

TRUE RATIONALE OF SŪRYA SIDDHĀNTA

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(Received 28 December 1995; after revision 27 November 1996 .)

The *Sūryasiddhānta* perhaps followed a model based on the precession of the equinoxes. The sidereal zodiac is implicit in the *Sūryasiddhānta* and can be deciphered from the configuration of the equinoxes and solstices with *Mūla* at 240^o as fiducial at the beginning of Kaliyuga. The mean Aries ingress of the *Sūryasiddhānta* coincided with vernal equinox of Kali 3623 elapsed at 356^o of the sidereal zodiac and the use of extra-long sidereal year made the zero-point to advance towards east. Zero point as per *Sūryasiddhānta* was the Mean Sun corresponding to expiry of the respective Kali Years instead of the vernal equinox till Kali 3623. As such Revati (Zeta Piscium) was at the *Siddhāntic* Zero point in Kali 3339. The initial point as deciphered from the polar-longitudes by the Calendar Reform Committee (CRC) do not fit with the scheme suggested here and stands for reexamination.

Key Words : *Ayanāṅga*, Fiducial Star, Hindu zodiac, Mathematical model, *Mūla*, Precession of the equinoxes, *Sūryasiddhānta*, Zeropoint.

INTRODUCTION

The *Sūryasiddhānta* (hence after SS) is one of the most fundamental treatise of Hindu astronomy and it is believed to be of an antiquity of more then 1500 years. The English translation of the SS was first published in 1860 by Rev. E.Burgess¹. In the known history of last 1500 years, there had been many commentaries on this treatise and since 1860 modern astronomers have subjected the text to scientific scrutiny as well as critical evaluation. The Calendar Reform Committee² (1953-1955) under the chairmanship of M.N.Saha considered all such available information to locate the Hindu zero-point or in other words, to find out the Hindu astronomical definition of the sidereal zodiac popularly known as *Rāśi-cakra*. In the course of their effort to recommend a uniform national calendar, the committee has made the following observations about Siddhāntic astronomy in general:

- (a) “We do not, however have any idea as to how the beginnings and endings of the *nakṣatra* division were fixed in india. The prominent ecliptic stars which were used as *Yogatārās* in pre- Siddhāntic period, are not distributed at regular intervals along the ecliptic: and so it was found very difficult to include the stars in their respective equal divisions. In fact no arrangement at any time appears to have been satisfactory enough for all the *Yogatārās* to fall within their respective division”. [p.183]

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- (b) "It is clear from the text that the compilers of the *Sūryasiddhānta* had no knowledge of the precession of the equinoxes...."[p.240]
- (c) "...How did the indian savants manage to have such a wrong value for the length of the year?

The year according to the *Sūryasiddhānta*, is meant to be clearly tropical, but as the Indian savants compiling the S.S. were ignorant of the phenomenon of precession of the equinoxes, they were unaware of the distinction between the sidereal year and the tropical year.....(p.240)

- (d) "...the above analysis seems to show that the co-ordinates of stars were determined at different epochs..The epochs come out to be 340 AD,500 AD and 560 AD respectively if it is assumed that Hindu astronomers assumed Citra (Spica or Alpha-Verginis) to occupy the first point of Libra, the epoch comes out to be 285 AD" (p.263)

The CRC recommendation of Citrā as fiducial based on the above assumption is in violation of the following explicitly known facts:

- (1) SS gives the polar longitude of Citra as 180° and the corresponding celestial longitude is $180^{\circ}.48'$. This is evident from page 265 of the CRC report itself.
- (2) *Pañca Siddhāntikā*³ gives the celestial longitude of Citra as $173^{\circ}20' + 7.5'' = 180^{\circ}50'$.
- (3) SS gives the longitude of Revati as $359^{\circ}50'$ (i.e. roughly 0°) and that of canopus as 90° in total contradiction to the concept of Citra as fiducial.⁴

In fact the whole argument of the CRC is deceptive as the tropical longitudes change by about $4''$ in course of A.D. 285 to A.D. 576. Neither of the longitudes are reliable without the knowledge of time (date) and possible error in the determination. Validity of the three epochs discovered by the CRC based on the polar longitudes will be examined further towards the end of this paper.

RATIONALE OF THE *MAHĀYUGAS* AND THE EXTRALONG SIDEREAL YEAR

Let us denote,

SS length of the solar year = 365.258756 days.....y

Modern tropical year = 365.24219 days.....y'

Modern sidereal year = 365.2563624 days.....y*

It is apparent from the above that y is greater than y' by 24 minutes or one *ghatika*

approximately the time taken by Sun to cover $1'$ of arc. In other words 360 Sāvana days in 21600 years or approximately 200 such revolutions in a Mahāyuga of 4320000 years. *This aspect of Hindu sidereal year was known to Muñjāla Bhata*, the South Indian astronomer who wrote *Laghu Mānasam* in Śaka 854, or A.D. 932. According to Muñjāla the Solstitial points make 199669 revolutions in a Kalpa or 199.669 in a *Mahāyuga* i.e. roughly 200. This information take us to the true rationale of the extra long sidereal year and *Mahāyugas*-

$4320000 = 200 \times 21600$ years i.e. *Mahāyuga* is an integral multiple of the precessional Cycle of *Sūrya Siddhānta*.

Based on the above clue *Sūrya Siddhānta* perhaps followed a Mathematical Model on the following lines.

MATHEMATICAL MODEL OF SŪRYA SIDDHĀNTA BASED ON THE PRECESSION OF THE EQUINOXES.

The *Sūrya Siddhānta* defines the mean Equinox since the beginning of *Kaliyuga* by the following relation* give exact references of verse from it follows:

$$(i) \text{ Ahargana (N}^{\text{th}} \text{ equinox)} = N \text{ Kali Years} + 60 - N (y-y^1) \text{ --- (A)}$$

$$= 60 + N.y^1$$

At the expiry of 3623 Kali years (1323332.45 days), $N (y-y^1) = 60$ and hence the mean Sun of Kali 3623 (elapsed) coincided with the vernal equinox. This is evident from the zero *ayanāmsa* years of Siddhāntic texts like *Laghumānasa* (śaka 449 or kali 3628) *Grahalāghava* (śaka 444 or kali 3623) etc. It must be noted here that as per the various texts of the Kerala School of Astronomy based on *Āryabhaṭīya* like '*Grahachāranibandhanam*' '*Dr̥ggaṇita*' etc. also the zero *ayanāmsa* year is Kali 3623 elapsed. According to the CRC report, for the expiry of 3600 Kali years the tropical mean Sun was only $359^{\circ} 42'$ as per modern computation instead of the 360° required as per *Āryabhaṭīya*. The decrement of $18'$ can be explained as $60-3600 (y-y^1) = 60-3600 \times 0.01656 = 60-59$ days $37 \text{ ghatis} = 23$ years for the precessional model of *Sūrya Siddhānta*. For the true sidereal year this amounts to only $18'$ of arc so that the mean tropical Sun coincided with the vernal equinox in Kali 3623 (elapsed). In short, $3623 = 3600 \times 21738 / 21600$ where 21738 is the period required as per SS- sidereal year for 360 days precession so that there is 60 days precession in 3623 years.

$$(ii) \text{ Mean tropical Sun (N}^{\text{th}} \text{ Kali)} = 360 - 60 + N (y-y^1)$$

$$\text{Where } N = \text{Kali years elapsed} = 300 + N (y-y^1) \text{(B)}$$

For $N (y-y^1) = 60$. Mean tropical Sun of SS coincided with the vernal equinox.

*Apparently no such rule is evident in the SS (Editor).

(iii) *Mean Sidereal Sun of Sūrya Siddhānta*

To understand the relation that governs the Sidereal Mean longitude of SS, we must know the *āyanāmsa* of the great epoch of Hindu astronomy *viz.* the beginning of *Kaliyuga* - Midnight of 17/18 February 3102 B.C. N.C. Lahiri's Secretary of the *Calendar Reform Committee* gives the value as 46°35'. Slight modification is suggested to the above value based on the following arguments.

(iv) *Division of the Ecliptic into Rāsīs & Nakṣatras*

Calendar Reform Committee has frankly admitted their ignorance on this vital aspect of Hindu Zodiac. A division of the ecliptic into 30° each and 13°20' each means a division of 360° into 108 parts of 3°20' each i.e. the so called four *padas* or quarters of 27 *nakṣatra* divisions.

$$108 \times 200' = 21600' = 360^\circ.$$

The obvious first step in any such process is a division of 360° into four quadrants. At any point of time, equinoxes and solstices are the most convenient references for a division of the ecliptic into 4 quadrangles of 90° each. *R̥gveda* (1.155.6) perhaps refers to such a division of the ecliptic by the equinoxes & solstices.

As regards division of the ecliptic into 108 parts of 3° 20' each, scriptural evidence is available in *Maitrāyaṇa Upaniṣad* VI. 14:

"The visibility of time is it's increase from the duration of the twinkling of the eye to the year of twelve parts. Of this year, the one half is consecrated to Agni and the other to Varuṇā. The movement from Maghā upto half of Śraviṣṭhāh, it is consecrated to Agni and the northward movement from half of Śraviṣṭhāh upto Sarpāh is consecrated to Soma. Every month of the year consists of nine quarters (fourth parts of the 27 nakṣatras) in conformity with the accompanying (nakṣatra)...". The epoch referred to herein correspond to the fall of solstices along 120° & 300° and equinoxes at 30°-210°, around B.C. 1900. This description of the year reflect a division of the ecliptic using the equinoxes and solstices as the references.

On the above basis, Lahiri's value of 46°35' can be modified as 46°40' i.e. the vernal equinox at the beginning of *Kaliyuga* was at Rohini Mid-point. Precisely this is the mathematical definition of Hindu Zodiac popularly known as *Rāsī Cakra*'.

The unknown Genius created *Sūrya Siddhānta* in such a way that the *Yugādi* equinoxes & solstices as well as the fiducial star '*Mūlā*' (*Lambda scorpii**)

* The pre-eminent position of Lambda scorpii over the zodiac has been already brought out by modern astronomy. It is located near to the galactic centre and is one of the two *yogatarās* having no proper motion. Hence Mūlā is more appropriate to serve as fiducial rather than Citrā.

becomes the reference point in the division of the ecliptic into 108 parts. *Aśvinyādi* was fixed by defining the sidereal longitude of 'Mūlā' to be 240°. The *Rāśī Cakra* is thus implicit in *Sūrya siddhānta* and the initial point can be deciphered mathematically. According to the above.

$$\begin{aligned} \text{Sidereal Mean Sun} &= 346^{\circ} 40' \frac{y^t}{360} + N (y-y^s) \\ &= 347^{\text{d}} 21^{\text{h}} + N (y-y^s) \quad \text{-----}(C) \end{aligned}$$

The function $\frac{yt}{360}$ is meaningful since it is used for converting 46°40' into equivalent days.

DEFINITION OF THE HINDU ZERO-POINT

As per the Siddhāntic astronomy all the Sidereal Mean longitudes were at the Hindu zero-point for the beginning of Kaliyuga. The mathematical model described above clearly demonstrate that *Aśvinyādi* or the zero-point was 60 days East of the tropical mean sun of *Yugādi* and 46°40' west of the vernal Equinox.

COINCIDENCE OF SIDEREAL & TROPICAL ZODIACS

(Zero *Ayanāmsa* Year)

Two requirements have to be met:

- Tropical & Sidereal Sun described above. (B) & (C) must coincide.
- The *Ahargana* must correspond to the Mean equinox of the respective year which is 60 days east of *Yugādi* Tropical Sun.

On equating B & C we get,

$$\begin{aligned} 300 + N (y-y^t) &= 347^{\text{d}} 21^{\text{h}} + N (y-y^s) \quad \text{-----}(D) \\ \text{i.e. } N &= \frac{47^{\text{d}} 21^{\text{h}}}{y^s - y^t} = 3339 \end{aligned}$$

i.e. the sidereal and tropical longitudes of Sun as per the SS model coincided at the expiry of Kali 3339.

Ahargana of 3339 Kali (elapsed) = 1219599 days. But 3339 x (y-y^t) = 55^d 17^h only. *Aśvinyādi* was 60 days east of *Yugādi* tropical Sun i.e. Sun reaches the

* In the model zodiac of the author the zero point of the zodiac at *Yugādi* has the anti-Citrā point (and Mūla was 240°) whereas the text SS demands Mūla at 242° 50' and Revati at 359° 50' sec (a) above, but, at the end of each Kali year, this zero point shifted towards east by an amount given by the excess in the SS length of the Sidereal year, i.e. the zero point has a slow east-ward motion.

This supposition, according to referee, is in violation of the concept of a sidereal zodiac, and none of the traditions of Hindu astronomy like number of revolutions of planets and their apogee, node etc. can be fitted in this model zodiac with a moving zero point (Editor).

Hindu zero-point after about 4 days 42 *ghaṭis*.

i.e. *Ahargana* = 1219599 + 4^d 42^{gh} = 1219603.684 approx.

This corresponds to the Mean equinox of AD 238 (23rd March, Friday) and hence the coincidence of Sidereal & tropical zodiac is confirmed.

EQUINOX OF KALI 3623 (ELAPSED)

The Calendar Reform Committee could not provide any explanation for rejecting the zero point of Siddhāntic texts like *Grahalāghava* that corresponded to the mean equinox of Kali 3623 (elapsed). The model described above explicitly brings out imbalance of equation (D) for Kali 3623 in view of the Sidereal mean Sun being at 356^o for the mean equinox. The real precession since the beginning of *Kaliyuga* is 50^o 38' instead of 46^o 40'.

EQUINOXES OF AD 285, AD 500 & AD 576.

It is apparent from equation (B) that the SS Mean tropical Sun coincided with vernal equinox in Kali 3623 (Elapsed) and as a result of the continued use of extra-long sidereal year the zero-point moved towards east 0.00239 days per year. *Revati* (Zeta Piscium) being on the west of the equinox of Kali 3623, the fall of equinox on *Revati* was of no consequence to *Sūrya Siddhānta*.

Alternatively, with *Mūla* at 240^o the sidereal longitude of *Revati* = 355^o 17'. Equation (B) suggests that the Mean Sun of *Sūrya Siddhānta* coincided with *Revati* for Kali year 3339 (elapsed) i.e. the zero longitude of *Revati* belong to AD 238 rather than AD 576.

Similar argument holds good for the point opposite *Citrā*. The east-ward progress of SS zero-point coincided equinox of AD 285 near about A.D. 1885; In fact, had the equinox of AD 285 or AD 576 been of any relevance to *Sūrya Siddhānta*, the year-length would have obviously undergone modification as can be seen in the case of Brahmagupta. Also we must note that Brahmagupta discarded his modification of year-length to compile the *Khaṇḍa Khādyaka*. E. Burgess did rightly point out⁷:

“We have seen, in treating of the *bīja* that it has been the aim of the modern Hindu astronomers, leaving the Sun’s errors untouched to amend those of the other planets to an accordance with it”.

Had, two equinoxes been zero-points in Siddhāntic astronomy, the year length of 365.25875 days would have definitely undergone severe modification.

ASTROLOGICAL RATIONALE OF THE INITIAL POINT

Mathematically (or geometrically) every point of a circle is on a par with the other to be considered as the zero point. As such the approach of the Calendar Reform Committee was that the choice of initial point of the zodiac was a matter of calendaric custom or convention. The Calendar Reform Committee thus recommended a standard initial point for bringing uniformity among the then prevailing regional calendars. Calendar Reform Committee did take note of the Al-Biruni's observation that the astronomical knowledge was a by-product of the astrological knowledge, but the astrological aspect was overlooked while recommending the arbitrary point opposite Citrā. If the purpose of creation of the zodiac was mainly astrological, there must be some astrological rationale that gives credibility for a point on the ecliptic to become the 'true' zero point of the zodiac. For example, in the realm of modern physics, a mathematical result is meaningless without a physical rationale that explains its relation with the phenomenal Universe. Citrā's opposite point has no physical rationale that justify its choice as the initial point of Rāśi Cakra. On the other hand an explicit rationale is forthcoming from the interpretation of SS based on Mūlā as fiducial at 240°.

The basic postulate of *Jyotiḥśāstra* is the 'Principle of Symbolic Equivalence of Man and Zodiac i.e. Microcosm & Macrocosm'. This principle we can find reflected even in the Upaniṣads as- '*Aham Brahmāsmi*'-and this demands an astronomically defined physical point over the human body. Another of the ancient Hindu disciplines viz., *Tantra* has fortunately preserved this information and the point of symbolic coincidence can be identified as "*Mūlādhāram*", the seat of *Kuṇḍalinī* at the bottom of the Cerebro-Spinal axis which falls at 240° over the human-zodiac. The nomenclature "*Mūlādhāram*" meaning - *Mūlā* the fiducial, infact is a reflection of the sidereal longitude of 240° for *Mūlā* on the *Rāśi-cakra*. An initial point becomes the true zero point only if it makes the resulting zodiac an exact replica of the human being. The synonymous phraseology prevailing in *Jyotiṣa* and *Tantra* lend further credence to the above bio-cosmic symbolic interconnection.

CONCLUSIONS

It is apparent from the above that the true zero *ayanāmsa* year according to *Sūrya Siddhānta* is Kali 3339 or AD 238 and the fiducial star is Mūla. *Yogatārās* have nothing to do with the division of the ecliptic into 27 equal divisions as the division was mathematical using the equinoxes & solstices of "*Yugādi*" as reference points. On this background the initial point as recommended by CRC stands for scrutiny and re-examination.

REFERENCES

1. *Sūrya Siddhānta* - English translation by Rev. E. Burgess, 1860.
2. *Reports of the Calendar Reform Committee* M.N. Saha & N.C. Lahiri, CSIR, 1955.
3. *Pañca Siddhāntikā* of Varāhamihira by T.S. Kuppanna Sastry, P.P.S.T. Foundation, Adyar, Madras, 1993.
4. *Sūrya Siddhānta*- English translation by Rev. E. Burgess, 1860.
5. *Tables of the Sun* by - N.C. Lahiri.
6. *Sixty Upaniṣads of the Veda* by Paul Deussen. Vol. I.
7. *Sūrya Siddhānta* - English translation by Rev. E. Burgess, 1860.