yuga" occurring in Rig X-72-3. He estimates the antiquity of Vedas about 10000 years after mentioning these hymns. (Artic Home page 376).

We differ with Tilak in respect of his findings about the original place of residence of Aryans, yet we agree with him about the antiquity of this hymn.

We therefore conclude that the home land of Vedas is Bharat.

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