

Three Strange Verses in Surya Siddhanta and Accurate Astrological Predictions

R. V. VAIDYA. M.A., B.T

Introduction

THE INDIAN ALMANAC makers of the present day follow the Nirayan system for calculating planets' places. The History of Indian Astronomy shows that the Indians definitely followed the Sayan system upto the time of Surya Siddhanta (S.S.) (Seeu'Dikshit', pages 417 to 419). The later astronomers, however, appear to have adopted the Nirayana system. It is curious to note that scholars, interested in Panchang controversy, point out to a group of three verses in Surya- Siddhant (S.S.) as their ground for adopting the Ayanamsas.

In the following brief article, I have to show :

- (i) that these verses were not composed by the author of S.S. but have been interpolated by some later astronomer, and
- (ii) that they do not advocate the use of a correction (Ayanasamskara) to be applied to the Sayan longitudes of planets, but
- (iii) that, in reality, they propound a very important theorem which has hitherto remained unknown to the Indian Astronomers.

The Three Verses

The following verses supposed to be written by the author of S.S., occur in the third chapter of the book, the subject matter of the book being त्रिप्रश्न (thriprasna) or the fundamental problems of time, place and direction:

त्रिंशत्कृत्ये युगे भानां चक्रम् प्राकू परिलंबते ।
तद्गुणात् भूदिनेर्भक्ताद् द्युगणाद् यदावाप्यते ॥
तज्ञोत्सिद्धा दशाप्तांशा विधेया अयनभिधा ।
तत्संस्कृतात् ग्रहात् कार्तिः छ याचरदलादिकं ॥
स्फुटम् दृकू चक्रं चलितम् हीने छाया कार्त् करणागते
अंतरांशैरथाकृत्य पञ्चच्छेषै स्ताथाधिके ॥

A careful scrutiny of the first 12 verses of this chapter will reveal that the first eight verses deal with the problems of the ascertaining of directions, measuring of shadows cast by gnomon the calculation of sine and cosine values of the Sun's declination, etc. The 12th and 13th verses deal with the calculation of the पलभा (equinoctial shadow) and अक्षांश (geographical latitude). The above mentioned verses occupy the intermediate place. The subject matter of these verses is the application of a certain correction to a coordinate of a plane Vs place. Naturally, these ought to have occurred somewhere in the first chapter on mean places मध्यमधिकार or in the second chapter which deals with the true places of planets स्पष्टधिकार. But the last* verse of the second chapter clearly states that according to the writer, "everything concerning the planetary places has been dealt with at length in the first two chapters and nothing else remains to be said. This clearly shows that the three verses have not been written by the author of S.S. They look like "unconcerned visitors" sitting in the midst of a party meeting.

The third chapter treats of shadow, planets, declination, the geographical latitude, the ascensional difference (A.D.) etc. hence, no one can expect an eminent astronomer like the author of S.S. to commit the blunder of "throwing-in" into this chapter verses which have nothing to do with the subject matter of the chapter.

I quite agree with Rev. Burgess who** regards these verses as "interpolated" by some later astronomer Mr. R. V. Patwardhan of Poona, a staunch supporter of Zeta School of Nirayan system, also holds the same view, I, however, differ from all astronomers on one point, viz., "the exact significance and purpose of those verses"; for, I hold the view that these verses do not contain a

* एषा स्फुटगतिः प्रोक्तः सूर्यादीनां खचारिणां (स्पष्टाधिकार 69)

**See Translation of S.S. by Rev Burgess, Pages 114 to 118

formula for Ayanamsa to be applied to planets' longitudes, but an important theorem relating to the practical side of observational astronomy. and I uphold the eminent astronomer as being perfectly right in writing these verses in their proper place determined by the logical sequence of thought.

The Theory of Oscillation of Equinoctial Points

Indian Astronomers have been advocating the theory that the equinoctial point oscillates 600 times, during a Mahayuga, on both the sides of the stationary point of Aswini, the limits being 27° on each side. They believe that this theory has been propounded by the author of S.S. and although modern astronomers know perfectly well that the equinoxes make a complete revolution along the Earth's orbit in about 26000 years and that it is quite unnatural for them to oscillate, they stick to this time-honoured belief as if they are too helpless to violate the rules laid down by the revered sage. I wonder, not one of them ever raised the question how such an eminent author could have assumed such an unnatural phenomenon.

Translation of the Verses

I translate the verses as follows:

"The starry belt (भानाम् चक्रम्) slowly slides Eastwards and makes rounds (प्राक् परिलम्बते) 600 times during the period of 4320000 years (महायुग). Multiply the अर्हाण by this number (600) and divide the product by the number of mean solar days in a yuga. Represent the result as $n\pi + d$ " where d would be an acute angle lying in one of the four quadrants. Call this the Multiply this by 3 and divide it by 10. Call this result by the name Ayanamsa (विज्ञेया अयनाभिधाः)

After applying this correction to a planets place (तत् संस्कृतात् ग्रहात्) the result will be seen to be true, if verified at any of the four cardinal सांक्रंती 's. (viz. the two solstices and the two equinoxes) The comparison of calculated and observed figures will lead you to find that they differ by a quantity which may be positive or negative (किरणागते (खौ) छायाकर्त्तु हीने सति तथा पश्चत् अधिके सति) : when this difference is made up (शेषः अन्तराशौरावृत्य) i. e., when the correction plus or minus is applied, one would find that (i) the starry belt is gradually moving eastwards (प्राक् चक्रम् चलितम्) and that (ii) the finally calculated figures tally with the observed ones (छाया चरलादिकम् स्फुठम् दृक्नुश्यता गच्छन्).

Every astronomer, who knows the method of taking observations of heavenly bodies, knows that while the calculator first finds the longitude and latitude of a planet, the observer gets (i) either the Right Ascension and Declination, or (ii) the Azimuth and Altitude or (iii) the ध्रुव and विक्षेप. The calculator in order to test the accuracy of his calculations, has to convert first set of co-ordinates (Long. and Lat.) into another set (R. A. and Decl.) by the help of conversion formulac

It is also a well known fact that चर (A. D.) depends upon the geographical latitude and the planets' declination, and the अक्षांश is verifiable by the observation of Sun's declination. Naturally, the author of these verses must have thought it proper to treat this "theorem on the verification of calculated results" in the chapter on the ' Three Problems " which commences with the अक्षांश, चर and क्रंति

Fall Import of the Passage

Let us try to understand these verses part by part, (A) The first verse clearly states that the celestial sphere (the starry belt) is slowly moving towards the East, away from some point in the sky which the author has chosen and with respect to which he has taken observations of all principal stars and has recorded them in a chapter in S. S. (this point was the position of the equinox in the year of observation).

The author of these verses clearly takes into consideration the movement of the starry sphere and is thus the follower of a Sayan system (but in a different sense). The difference then, clearly lies in the fact that while we get a Nirayan place from the Sayan by the formula " Sayan place Ayanamsa = Nirayana place " we should, while making use of the S. S. rules, follow the formula " Sayan + Ayanamsa = Nirayan

(B) The author clearly gives, if not the rate of precession of equinoxes, the rate of change of longitudinal place by the words त्रिशत्कृत्ये युगे i. e., 600 times per Mahayuga (according to popular belief). त्रिशत् means 30. कृत्यो means 20 or 22. If the correct पाठ be कृतयो it would mean a 'square'. Hence त्रिशत्कृत्यो or 33qt would mean 600, 660 or 900 revolutions per Mahayuga, i. e., 3, $3\frac{1}{2}$ or $4\frac{1}{2}$ minutes of arc per year.

Those, who believe that the S. S. advocates the Nirayan basis of calculation, will have to adopt one of these 3 rates of correction to be applied to the longitude of a planet, the different figures depending upon the sense which त्रिशत्कृत्ये is believed to convey.

(C) The second verse asks one to perform some intricate calculations and to arrive at some result and to name it as Ayanamsa. Suppose, the number of mean solar days in a Mahayuga is x and the Ahargana on a particular day is y . Then the first step of the result would be $y \times 600 \times 360/x$ degrees. This result can happen to be a very big one. Let us suppose it to be, say, 3765 days. This is equal to 10 revolutions + 165° . This latter figure is to be represented as a i.e., an acute angle differing from 90° , 180° , 270° , or 360° by some value. In this example, $165^\circ = 180 - 15^\circ$. Then 15° is said to be a μ pf. This multiplied by 3 and divided by 10 would give This is to be called the Ayanamsa.

If, for instance, we try to find the Ayanamsa for the 1821, the time elapsed from Kalyadi (the popular date of 3101 B. C. being taken) would be 5000 years. The starry belt should be supposed to have moved through 250° , 275° or 375° (according to different interpretations of त्रिशकृत्यः). The author enjoins us to reduce this to an angle in one of the 4 quadrants. The भुजा of these angles would be 70° , 5° , and 15° respectively. One can clearly understand that since every big result must be reduced to an acute angle and since each such angle is always to be multiplied by $3/10$, this multiplier acts as a controller and the net result would never exceed 27° , because the maximum value of a भुजा would never exceed 90° , which when multiplied by $3/10$ gives 27° .

Also, since the acute angle can be found always to lie in one of the 4 quadrants, the value of the Ayanamsa naturally increases from $+ 0^\circ$ to $+ 27^\circ$ in the 1st quadrant, then decreases from $+ 27^\circ$ to 0° in the 2nd quadrant, then 0° to $- 27^\circ$ in the 3rd and from 27° to 0° in the fourth.

The following important corollaries naturally follow from the above considerations:—

(i) The ayanamsa value oscillates between plus 27° and -27° ; and that

(ii) it is independent of the rate of movement of the starry belt, since no figure in the list of natural numbers for that rate can cause any change in the limiting values of Ayanamsas which are obtained by the "multiplier control" of $3/10$ being applied to an acute angle (भुजा) which each angle is got to be reduced.

(D) The third verse enjoins the calculator to apply this correction (Ayanamsa) to a planet. The language is very ambiguous here. The author does not state in clear terms as to which coordinate of the planet's place is meant.

The commentators of the S.S. have deluded themselves into believing that this is a correction to be applied to the planet's longitude. The author does not give this verse in the chapters on "planets' places". The correction in this respect is clearly the rate of motion given by त्रिशकृत्यः.

In my opinion, this is not the correction to be applied either to the latitude or the longitude of a planet, but to that co-ordinate of the planet's place which is known as "Declination" (क्रान्ति) i.e., the distance of the planet from the Equator (North or South).

It is a well-known phenomenon of modern astronomy that as the Equator slides on the Elciptic, the equinox makes one complete revolution in about 26000 years. The equator passes through each star (situated within the belt of $\pm 23^\circ$ of the ecliptic) sometime during the revolution of the equinoctial point; it is sometimes seen to lie to the East and sometimes to the West of each such star. Thus, it will be seen that, when the equator passes through a star, its declination is zero, some centuries before this event it must have been positive and some centuries later it will continue to be negative. The value of the declination for each such star will thus be seen to have oscillated between $+ 23\frac{1}{2}^\circ$ and $- 23\frac{1}{2}^\circ$.

The History of Indian Astronomy tells us that in the days of शतपथब्राह्मण (Sathapatha Brahmana) the Pleades' (Krihika) used to rise exactly in the East. This shows that the declination of the star was, thus, zero in those times. The S. S., however, gives $+19^\circ$ as the declination and in our present times the declination of this star is about $+ 24^\circ$. As centuries will roll by, this value will appear to be decreasing.

The author of these verses very well knew that the formulae of calculating planets 'विक्षेपां' and declinations as given by S. S. in verses 56, 58 (Chapter II) will not continue to hold good after some centuries. He also believed that the starry belt gradually revolved eastwards and hence the declination value of each star when observed in future centuries, will not tally with the places as calculated by the standard formulae of S. S. He was, therefore, forced to introduce some correction to be applied to the declination value. He seems to have estimated the rate of variation which he gives by the term त्रिशकृत्योयुगे:

(E) In the last portion of the verse the author says that this corrected figure will appear to tally with the observed declination of the planet. He recommends 4 occasions for taking observations viz. two solstices and two equinoxes. The reasons for selecting these days are quite obvious.

In this connection, it is worth noting that while the declination of each star does change as the centuries pass, the rate of variation is never constant e.g., the rate of variation between 1° and 14° is about 200 years per degree; from 14° to 18° , it is about 250 years per degree; from 18° to 21° it is about 300 years, and from 21° to 22° it is 500 years per degree and finally during the last degree of declination its rate is about 1200 years per degree.

The author of these verses has, however, assumed a constant rate of variation which is a drawback.

(F) Another drawback appears to be the value of $+27^\circ$ in place of $\pm 24^\circ$ (the value for the obliquity of the ecliptic as adopted by S.S.). I do not quite understand why this figure has been adopted by the astronomer. I am inclined to presume that, since during a period of 26000 years the value of the planets' longitude increases continuously from 0° to 360° (it is, as it were, measured along the circumference of a circle) the declination value makes a complete oscillation along the diameter, the astronomer must have supposed the rate of variation roughly to vary in the ratio of the "diameter to the circumference". This is simply a conjecture. I leave it to learned research scholars to find a better explanation.

Is त्रिंशत्कृत्यो a Correct Term ?

If त्रिंशत्कृत्यो be taken to be the author's words, one must be ready to accept 3 min., 3[^] min. or 4¹ min. of arc as the annual rate of motion for the starry sphere; but none would be willing to accept this rate even as "approximately correct". Bhaskaracharya has suggested त्रिंशत्कृत्यो as the correct meaning thereby that the rate of motion (in longitude) would be 30 revolutions for Mahayuga or *400 years per degree or 9 seconds of arc per year.

This appears to be a correct figure. The duration of a year (according to S. S.) is 365d. 15 gh. 31 p. 30 v. I have proved in an independent article that according to S. S. the year is definitely a सौर वर्ष (i.e., an interval between the Sun's successive crossings of the equator in its northerly course). Since the author of the 3 verses supposes the starry belt to move eastwards, the Sayan year must necessarily be a bit longer than the true sidereal year. The eastward motion of the sphere is 9" per year. Hence, the correct measure of a नाक्षत्र वर्ष would be 365d. 15gh. 31p. 30v.

minus 9 palas which gives 365d. 15-22-30—measure which tallies with the modern one within a few seconds.

From this, we can appreciate the greatness of an eminent astronomer who lived nearly 1500 years ago.

Conclusion

I place before the learned public, for the first time, the following conclusions for their consideration :—

- 1) The Surya Siddhant has, in verses 9 to 11 of Chapter III, given a theorem for verifying the calculated declination of a planet with its observed place.
- 2) He supposes an eastward motion to the starry sphere—a motion which is not oscillatory but circular or — its rate being "त्रिंशत्कृत्यायुगे" Per year.
- 3) He declares that the declination value of each celestial body if calculated according to standard rules of S.S., will be found to vary from 0° to 27° both ways during each revolution.
- 4) The S. S. is thus not an advocator of any kind of Nirayan system of longitudes.
- 5) Hence, the adoption of a Sayan system for Panchangas is the solution of the Panchang Controversy. (FOR) ■