On Exploring the Vedic Sky with Modern Computer Software

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I. Introduction

As has been observed recently by Witzel,[1] the Vedic night sky has not received the full attention it deserves, and many Vedic passages, which allude to astronomical phenomena, have remained not yet fully understood. It is obvious that the sky as it appears to us now is quite unlike the sky that the Vedic people saw, and extensive calculations would have to be carried out before any meaningful comparison of the current sky with the stellar information in the Vedic passages can be made. However, in recent years there has become commercially available some very powerful astronomy software, the so-called Planetarium Software. These software products can generate and display on a personal computer, with a high degree of reliability, millions of stars and other heavenly objects as seen from any given location on earth and on any given date, all at the click of a mouse. These are used as tools in astronomical explorations with both conventional and automated telescope applications for determining when and in which part of the sky a particular object becomes visible. These computer programs, with the capability to generate and display the night sky at any date and place, can, therefore, be effectively used as research tools to generate and display the night sky as it was seen by the Vedic people. The Vedic passages describing the night sky can be studied in conjunction with such displays. It is to be expected that such an effort would lead to a better understanding of those Vedic passages. It is the purpose of this report to illustrate the application of a planetarium program, SkyMap Pro,[2], as a research tool[3] to study the Vedic sky in conjunction with Vedic passages,

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1 Witzel, M., "Looking for the Heavenly Casket", Electronic Journal of Vedic Studies, 1, 2,(1995). A longer version of this paper has appeared in Studien zur Indologie und Iranistik, 20; cf. also the discussion of the Milky Way and several asterisms in Vedic times in "Sur le chemin du ciel", Bulletin des etudes indiennes 2, 1984.

2 Marriott, C., SkyMap Software, 9 Severn Road, Culcheth, Cheshire WA3 5ED, UK (1993-1998). The latest version is called SkyMap Pro.

3 Achar, Narahari B. N., "The age of the Śatapatha Brāhmaṇa: a reexamination of Dikshit's theory", Indian Journal of History of Science, (in press). This paper, based on

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using as example some passages from *Śatapatha Brāhmaṇa* (ŚB). Another powerful program, PancAng2, developed by M. Yano and M. Fushimi[4] can calculate the *tithi* and *nakṣatra* for any date from 3100 BC onwards and is based on the *sūrya siddhānta*. This turns out to be a valuable tool in studying the Vedic rituals. Here it is used for identifying dates with a particular *nakṣatra*, *kṛttika*.

II. The passages in *Śatapatha Brāhmaṇa*

In the second *Brāhmaṇa* , the *Nakṣatra Brāhmaṇa* , of the first *adhyāya* of the second *kāṇḍa* of ŚB, occur the following lines:

> *kṛttikāsv agnī ādadhīta / etā vā agninakṣatraṃ yat kṛttikāḥ / tad vai saloma yo agninakṣatre agnī ādadhātai / tasmāt kṛttikāsv ādadhīta //* (II. 1. 2.1)
>
> He may set up the two fires under *kṛttikā*s; for they, the *kṛttikā*s are doubtless Agni's asterism, so that if he sets up his fires under Agni's asterism, (he will bring about) a correspondence (between his fires and the asterism): for this reason he may set up his fires under the *kṛttikā*s (tr. Eggeling[5])

> *ekaṃ dve trīṇi / catvārīti vā anyāni nakṣatrāṇi / athaitā eva bhūyiṣṭhāḥ yat kṛttikāḥ tad bhūmānam evaitad upaiti/ tasmāt kṛttikāsv ādadhīta //* (II. 1. 2.2)
>
> Moreover, the other lunar asterisms (consist of) one, two, three or four (stars), so that *kṛttikā*s are the most numerous (of asterisms): hence he there by obtains an abundance. For this reason he may set up his fires under the *kṛttikā*s (tr. Eggeling[5])

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an older version of the software SkyMapV2.2, argues erroneously for a site of observation far south of Delhi and is superseded by the present work.

[4] Yano, M. and Fushimi, M., Pancang2, a program based on *sūrya siddhānta*, available by ftp://ccftp.kyoto-su.ac.jp/pub/doc/sanskrit/

[5] Eggeling, J., The Śatapatha Brāhmaṇa According to the Mādhyandina School, Motilal Banarasidass, (Delhi, 1963), Part I, pp. 282-283.

[5] Eggeling, J., The Śatapatha Brāhmaṇa According to the Mādhyandina School, Motilal Banarasidass, (Delhi, 1963), Part I, pp. 282-283.

> *etā ha vai prācyai diśo na cyavante / sarvāṇi ha vā anyāni nakṣatrāṇi prāchyai diśo cyavante / tat prācyam evāsyaitad diśy āhitau bhavataḥ / tasmāt kṛttikāsv ādadhīta //* (II. 1. 2.3)
>
> And again they do not move away from the eastern quarter, whilst the other asterisms do move from the eastern quarter. Thus his (two fires) are established in the eastern quarter: for this reason he may set up his fires under the *kṛttikā*s. (tr. Eggeling[5])

The context is a discussion about the suitable time and *nakṣatra* under which it would be most auspicious to perform *agnyādhāna*, the establishment of the ritual fires for the first time by a householder. It is proposed that the new householder should establish the traditional *gārhapatya* and *āhavanīya* fires on the day of *kṛttikā nakṣatra*. For, the presiding deity of *kṛttikā* is Agni, the *kṛttikā*s alone consist of many stars and they never swerve from the east. He who performs *agnyādhāna* under *kṛttikā* , therefore, is blessed with abundance, and gets his household fires firmly established in the east. However, in the very next section arguments are presented against this proposition; for, the *kṛttikā*s were married to the *saptarṣis* who rise only in the north and hence are constantly separated from their spouses who rise in the east. "*amī hy uttarāhi saptarṣayaḥ udyanti pura etāḥ*". (II.1.2.4) This portends the same fate to befall the new householder, who establishes the household fires for the first time under *kṛttikā*. Hence, the day of *kṛttikā* is not to be considered suitable for performing this ritual. But counter arguments are presented later in the section, and finally, it is argued that *kṛttikā*s are the most auspicious for *agnyādhāna*; but, some other *nakṣatra*s, which may also be considered auspicious are suggested.

III. Dikshit's theory

The lines given above are obviously of great astronomical importance and Shankar Balkrishna Dikshit[6] was perhaps the first one to use them to propose

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[5] Eggeling, J., The Śatapatha Brāhmaṇa According to the Mādhyandina School, Motilal Banarasidass, (Delhi, 1963), Part I, pp. 282-283.

[6] Dikshit, S. B., "The Age of the Śatapatha Brāhmaṇa ", Indian Antiquary, 24, 245-246, (1895).

a date for ŚB. Although many others[7] [8] [9] [10] have discussed this issue in the literature since then, none expresses more eloquently than Dikshit himself:[11]

> The statement that *kṛittikās* never deviate from the east implies that these stars always rise in the east, i.e., they are situated on the [celestial] equator or that their declination is zero. At present they do not appear to rise exactly in the east, but at a point north of east; this happens because of the precessional motion of the equinox. Assuming 50" as annual motion, the time when the junction star of the *kṛttikā*s had zero declination, comes to be 3068 years before Śaka and even 150 years earlier i.e., the approximate time of the commencement of Kali era, if 48" be adopted as the precessional annual motion. Calculating the declination of some other stars in this age, we find that the northernmost star of *rohiṇī* group, southern three of the *hasta* group, two from *anūrādhā*, one from *jyeṣṭhā*, and one from *aśvinī* were situated near the equator, only some one star from the *hasta* group (if at all) could possibly have been situated exactly on the equator, otherwise none. The statement about *kṛttikā*s rising in the east is made in the present tense and they cannot always do so because of precessional motion of equinoxes. In our time we find them rising to the north of east and they used to rise to its south in 3100 BS [before Śaka]. From this it can be inferred that the corresponding portion in Śatapatha Brāhmaṇa was written about 3100 years before the Śaka era.

Pingree[12] has argued that the phrase "never swerve from the east" cannot be taken to mean rise "heliacally precisely at the east point" as was done by Dikshit, who deduced that this could have occurred only when the Pleiades were on the equator in about 3000 BC. Pingree vehemently counters, "unfortunately for this theory [of Dikshit], parts of the *nakṣatra*s, *hasta*,

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7 Chakravarty, A. K., "The Asterisms" in History of Oriental Astronomy, (ed.) Swarup, G., Bag, A. K., and Shukla, K. S., Cambridge University Press, (Cambridge, 1987), pp. 23-28.

8 Kaye, G. R., "The Nakshatras and Precession", Indian Antiquary, 50, 44-48, (1921).

9 Kansara, N. M., "The Vedic Sources of vedāṅga jyotiṣa", in Issues in Vedic Astronomy and Astrology, (ed.) Pandya, H., Dikshit, S., and Kansara, N. M., Motilal Banarasidass Publishers Pvt. Ltd., (Delhi, 1992), pp. 273-296.

10 Sarkar, R., "Vedic Literature vis-a-vis Mathematical Astronomy" in History of Oriental Astronomy, (ed.) Swarup, G., Bag, A. K., and Shukla, K. S., Cambridge University Press, (Cambridge, 1987), pp. 29-32.

11 Dikshit, S. B., Bharatiya Jyotish Sastra, Government of India Press, (Calcutta, 1969), pp. 128-129.

12 Pingree, D., "Mulapin and Vedic Astronomy" in Dumu-E2-Dub-ba-a, (ed.) Behrens, H., Loding, D., and Roth, M. (Philadelphia, 1989), pp. 439-445.

viṣākhe, and perhaps *śravaṇa* were also on the equator in 3000 BC." According to Pingree, this fact would there by contradict the claim in Śatapatha Brāhmaṇa that only the *kṛttikā*s 'never swerve from the east'; hence, he doubts whether that phrase can bear the meaning attributed to it by Dikshit. One of the purposes of the present report is to establish the relative merits of these two claims by observing the sky-view generated by using the software "SkyMap Pro", in conjunction with the program "PancAng2". These views of the sky correspond to the latitude of Delhi and represent the sky as the Vedic people themselves might have seen.

IV. The sky at present

The SkyMap Pro software takes into account the precessional motion of the earth's rotation axis and produces the images of the entire sky at any location on earth and at any date from 4000 BC to 8000 AD. It is a very sophisticated mapping tool, which shows all the heavenly objects above the horizon at any given location at any given time within certain limits. It can display stars as faint as magnitude sixteen, and zoom in to a practically unlimited extent to produce area maps with greater details to any desired degree. Furthermore, the celestial coordinates, right ascension and declination,[13] and a host of other astrophysical data can be determined for any object for the epoch corresponding to a given date. The local rising and setting times for the object can also be determined. Figure 1 shows the sky as it appears at Delhi on September 1, 1999 AD, looking in the direction of east at 10:50 pm, a few minutes after the moon rise. The arc at the bottom represents the horizon. The coordinates in the map are the azimuth and altitude, with zenith at the top. The

[13] The coordinates right ascension and declination are the analogs of longitude and latitude, respectively, and are fixed on the celestial sphere. Right ascension is measured in hours (h.), minutes (m), and seconds (s), and has a range of zero to twenty-three hours.
Declination is measured in degrees (d), minutes (m), and seconds (s), and has a range from -90 degrees to +90 degrees, with the 0 degree being on the equator. The coordinates of a star when expressed in right ascension and declination are the same for all observers on earth. In contrast, azimuth and altitude, both measured in degrees, minutes and seconds are "local" coordinates for a given star, and differ from observer to observer.
Azimuth is measured from the North Point, for which it is zero all the way around to 360 degrees in a full circle along the horizon. Thus, it is 90 degrees for East Point, 180 degrees for the South Point, and 270 degrees for the West Point. Altitude is measured from the horizon to the zenith, which is 90 degrees.

azimuth angle of 90 degrees marks the East Point. Only stars brighter than magnitude 5 are displayed to avoid clutter. According to Panchanga, it is *kṛṣṇa saptamī* and *kṛttikā nakṣatra* on this day. As Sāyaṇa explains, '*yasmin dine candreṇa samyujyante tasmin dine*,' it is the day when *kṛttikā*s are joined with the moon. We take the Pleiades as *kṛttikā*s and eta-tauri as the representative for the group. One can see in the picture the waning (almost third quarter) moon and *kṛttikā* just above the horizon, and both are considerably to the north of east. The *kṛttikā*s are displayed in an Area Map in figure 2, which is an expanded view of the region whose boundaries are marked by the equatorial coordinates as shown. Figure 2 resolves the stars of the Pleiades group. *Taittirīya Brāhmaṇa* (TB 3.1.4.1, and earlier on, TS 4.4.5.1, MS 2.8.13, KS 40.4) give the names of the stars belonging to the group as *ambā, dulā, nitatnī, abhrayantī, meghayantī, varṣayantī*, and *cupuṇikā* (MS variant *bulā* for *dulā*, and *stanayantī* for *varṣayantī*). There is a spread of about 30 minutes in the declination coordinates of different members of the group. From the display in figure 1 it is determined that the moon has a declination of 13 degrees and 3 minutes, and an azimuth of 76 degrees and 43 minutes. Eta-tauri has a declination of 24 degrees and 6 minutes and an azimuth of 65 degrees. Thus it is clear that the moon rises at a point about 13.25 degrees north of east, and eta-tauri rises at a point about 25 degrees north of east. In fact, the latter is further north than the sun. This is exactly as described by Dikshit, with reference to the current position of *kṛttikā*. Figure 3 shows a view to the north and shows the *saptarṣis* rising at a point east of north. At the present time then both *saptarṣis* and *kṛttikā*s rise in the north, in agreement with Dikshit.[12]

[12] Pingree, D., "Mulapin and Vedic Astronomy" in Dumu-E2-Dub-ba-a, (ed.) Behrens, H., Loding, D., and Roth, M. (Philadelphia, 1989), pp. 439-445.

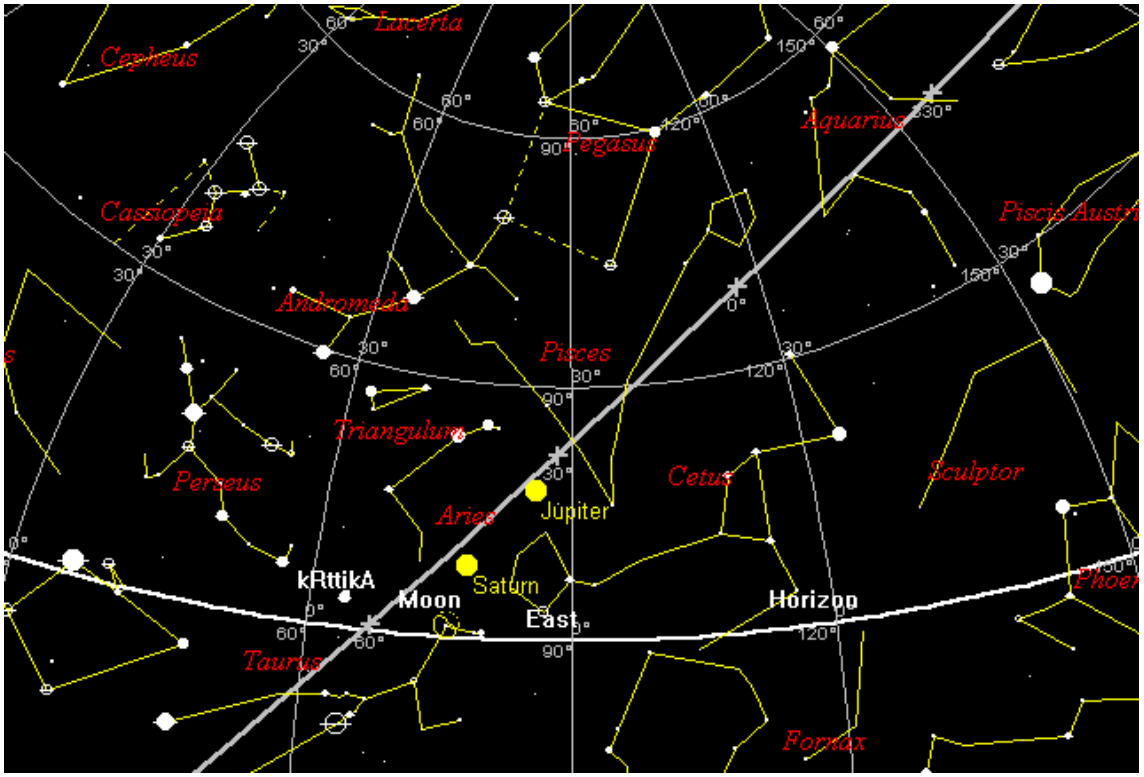
Lacerta
Cepheus
Pegasus
Aquarius
Cassiopeia
Andromeda
Pisces
Triangulum
Perseus
Aries
Jupiter
Cetus
Sculptor
kRttikA
Moon
Saturn
East
Horizon
Taurus
Fornax

Fig.1

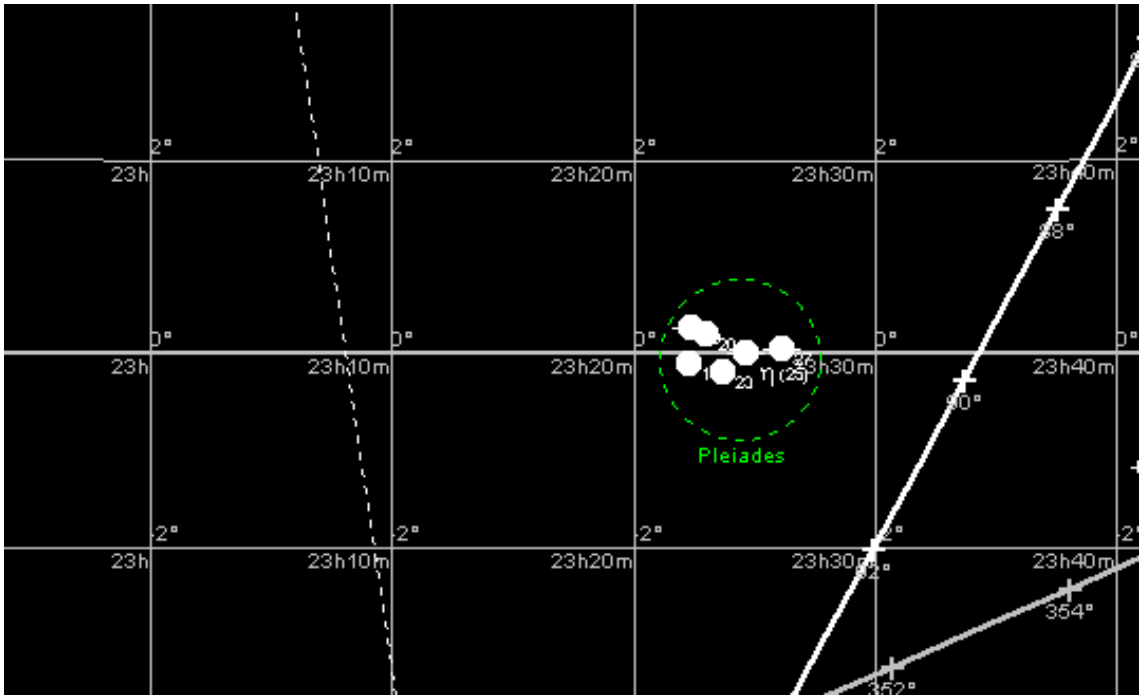
23h
23h10m
23h20m
23h30m
23h40m
Pleiades

Fig. 2

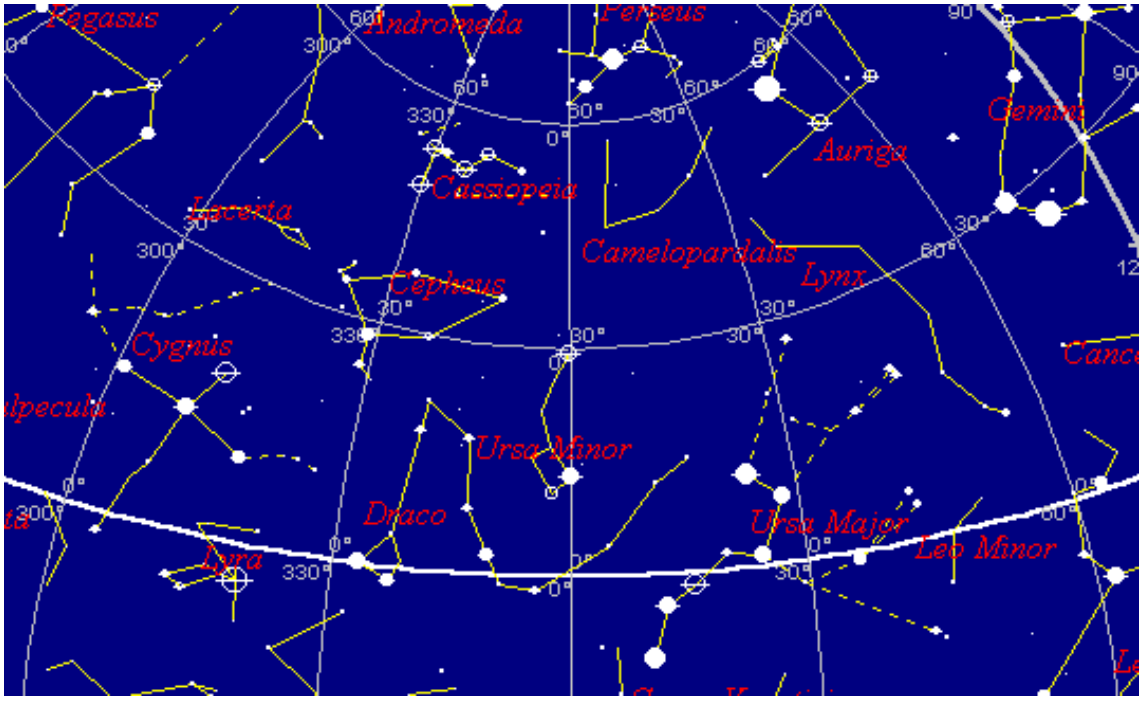

Fig. 3

V. *kṛttikā*s on the celestial equator

Using the software SkyMap Pro, we can determine the date when eta-tauri was at a position of zero declination. At that time it would be exactly on the equator and would rise exactly at the East Point. Since there is a spread of about 30 minutes in declination of the different members of the Pleiades group, the other members will not be technically exactly on the equator at the same time and hence would not rise exactly at the east. However, this small spread in declination would have been hardly noticeable. In fact, for a couple of centuries on either side of this date, the *kṛttikā* group would still be seen as rising in the east. Figure 4 shows the view of the sky for Delhi on July 8, 1200 BC. According to pancAng2, It is *śrāvaṇa aṣṭamī* in *kṛṣṇa pakṣa*, and it is *kṛttikā nakṣatra*. The picture shows the view of the sky to the east soon after moonrise and *kṛttikā* is also seen just above the horizon. On this date eta-tauri has a declination of 9 degrees and 41minutes, and rises at a point about 10 degrees north of east. Obviously, the event described in ŚB occurred much earlier than 1200 BC. Figure 5 is a sky map corresponding to August 16, 2927 BC, when *kṛttikā*s (actually, just eta-tauri) rise exactly in the east. With *kṛttikā*s rising in the east, the Vedic people watching the sky would declare, "*etā ha vai prācyai diśo na cyavante*."

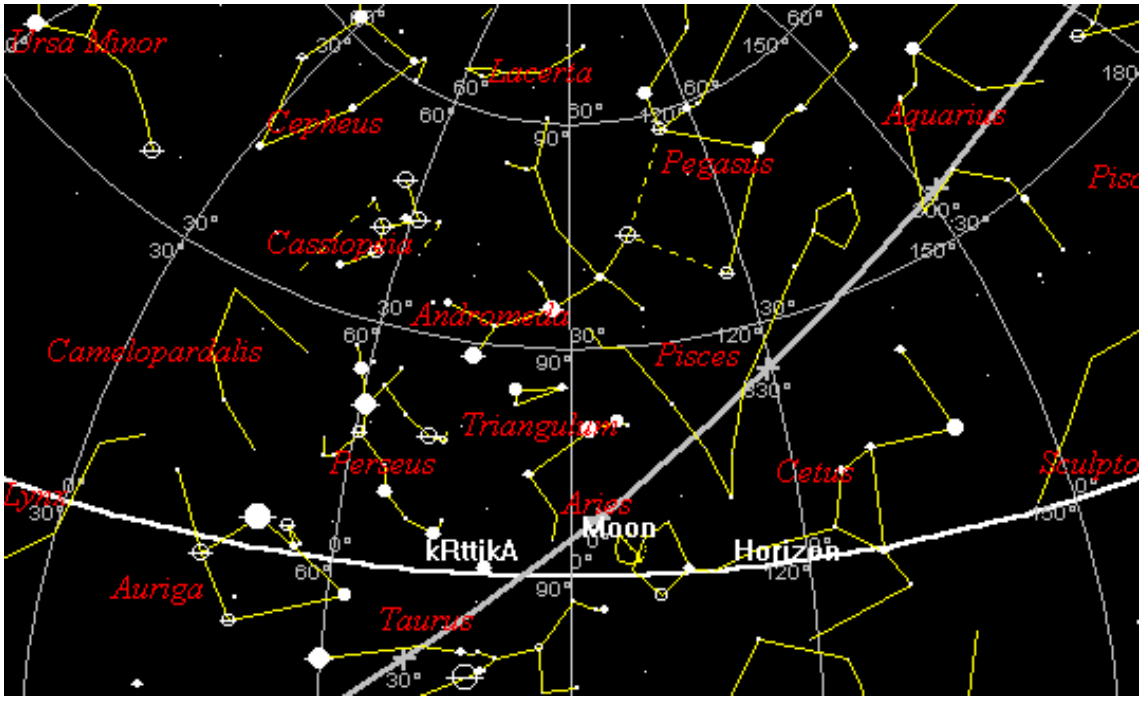
Ursa Minor
Lacerta
Cepheus
Aquarius
Pegasus
Cassiopeia
Andromeda
Camelopardalis
Pisces
Triangulum
Perseus
Cetus
Aries
Moon
kRttikA
Horizon
Auriga
Taurus

Fig. 4

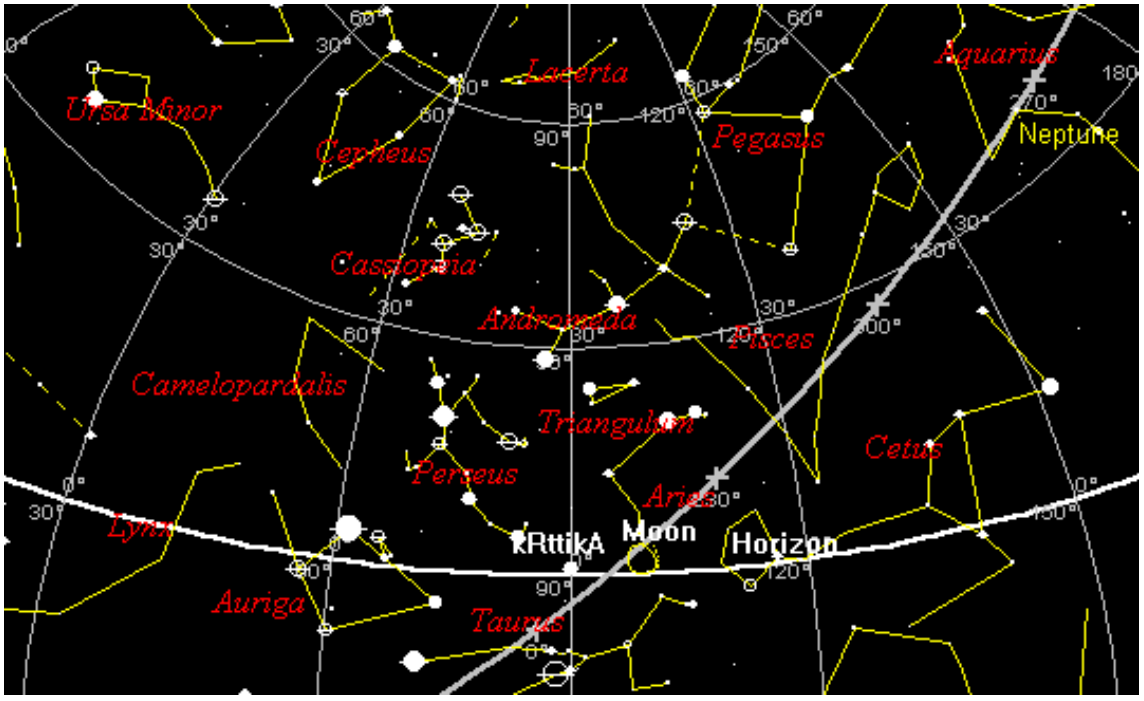
Lacerta
Aquarius
Ursa Minor
Pegasus
Neptune
Cepheus
Cassiopeia
Andromeda
Pisces
Camelopardalis
Triangulum
Cetus
Perseus
Aries
Moon
kRttikA
Horizon
Auriga
Taurus

Fig. 5

VI. Other *nakṣatra*s on the equator

Pingree has questioned the interpretation, that the phrase "never swerve from the east" means "they always rise exactly at the East Point". For, according to Pingree, parts of *nakṣatra*s*, hasta, viśākha*, and perhaps *śravaṇa* would also be on the equator on this date and this would contradict ŚB's claim that only *kṛttikā*s "never swerve from the east." We have generated sky maps for Delhi for this date, August 16, 2927 BC, facing east and separated by six hours in time interval so that the entire sky for right ascension from 0-23 hours near the equator region could be presented. Table 1 presents, as obtained from these maps, a list of stars, which are brighter than magnitude 4 and lie close to the equator by 2 degrees or less. The table also gives the values of their magnitude, right ascension and declination for the epoch 2927 BC. It is seen that there are about a dozen stars close to the equator. Of these, three are 30 minutes or less away from the equator, and four more are less than a degree away. There are additional four stars at about 1.5 degrees and the last one is about 2 degrees away from it.

Stars	**Magnitude**	**Right Ascn.**	**Declination**		
41-Arietis	3.70	22h	31m	1d	28m
epsilon-Pegasi	2.50	17h	38m	-1d	23m
theta-Aquilae	3.40	15h	56m	-1d	7m
zi-Serpentis	3.60	13h	14m	1d	21m
delta-Scorpi	2.50	11h	38m	0d	57m
sigma-Librae	3.40	10h	46m	0d	23m
nu-Hydrae	3.30	6h	46m	1d	12m
lambda-Hydrae	3.80	6h	6m	1d	54m
pi-Hydrae	3.50	9h	53m	-0d	10m
alpha-Hydrae	2.20	5h	21m	0d	48m
beta-Corvi	2.80	8h	29m	1d	5m
epsilon-Corvi	3.20	8h	7m	0d	41m
Eridanus	4.00	4h	18m	-1d	27m

Table 1. Stars located close to the equator in 2927 BC (epoch: 2927 BC)

Based on Pingree's own scheme of identifying stars,[14] *hasta, viśākha*, and *śravaṇa* correspond to delta-Corvi, iota-Librae, and alpha-Aquilae respectively. From the star maps, it is determined that none of these stars are really close to the equator in 2927 BC, and hence, are not found among those listed in table 1. In fact, the declinations of these stars are 7 degrees 49 minutes, 5 degrees 38 minutes, and 9 degrees 41 minutes respectively. Therefore, these stars would rise noticeably far from the East Point. None of the stars in table 1 can be identified with the junction stars or the *yogatārā*s themselves. It is true however, that there are stars in table 1, which may be considered to be other members of the groups associated with some junction stars, i.e., asterisms. For hasta, it is beta-Corvi, with a declination 1 degree 5 minutes, and epsilon-Corvi, with a declination of just 41minutes. For *viśākha*, it may be sigma-Librae with a declination of mere 23 minutes; and/or delta-Scorpi with a declination of 57 minutes, and perhaps *uttara proṣṭhapada*, epsilon-Pegasi, with a declination of -1 degree 23 minutes. Hence, these could also be described as "rising exactly in the east", or "not swerving from the east." Except for these, no other stars in table 1 can be regarded as belonging to the traditional list of *nakṣatra*s. Pingree's point (namely, ŚB's statement that only *kṛttikā*s never swerve from the east cannot have the meaning that they rise exactly in the east) would appear to be well taken since, *hasta, viśākha* and even *uttara proṣṭhapada*, are also on or near the equator, just as the *kṛttikā*s.

However, this objection does not really have any efficacy when one examines carefully the context under which that statement is made, namely, choosing the most auspicious *nakṣatra* for performing *agnyādhāna*. If the ritual of *agnyādhāna* is to be done under *kṛttikā*s because, "they never swerve from the east", then, Pingree's point would be equivalent to stating that the same ritual could be performed equally well under *hasta, viśākha*, and even *uttara proṣṭhapada*. For, they also would "never swerve from the east." In fact, hasta is considered as an alternate auspicious star for *agnyādhāna*, as discussed later in the same section in ŚB. *Āśvalāyana sūtra* (II.1. 10) permits both *viśākha* and *uttara proṣṭhapada* for the same ritual. Pingree might have scored a point, had these *nakṣatra*s been denied the status of being auspicious for performing *agnyādhāna*. While "never swerving from the east" may be a criterion for selection as a suitable *nakṣatra* for the ritual, there may be other reasons why *kṛttikā*s are preferred, such as the presiding deity being Agni. Thus the phrase

[14] Pingree, D. and Morissey, P., "On the Identification of the yogatārās of the Indian *nakṣatra*s", Journal for the History of Astronomy, xx, 99-119, (1989).

"never swerve from east" cannot mean anything other than "rising heliacally exactly at the East Point", for, ŚB itself declares: "*udyanti pura etā[ḥ]*" "they rise in the east." On this point, Sāyaṇa also says in his exegesis "*śuddha-prācyam evodyanti*" "they rise in the true east."

VII. *Saptarṣis* in the north

It was mentioned earlier that at the present time all members of group the *saptarṣis*, except alpha-Ursa majoris rise (and set) in the north as observed from Delhi (figure 3). However, in 2927 BC, it can be seen in figure 6, that Thuban is the pole star (later on called *dhruva*)and that all members of the *saptarṣis* are circumpolar and are quite to the north. Hence the *saptarṣis* would neither rise nor set. We have verified that the *saptarṣis* remain circumpolar at Delhi from about 4500BC to about 100 BC, at which time only one star of the group, eta-Ursa majoris, becomes non-circumpolar and rises and sets. It is only at about 600 AD that a second member of the group becomes non-circumpolar at Delhi. If they are all circumpolar as seen in Delhi at about 3000 BC, what is the meaning of "they rise in the north"? In order to see at least one of them rise and set, one would have to observe from a place south of Delhi. In fact, beta-Ursa-majoris, (declination: +66 degrees 8 minutes) could be observed as rising or setting from a place whose latitude is about 24degrees N, compared to Delhi's 28 degrees 22 minutes N. One would have to be at latitude of about 10 degrees N to observe all of *saptarṣis* to rise and set. Then what is the real meaning of *amī hy uttarāhi saptarṣayaḥ udyanti pura etā[ḥ]* (ŚB II.1.2.4)? Eggeling translates it as "for the latter, the seven ṛṣis, rise in the north, and they (the *kṛttikā*s) in the east." We feel that the confusion arises because, "*udyanti*" is associated with both "*saptarṣayaḥ*" and "*etāḥ*." The sentence should be broken as *āmī hy uttarāhi saptarṣayaḥ / udyanti pura etāḥ* /, associating *udyanti* with *etāḥ* only. The first part would simply state "*amī hy uttarāhi saptarṣayaḥ (santi)*". As Sāyaṇa explains, '*āhi ca dūre*', (PS 5.3.37) *iti*. *-āhi* is a *pratyaya, uttarāhi* would mean '*dūradeśe uttaradigbhāge'* 'at a far off place in the north'. Thus, ŚB (II.1.2.4) would mean "for these seven *ṛsis* indeed (stay) far to the north and they (the *kṛttikā*s) rise in the east." There is even a hint of the circumpolar nature of the *saptarṣis*, by the absence of 'rising'!

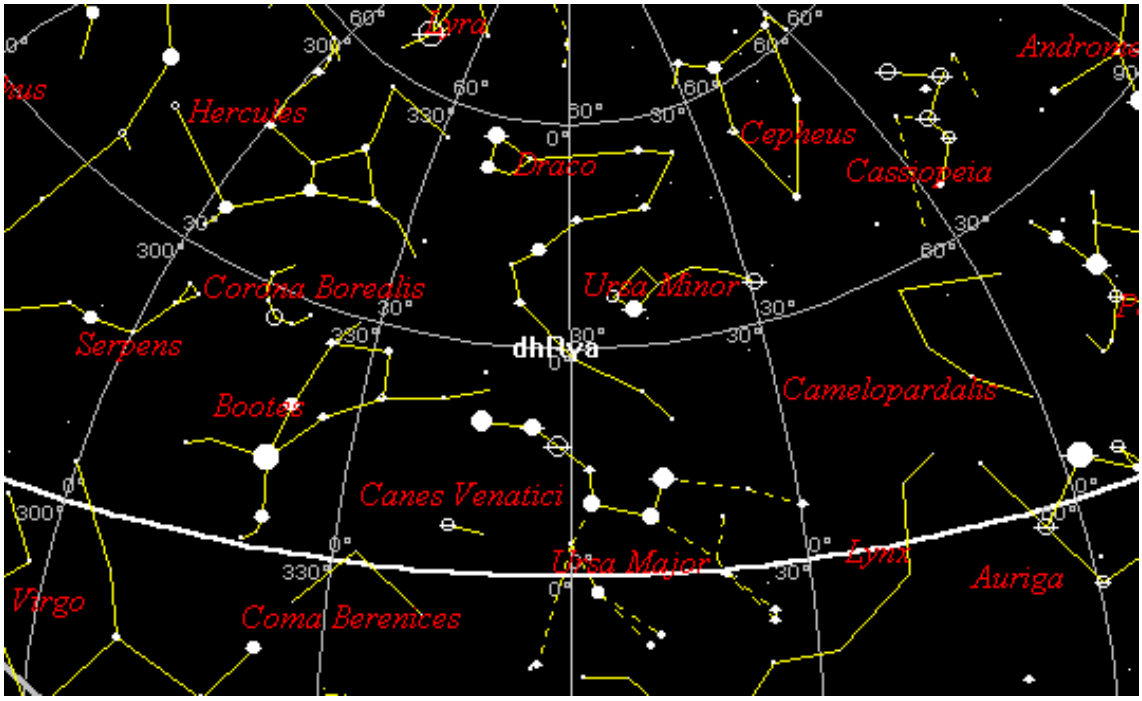

Fig. 6.

VIII. Some comments on the computer software

SkyMap Pro and Pancang2 agree with each other remarkably well even though one is based on *sūrya siddhānta* and the other is modern astronomical software. For example, on spot-checking the occurrence of new moons and full moons over a period from 3100 BC to 3000 AD, there is a difference of utmost a day (sometimes two). This difference arises mainly because of the convention for assigning *tithi* at sunrise and also because the program Pancang2 does not give the time when a *tithi* or *nakṣatra* begins or ends. Moreover, there are "*kṣaya*" and "*vṛddhi*" *tithis*. Nevertheless, this difference did not cause any serious difficulty in selecting the days of *kṛttikā nakṣatra*. There are a number of planetarium-type software available for PCs: The Sky, Red Shift, and Starry Night, just to mention a few. While they may perform more or less equally well for telescopic applications, there were some difficulties in using them for the present application. For example, on extrapolating to BC years, there was general agreement with the coordinates of stars, but not for the phases of the Moon. In fact, there was a difference of about eight days for full moon between the SkyMap Pro and The Sky in the year 2500 BC. In the case of Red Shift and Starry Night, sometimes the star map did not display the correct coordinates for the stars, even though the calculated coordinates were correct.

IX. Conclusions

A simulation using the software SkyMap Pro in conjunction with Pancang2 has been used to verify that the statements in ŚB about the *kṛttikā*s never swerving from east and about *saptarṣis* rising in the north point to events that could have been observed around 3000 BC. The fact that there are other *nakṣatra*s besides *kṛttikā*s which also do not deviate from the east appears to have been recognized, for, these other *nakṣatra*s have been suggested in the *śāstras* as alternate choices for performing the *agnyādhāna* ritual. The simulation also helps to understand better the statement about the *saptarṣis* being in the far off north.

X. Acknowledgement

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Abbreviations

ŚB *Śatapatha Brāhmaṇa*

PS *Pāṇini Sūtra*