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A CASE FOR REVISING THE DATE OF VEDĀṄGA JYOTIṢA

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It is argued that the date of *Vedāṅga Jyotiṣa* (VJ) should be revised from the generally accepted value of about 1200 BC to 1800 BC. The basis for this argument is the astronomical fact described in the verses of VJ about the sun and the moon coming together in the *Dhaniṣṭha nakṣatra* at the time of winter solstice. A computer simulation of the Vedic sky using the planetarium program SkyMap Pro suggests that *Dhaniṣṭha* be identified with δ Capricorni and shows that the situation described in VJ would occur around 1800 BC. The new date is to be preferred because the previous date of 1200 BC was arrived at on the basis of *Dhaniṣṭha* being identified as β Delphini. However, β Delphini is too far from the ecliptic to be considered among the Vedic *nakṣatras* as clearly shown by the simulations.

Keywords: Date of *Vedāṅga Jyotiṣa*, date of Vedic astronomy.

In a series of papers the author has demonstrated how modern computer software, namely planetarium software can be used to study ancient Vedic astronomy by simulating the sky as the Vedic people themselves would have seen. In the first paper[1] a commercially available software with the trade name SkyMap is used to show the correctness of the theory put forth by the illustrious historian of ancient Indian astronomy, Sri Shankar Balakrishna Dikshit, regarding the age of *Śatapatha Brāhmaṇa*

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[1] B. N. Narahari Achar, "On the Astronomical Basis of the Date of *Śatapatha Brāhmaṇa:* A Re-examination of Diskshit's Theory," IJHS, 35.1 (2000) 1-19.

as determined by the the time when *Kṛttikās* were on the equator. In the next paper[2] it is demonstrated that the circumpolar nature of the *Saptarṣi Maṇḍala*, clearly seen in the simulations is recognized in the *Śatapatha Brāhmaṇa*. In the third paper[3] the question of historic beginnings of the *Caitrādi* scheme of naming the months on the basis of full moon occurring at different *nakṣatras* is examined. It is shown that the scheme really has its beginnings in the *Ṛgveda*. In the present paper, the problem of determining the date of *Vedāṅga Jyotiṣa* (VJ) is addressed using the updated version of the software, SkyMap Pro. It will be shown that the current estimates of the date of VJ of about 1200 BC may have to be revised to about 1800 BC or so.

VEDĀṄGA JYOTIṢA

Vedāṅga Jyotiṣa is general name by which one refers to the earliest codified texts of astronomy of India, called the *Ṛg Jyotiṣa* (RJ), *Yājuṣa Jyotiṣa* (YJ) and *Atharva Jyotiṣa* (AJ). For purposes of this paper, we will concentrate only on RJ, and use VJ also to refer to RJ. The codified knowledge in RJ is due to Ṛṣi Lagadha, but it is his disciple Śuci who composed and preserved that knowledge in the text of RJ. The age of Lagadha, which can also be considered to be the date of VJ, has been discussed at great length in literature.[4] These discussions are based on the two verses 5 and 6 of RJ:

svar ākramete somārkau yadā sākaṃ savāsavau /
syāt tadādi yugaṃ māghaḥ tapaḥ śuklo 'yanaṃ hy udak //
prapadyete śraviṣṭādau sūryācandramasāv udak /
sārpārdhe dakṣiṇārkas tu māghaśrāvaṇayoḥ sadā //

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2 B. N. Narahari Achar, "On Exploring the Vedic Sky with Modern Computer Software," *Electronic Journal of Vedic Studies*, 5.2 (1999); see also, idem, Comments on "The Pleiades and the Bears viewed from inside the Vedic Texts" (by M. Witzel), EJVS 5. 2 (1999), to appear in EJVS.

3 B. N. Narahari Achar, "On the *Caitrādi* Scheme," to be published.

4 S. B. Dikshit, *Bhāratīya Jyotiṣaśāstra*, Calcutta, 1969; B. G. Tilak, *The Orion*, reprint: Cosmo Publications, New Delhi, 1984; T.S. Kuppanna Sastry, *Vedāṅga Jyotiṣa of Lagadha*, Indian National Science Academy, New Delhi, 1985.

"When the sun and the moon (while moving in the sky) come to *vāsava (Dhaniṣṭha)* star together, then the Yuga, the (month of) *Māgha*, and the (season) *Tapas*, the bright fortnight, and the winter solstice all commence together."

"The sun and the moon turn towards north in the beginning of *Dhaniṣṭha* and towards the south in the middle of *Āśleṣa*. The sun always does this in the months of *Māgha and Śravaṇa* respectively."[5]

CURRENT ESTIMATES

The current estimates[6] of the date of VJ are based on the identification of *Dhaniṣṭha* with β Delphini, and of *Āśleṣa* with ε Hydrae, and on the calculation of the time when the winter solstice occurred at β Delphini. Several dates which are sensibly close to each other in the range 1400 BC to 1150 BC have been proposed as possible dates, depending upon the particular value of rate of precession used, the generally accepted date being 1180 BC. Sastry who has discussed the date of VJ at some length in his critical edition of the text prefers the date 1150 BC.[7] We can verify this date using SkyMap Pro.

Figures 1-4 show the view of the sky at Delhi in 1180 BC on the day of winter solstice, full moon day immediately after winter solstice, day of summer solstice and the full moon day following summer solstice respectively. Figure 1 clearly shows (Note: this is only a computer simulation; the sun, the moon and all stars are shown!) that winter solstice occurs on

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[5] Translation is based on S. B. Dikshit, op. cit.

[6] We do not consider here the very late dates of about 400 BC to 200 AD, proposed by certain scholars who invoke a Babylonian origin for VJ. The inappropriateness of assuming a Babylonian origin for VJ, and the fact that every astronomical concept in VJ can be traced to Vedic sources have been discussed by the author in the following articles: "A Mesopotamian Origin for Vedāṅga Jyotiṣa is it Justified?" *Journal of Indian Philosophy and Religion*, 2(1997)29-32, and "On The Vedic Origin of Ancient Mathematical Astronomy of India," to appear in *Journal of Studies on Ancient India.*

[7] T. S. Kuppanna Sastry, op. cit.

the new moon day, when the sun and the moon are aligned with β Delphini. Figure 2 shows that the following full moon occurs when the moon is near *Makhā* (α Leonis). The summer solstice occurs when the sun is aligned with *Āśleṣa* (ε Hydrae), and the full moon is near *Śravaṇa* (α Aquilae). These results are in agreement with the statements from VJ discussed above and it appears that the SkyMap Pro program has indeed provided the necessary verification.

However, this result is based on the identification of the *nakṣatras Dhaniṣṭha, Āśleṣa,* and *Śravaṇa* as the stars β Delphini, ε Hydrae, and *α* Aquilae respectively. Some of these stars are quite far removed from the ecliptic. For example, α Aquilae is at an angular distance of 34° 42′ from the moon as seen in figure 1 and β Delphini is at an angular distance of 32° 22′. Furthermore, the stars so identified are derived from the so-called *yogatārās* of the Siddhāntic period and may or may not correspond to the *nakṣatras* that the Vedic people themselves observed. The Vedic people observed the sky with keen interest for the sake of rituals, and there were *nakṣatradarśas* or observers of stars. Furthermore, the moon is considered to be the one who shapes the year (*samānāṃ māsa ākṛtiḥ,* RV X. 85. 5), and he moves in the vicinity of the *nakṣatras* (*atho nakṣatrāṇām eṣāṃ upasthe soma āhitaḥ,* RV X. 85. 2). The stars to be identified as *nakṣatras* cannot therefore be too far removed from the ecliptic. Thus stars and asterisms, which are situated more than about 10° from the ecliptic, may not be considered for identification with the Vedic *nakṣatras.* In particular the simulation with the SkyMap Pro raises question about the identification of *Śraviṣṭha* (*i.e., Dhaniṣṭha*) with β Delphini, which is more than 30° removed from the ecliptic. Furthemore, with *Kṛttikās* on the celestial equator, the simulation suggests that δ Capricorni be identified with *Śraviṣṭha* (i.e. *Dhaniṣṭha*). δ Capricorni is considerably closer to the ecliptic. The proposed estimates for the date of VJ are based on this new identification with δ Capricorni.

NEW ESTIMATES FOR THE DATE OF VJ

The estimate for the date of VJ proposed in this work is based on simulations of the views of the Vedic sky to determine when the sun and the moon could come together in δ Capricorni for the winter solstice. The right ascension for δ Capricorni would reach a value of 18 hours in the year 1820 BC. Thus, winter solstice would occur exactly at δ Capricorni in 1820 BC, and would occur sufficiently near it for many years on either side of that date. One such year near 1820 BC could be chosen for discussion.

Figure 5 shows the view of the sky on 3 January 1752 BC, the day of winter solstice. The sun and the moon are both near δ Capricorni and one can see β Delphini far from the ecliptic. Figure 6 shows the view of the sky on the full moon day following winter solstice, and the full moon is near *Makhā* (α Leonis). So it is the month of *Māgha* corresponding the situation described in verse 5 of VJ. Figure 7 shows the view of the sky on summer solstice (9 July 1752 BC). It occurs when the sun is near *Āśleṣa,* also in accordance with verse 6 of VJ. It therefore follows that the date of VJ should be considered to be about 1800 BC.

DISCUSSION

The date of 1800 BC proposed here is the earliest of all the dates proposed for VJ ever since it began to receive scholarly attention. The date is arrived at in the same manner as that of the previously accepted figure of 1180 BC on the basis of verses 5 and 6 of VJ. The winter solstice occurs when the sun and the moon are together in *Dhaniṣṭha* and the summer solstice occures when the sun is in the middle of *Āśleṣa.* These two events occur in the months of *Māgha* and *Śrāvaṇa* respectively. The date of 1180 BC is based on identifying β Delphini with *Dhaniṣṭha,* ε Hydrae with *Āśleṣa,* and α Aquilae with *Śravaṇa* respectively. These identifications, although accepted for a long time, are based on the so-called *yogatarās* of the Siddhānta period. They are obtained by first converting the polar coordinates of the *yogatarā* to equatorial coordinates (i.e., right ascension and declination), extrapolating the latter from about 500 AD to about 2000 AD, and then comparing to the coordinates of a star in a modern catalogue to make the final identification as *nakṣatra.* This approach is not very satisfactory at all. For, many of the stars are quite far from the ecliptic, as already indicated earlier, and this list cannot explain the Vedic classification of *deva* and *yama nakṣatras.* The simulation with the SkyMap Pro has produced some interesting results. It has verified the correctness of Dikshit's theory for the age of *Śatapatha Brāhmaṇa,* brought out the circumpolar nature of *Saptarṣi,* and has suggested δ Capricorni to be identified as *Śraviṣṭha* (i.e. *Dhaniṣṭha*), because it is much closer to the ecliptic than β Delphini. It is then compelling to accept the date of VJ as 1800 BC. Identification of *Dhaniṣṭa* with β Aquarii as proposed by K. D. Abhyankar[8] will also lead to the same epoch.

A Babylonian origin has been advocated for the mathematical theory of VJ by some scholars after contriving a date of about 400 BC for VJ.[9] However, it has been shown that all the astronomical knowledge in VJ can be traced to the Vedas, including the measurement of time using a water clock.[10] The use of a zig-zag function for the variation of the the length of day time during the year has been shown to be based on the measurements done at Delhi around equinox.[11] Finally, while the date of 1200 BC for VJ should have been sufficient, the date of 1800 BC for VJ should put to rest any further claims of proponents of the Babylonian origin.

[8] K. D. Abhyankar, "Misidentification of some Indian Nakṣatras," IJHS, 26.1 (1991) 1-10.

[9] See n. 6 above.

[10] B. N. Narahari Achar, "On the Meaning of AV XIX. 53.3: Measurement of Time?" *Electronic Journal of Vedic Studies,*" 4.2(1998).

[11] Y. Ohashi, "Development of Astronomical Observation in Vedic and Post-Vedic India," IJHS, 28.3 (1993) 185-251.

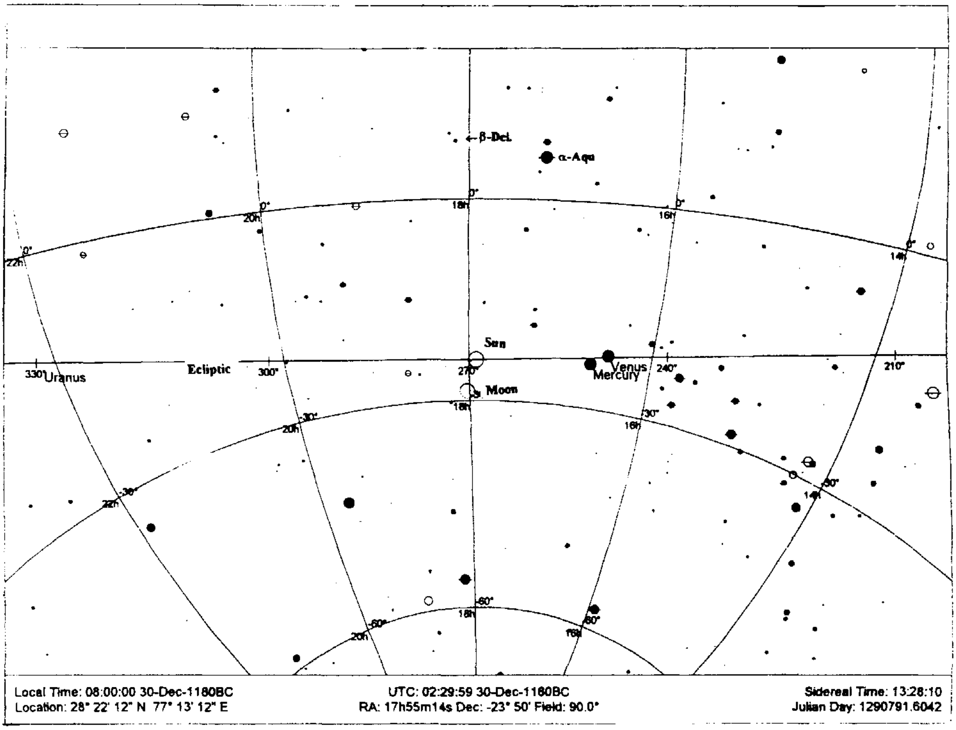

Figure 1: Winter Solstice in 1180 BC

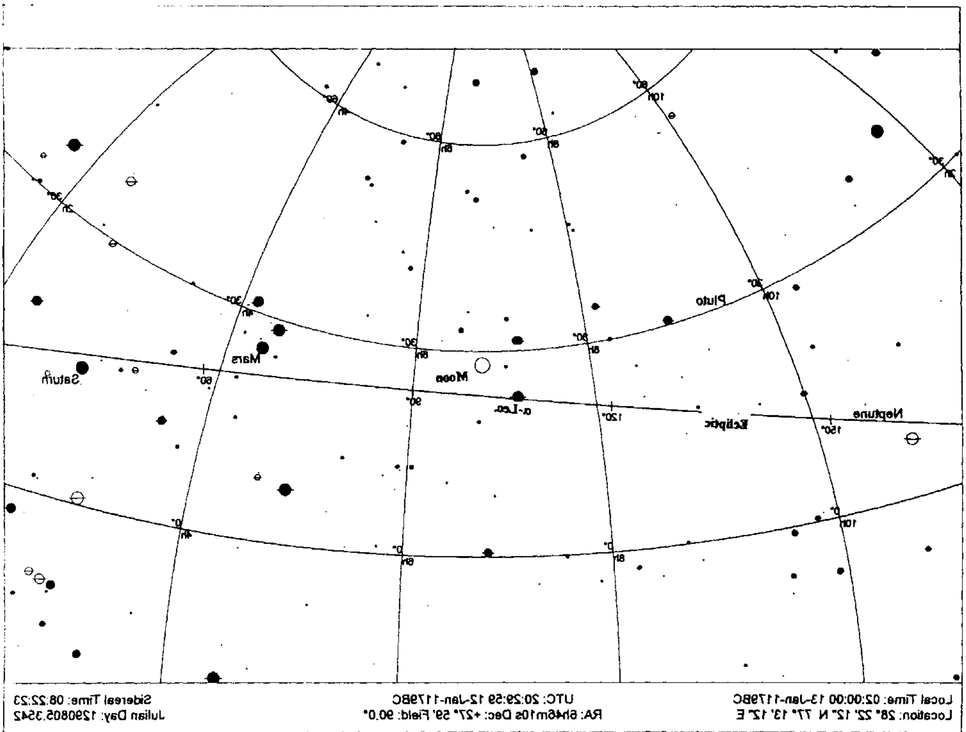

Figure 2: Full Moon after Winter Solstice in 1180 BC

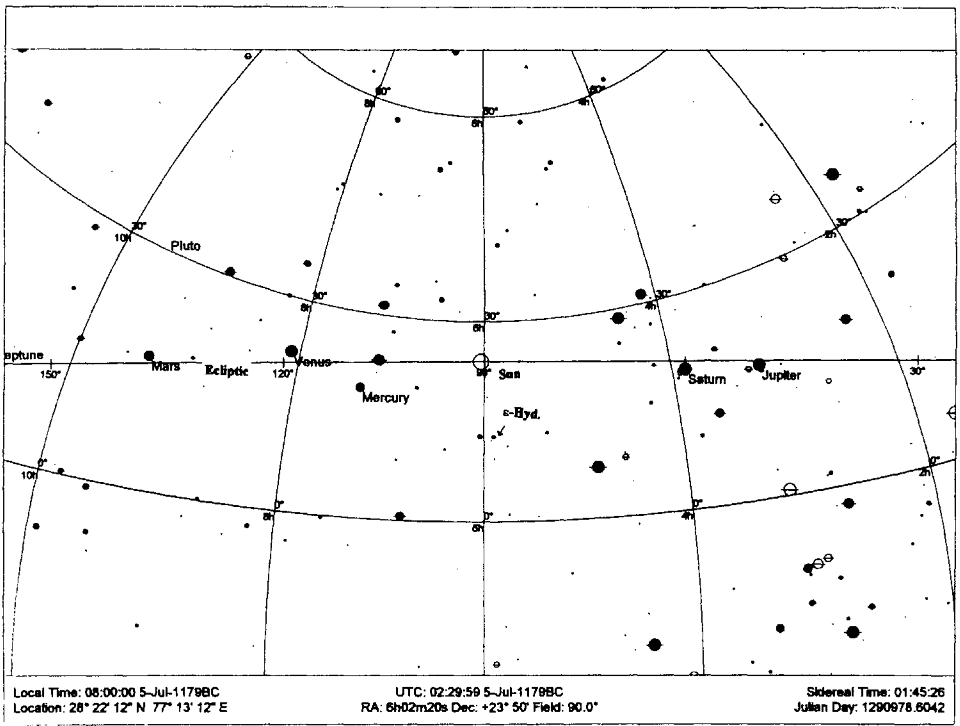

Figure 3: Summer Solstice in 1180 BC

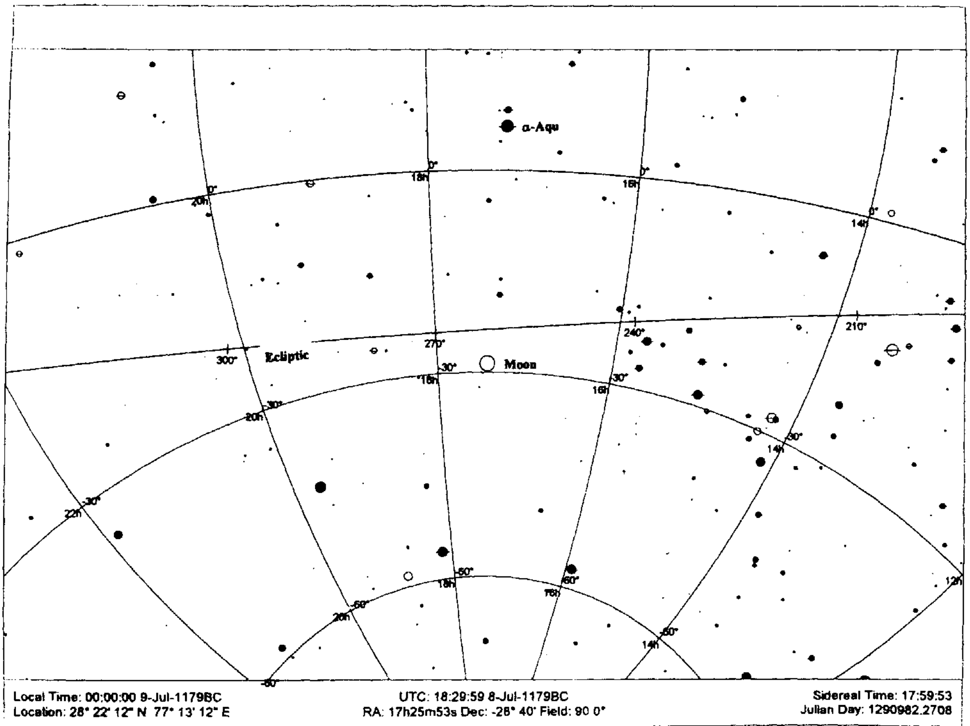

Figure 4: Full Moon Summer Solstice in 1180 BC

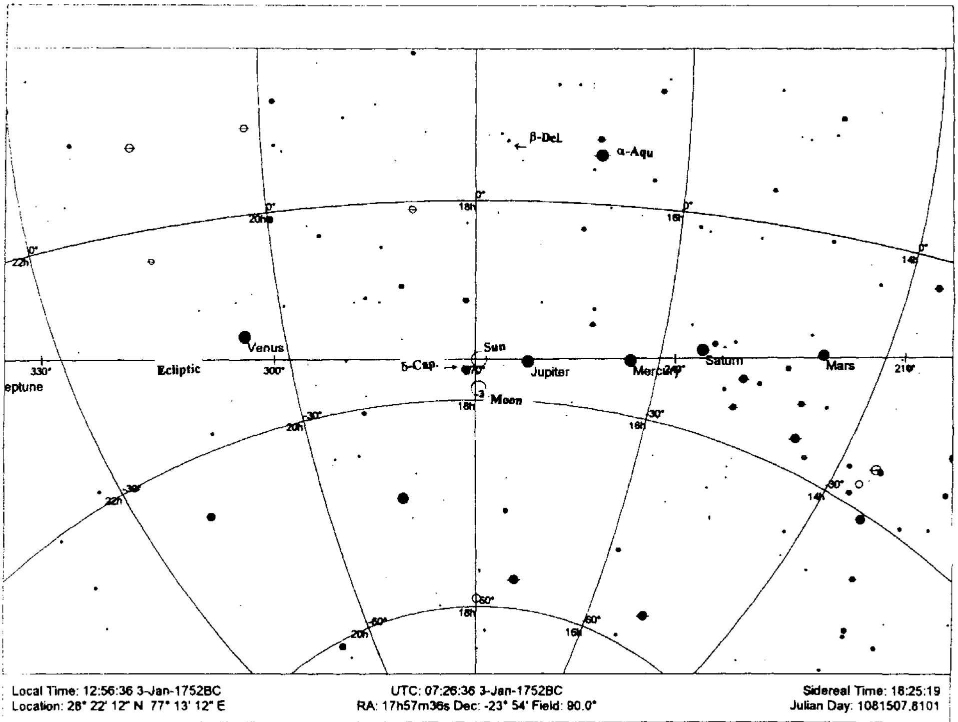

Figure 5: Winter Solstice in 1752 BC