

CONJUNCTION OF JUPITER WITH δ CANCRI

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An occultation of Jupiter with δ -Cancer is mentioned in Vedic literature. This is in fact an old historical event of Jupiter observed by ancients. Computations are done here for the approximate date when this occultation could have taken place. It is found that a Jupiter- δ -Cancer conjunction did take place around 4350 ± 80 B.C. It is also shown that this event happened about 12 times (i.e. in 12 cycles of Jupiter). The same event is expected to repeat after about every half Jovian nodal period of about 4700 years. From this it is concluded that the allied Vedic hymns belong to the date around 4500 BC. These findings have no conflict with any archaeological findings as the Vedic literature has descended to us through oral tradition.

Key Words: Occultations of Jupiter, Jovian node, Ketakara's date.

In the International Congress on History of Sciences in Scotland during 1977, there was discussion about the antiquity of some Vedic hymns. The author pointed out that there is a mention of an occultation of Jupiter with δ -Cancer in the Vedic literature which took place around 4500 B.C. The scholars wanted a detailed note of this claim on high antiquity of Vedic literature. The paper deals with this problem in detail.

Some Vedic verses talk of Jupiter's first appearance, probably as a planet moving in the background of stars in the vast open sky. Such hymns are found in *Rgveda* (RV. 4.50.45), *Taittirīya Saṃhitā* (T.S. 2.8.2). The most important verse in *Taittirīya Brāhmaṇa* (T.B. 3.1.1.5) reads:

“बृहस्पतिः प्रथमं जायमानः
तिष्यं नक्षत्रम् अभिसम्बभूव”

“br̥haspatiḥ prathamam jāyamānaḥ
tiṣyam nakṣatram abhisambabhūva”

“The Jupiter is first (recognised) moving and appeared occulted with *Tiṣya* (i.e. δ -Cancer)”

There is only one identifying *yoga-tārā* of *Tiṣya* (*Puṣya*) *nakṣatra* and that is δ -

Canceri. Whitney, Baintley, Kaye, Ketakara, Balashankar Dikṣita and all others agree on this point and suggest that the fact is clear to the sky-gazers.

According to the referee, the discussion is valid as far as telescopic observations are concerned. The naked eye observations cannot resolve objects clear than 1'. Hence one has to consider two other cases when $PC = 4'36'' \pm 1'24''$ also. They give $AB = 4^{\circ}25'$ and $2^{\circ}21'$ respectively. So the occultation of δ -Canceri by Jupiter can be observed for a longer period of time required by Jupiter's node to move through $2^{\circ}04'$, which comes out to be of the order of 550 years. Further, the central occultation can last for a period during which Jupiter moves through $2'48''$, which comes out to be 32 minutes.

The inclination of Jupiter's orbit is about $1^{\circ}, 18'$. The sidereal (nirayaṇa) longitude (i.e. the longitude without precession with reference to longitude of Spica = 180°) of δ -Canceri is $104^{\circ} 53'$ and its latitude is $4'36''$. Sidereal longitude of the *north node* of Jupiter's orbit was $77^{\circ}.4'$ in 1977 AD. The maximum radius of Jupiter's disc⁴ is $23''5$. The junction Star, δ -Canceri, will be considered here as a point. Since its latitude is very small so its position angle do not effect much and is not taken into account. The position of the node (W) of Jovian orbit at time T (expressed in Julian centuries after 1900 AD) is given as:

$$W \text{ (i.e. the tropical longitude of node)}^2 \\ = A + BT + CT^2 + DT^3 + \dots$$

Where A, B, C, D..... are constants:

A similar expression holds for the *ayanāmsa* (i.e. the angle of precession) and considering the terms only up to T^2 the sidereal period of the node of Jovian orbit comes out to be about 93000 years or so.³

Jupiter will occult δ -Canceri during each of its cycle whenever its node is near δ -Canceri. During a certain cycle when the node is the nearest to δ -Canceri, the occultation will be the best and will last for maximum duration. After a few more cycles, the duration of the overlap will decrease appreciably and finally the occultation will cease altogether. This whole phenomenon will be repeated after about half full nodal period (i.e. after about 47,000 years).³⁻⁷ Hence in order to find the duration of occultation of δ -Canceri by Jupiter the following three situations have been considered here:

i) The first edge to edge occultation.

ii) centre to centre occultation after a few Jovian cycles from its first edge to

edge occultation.

- iii) The last edge to edge occultation after another few Jovian cycles from centre to centre occultation.

These three positions of occultation have been shown in Fig. 1 (a,b,c) respectively. In the figures C is Jupiter's centre, P is Puşya (δ -Cancri). PCB is a segment of "Kadamba Protā" of C and P. (i.e. of the circle passing through the pole of the ecliptic and centres of Jupiter and δ -Cancri). It may be pointed out that the situation has been approximated here by taking equal celestial longitudes for Jupiter and δ -Cancri. This assumption does not make appreciable difference here since latitude of δ -Cancri is very small.

From the figure it is clear that $BAC = 1^\circ 18'$

$$\angle B = 90^\circ$$

At the beginning of the occultation cycle Fig. 1(a)

$$\begin{aligned} BC &= BP - CP \\ &= 4' 36'' - 23''.5 \\ &= 252.5'' \end{aligned}$$

Then from sine - formula it follows that

$$\begin{aligned} (\sin AC) (\sin \angle BAC) &= (\sin < BC) (\sin \angle B) \\ \sin (AC) &= \frac{(\sin 252.5'') (\sin 90^\circ)}{\sin 1^\circ 18'} \\ \text{i.e. } AC &= 3^\circ 6' \end{aligned}$$

At the time of centre to centre occultation Fig. 1(b)

$$BC = BP = 4'36''$$

By sine-formula, $AC = 3^\circ 23'$

At the time of the last occultation Fig. 1(c)

$$BC = BP + PC = 299.5''$$

By sine-formula, $AC = 3^\circ 40'$

Hence the duration of occultation is only over 34' (= 3° 40' – 3°6') in the sense that the occultation takes place over a range for 34' in the motion of Jovian node about its mean position at 3°23' from δ -Cancer. In 1977 AD the Jovian node and δ -Cancer are 27° 49' (\cong 104° 53' – 77°4') apart. Since the period of Jovian node is about 93,000 years so the time in which their separation has changed to 3°23' is about 6312 years*. Hence it follows that the centre to centre occultation of Jupiter and δ -cancer place about 4350 BC Since the Jovian node takes about 150 years to move through 34' so the occultation took place for about 12 cycles of Jupiter. Thus it is proved that this event took place from about 4425 BC to about 4275 BC (i.e. 4350 \pm 75) It may be pointed out here that Ketakara⁸ calculated 4650 BC as the era of this event as mentioned by Tilak and Kaye.⁷ The era that results from the present original computations differs by about 300 years from Ketakara's results. the difference is due to the fact that here in the present computations the T² term of equation (1) has been taken into account while it has been ignored by Ketakara as is clear from his original documents procured from his family.⁸ Moreover the present work is not only more exact but also has proved by taking three positions (first edge to edge, centre to centre and last edge to edge) of the occultation that this event took place for about 12 cycles of Jupiter.

This is an important old historical record of Jupiter's passage among stars. The archeological evidences have nothing to contradict it because this event survived in Vedic literature through oral traditions (*śruti paramparās*). It may be added that such astronomical evidences in general are more reliable than the indirect archeological evidences. Moreover, these old records are actual naked eye records. These are not in anyway back calculated by the ancients to befool the later generations as they did not know the theoretical techniques based on law of gravitation. Carbon dating methodology may have sometimes errors or the order of \pm 800 years or so in the estimation of the ages of the antiques of about 2500 BC. On the contrary the inferences from slow motions of nodes etc. are more reliable as they are based on a relatively more exact law the law of universal gravitation. Thus the allied hymns R.V., T.B. and T.S. etc. probably belong to about 4500 BC or so.

REFERENCES AND NOTES

1. *R̥gveda* (RV 4.50-4) and *Taittirīya Saṃhitā* (TS 2-8-2).
2. *Taittirīya Brāhmaṇa* (TB. 3-1-1-5) Talks of conjunction of Jupiter with δ -Cancer.

It may be pointed out that in all these references (RV., TS. and TB.) Brahaspati does not stand for *purohita* instead it is a planet as is evident from the fact that these statements are mentioning the open sky as the surrounding and also the *nakṣatras* Pusya & Āśleṣā which formed the background.

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$$\frac{93,000 \times (27^\circ 49' - 3^\circ 23')}{360} = 6312 \text{ years}$$

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