POST-VEDĀṄGA PRE-SIDDHĀNTIC INDIAN ASTRONOMY*

(STUDIES IN JAINA ASTRONOMY)

Sajjan Singh Lishk and S. D. Sharma

Department of Physics, Punjabi University, Patiala

Abstract

Nothing is obscure about Vedāṅga Jyotiṣa (Vedic astronomy) and Siddhāntic astronomy but the post-Vedāṅga pre-Siddhāntic Indian astronomy has hitherto remained as a forgotten chapter in the history of ancient Indian Astronomy. The paper renders a simple probe into this field. These studies are based on mathematical analysis of astronomical texts as extant in Jaina canonical literature. It highlights the importance of astronomical analysis of Buddhistic texts and the Hindu literature like Purāṇas, Smṛtis etc. D. Pingrees views about Masopotamian origin of ancient Indian astronomy become questionable.

Theory

The history of astronomy owes its origin to a remote antiquity. In the cradle of human civilization, history reveals that man's place in nature has always been relevant to religion[1] and his curiosity for regulating the mode of periodic religious performances must have catered to the need for observation of celestial phenomena.[2] It is interesting to note that in China, since the Han dynasty, calenderical reforms were considered indispensable in order to keep the political and cosmic orders in tune.[3] Carruccio[4] has rightly remarked that scientific problems in general and mathematical and astronomical problems in particular show their full meanings only when they are considered in their own historical backgrounds respectively. Most of the Western scholars believe that the Hindus borrowed much of their sciences from Greece.[5] As a matter of fact, the facts and figures from earlier texts of India have as yet remained unexposed to the western windows due to several reasons.[6] Primarily, as Dange opines that history was used by the English rulers of India to demoralise the rising freedom movement; to build a psychosis in the leadership of the people that compared world history, its age and its achievements, Indian history leads to conclude that this country and its people were historically destined to be always conquered and ruled by foreign invaders.[7] Secondly, dazed by firearms and dazzled by the enterprise and material advancement of the

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foreign intruders, Indians began to look down upon native scholarship and achievements.[8] Thirdly, we had no Papyrus Prisse to prove our age, no Pyramids of Gizah, nor mummies of Akhnaton and Tutankhamen, no towns dug up like Ur and Babylon except the Vedas, Purāṇas and the like to speak for us.[9] Indian astronomy has lost much more than any other subject by such attempts to dissociate it from its history.

Although much of the ancient Veda, as Plunket opines, still remains a cypher and it can be properly revealed only with the help of modern sciences[10], yet it may be remarked that Vedāṅga Jyotiṣa (Vedic astronomy) has already been commented upon by several scholars[11] like Somākaṛa (first edited by A. Weber and again edited by S. Dvivedi), Thibaut, Bārhaspatya, R. Shamasastry, B. R. Kulkarni, G. Prasad, A. K. Chakravarty and D. Pingree etc. Also nothing is obscure and unknown about Siddhāntic texts. Some theses[12] like those of M. L. Sharma, D.A. Somayaji and R. Billiard etc. are scholarly works of profoundity in this field. Still lies a big gap between Vedāṅga Jyotiṣa period (about fourteenth century B. C. and that of Siddhāntic astronomy (third/fourth century A. D.). This gap, commonly known as a dark period[13] hitherto remained as a forgotten chapter in the history of ancient Indian astronomy. There lies a vast treasure of astronomical knowledge embodied in Jaina Prakrit texts like Sūrya Prajñapti and Jambūdvīpa Prajñapti etc. forming Jaina canon of sacred literature[14] belonging to dark period in the history of ancient Indian astronomy. In his lecture at Oklahoma University, S. D. Sharma had stressed upon the need for research into this field, and it was his first Ph. D. student, S. S. Lishk, who analysed mathematically the astronomical data extant in Jaina canonical literatures in his doctoral thesis[15], which was awarded an outstanding merit by scholars of the calibre of Hidee Hirose (Japan), W. Petri (Germany) and M. L. Sharma (Varanasi, India). The author collected relevant data on certain topics from various texts (in chronological order) and then attempted to analyse to have a perspective view. A pre-conceived chronology has been disregarded unlike Kuglar who was one of the Panbabylenistic school and created a fantastic picture by ascribing everything to Babylon.[16]

It is worth-mentioning that the post-vedāṅga pre-Siddhāntic astronomical literature comprises of Jaina canonical texts, Buddhistic canonical texts, and Hindu works like Purāṇas, Smṛtis, and the Sanhitās including Bhadrabāhu Sanhitā (a Jaina work) etc. We have so far been concentrating our efforts on analysing the Jaina canonical texts and thus our findings elucidate particuarly the salient features of pre-Āryabhaṭian Jaina School of astronomy. Some peculiarities are given as below:

1. Units

There had been a great diversity of systems of units of time, length and arc-division at different times in different parts of ancient India. Trigesimal

system (Thirty-fold divisions system) was gradually changed into sexagesimal system of time-units.[17] The length of a yojana was standardized and the relation between three different types of yojanas is explicitly mentioned in Anuyogadvāra Sūtra, a Jaina canonical work.[18] The zodiacal circumference was graduated in time-degrees days of a nakṣatra month (lunar sideral revolution) and subsequently in time-degrees muhūrtas (one muhūrta = 48 minuts) of a nakṣatra month, 54900 ganana khaṇḍas (celestial parts) (numerically equal to 54900 muhūrtas of a five-year cycle), and finally in 360 saura days (a saura day means the time taken by the Sun to traverse 1/360 the part of zodiacal circle).[19]

2. Cosmography

Jainas had been striving for the scientific formulation of the real world around. They had devised the theory of two Suns and two Moons for certain mysterious calculations. The concept of the mount Meru whose dimensions form a consistent picture, implies Jainian trends towards the motions of certain astronomical constants, mainly that of obliquity of ecliptic.[20]

It is worthy of note that the notion that the Moon is eighty yojanas higher than the Sun, has been quite confusing with the notion of vertical height but it actually depicts Jainian notion of celestial latitude of Moon measured as distance-degrees along the surface of earth.[21]

3. The Science of Sciatherics

Jainas measured time as a function of shadow-lengths and thus they could determine the time of day directly from the table of shadow-lengths versus the corresponding parts of the day elapsed.[22] as the practice is still in current among some sects of Buddhistic monks in Ceylon etc. Jainas had also employed the use of shadow-lengths for the determination of seasons.[23] They had advanced in measuring shadow-lengths to such an extent that Summer solstice was determined upto thirty muhūrtas of one day.[24]

4. Kinematics

Solar and lunar motions among their respective maṇḍalas (diurnal paths) imply a motion of declination. But they could not make out the algebraic sense of declination (that is, that it increases on both sides of the equator).[25]

Besides, the average relative velocity of Venus in heliacal combustion in different parts of lunar zodiac was compared with some conventionally known relative as well as discrete velocities like those of snake, horse, elephant etc. and the corresponding vīthis (lanes) of Venus were specified among the stars. The relative north-south directions of vīthis (lanes) of Venus also imply their trends towards notion of geocentric latitudinal motion of Venus.[26] Such kinematical studies of Venus are parallel to those of planetary ephemerides of Seleucid and Menomides periods.

5. Calendar

The quinquennial cycle of Vedāṅga Jyotiṣa remained in vogue during Jaina astronomical period but with different solstices (winter solstice occurred at Dhaniṣṭhā i. e., β Delphini and Abhijit i. e., α Lyrae during Vedāṅga Jyotiṣa and Jaina astronomical periods respectively.)[27] They might have also strived for the reformation of the five-year cycle as they had conceived some other planetary cycles like twelve-year cycle of Jupiter, twenty-eight year cycle of Saturn and later a cycle of sixty Jovian years etc.

Besides, it is worth mentioning that the ratio 3:2 of maximum and minimum lengths of the day is frequently used in Vedāṅga Jyotiṣa and Jaina calendar. By applying Bernoulli's theorem to account for the error due to rate of flow of water through the orifice of water clepsydra, it is revealed that the ratio 3:2 between amounts of water to be poured into Clepsydra on maximum and minimum lengths of the day corresponds to the actual time ratio $\sqrt{3} : \sqrt{2}$ between actual maximum and minimum lengths of daylight. This ratio $\sqrt{3} : \sqrt{2}$ belongs to a latitude very near to that of Ujjaini, a renowned seat of ancient Indian culture.[28]

6. Cycles of Eclipses

Jainian forty-two-eclipse months cycle of lunar eclipses and forty-eight-eclipse years cycle of solar eclipses were based upon observation of periodic repeatition of eclipses in five different colours irrespective of any accurate knowledge of true motion of Rāhu (lunar ascending node). These eclipse cycles are completely free from any foreign influences of Chaldean Saros or Metonic cycle.[29]

7. Lunar Occultations

Jainian concept of direction of lunar conjunction with a nakṣatra implies the notion of position of identifying star (of the nakṣatra) with respect to the region where the Moon moves among the stars. Belt of lunar zodiac was properly specified.[30]

8 Measurement of Celestial Distances

Celestial angular distances were measured in yojanas (basically, linear measures of length) in terms of corresponding distances projected over the surface of earth. The real determinations of distance degrees fit the actual geometry of the earth.[31]

9. Observation of the Celestial Phenomena

Jaina astronomers had a keen sense of observation. They measured precisely the time as a function of shadow and determined time of the day through shadow-lengths of a gnomon. They observed lunar occultations, determined Summer solstice upto 30 muhūrtas or one day, studied the phenomenon of heliacal combustion of Venus in different parts of the lunar zodiac. The latitude of the Moon was also determined. Shapes (star figures) of nakṣatras (asterisms) and their respective numbers of stars were also observed. The Jainian cycles of eclipses are based on the periodic observation of colours of (parva) Rāhu denoting Jainian

concept of shadow causing eclipse. The categorization of mahāgrahas (great-planets), and tārakagrahas (star-planets), the classification of nakṣatras into kula (category), upakula (sub-category) and kulopakula (sub-sub-category) in relation to their conjunctions with the Moon at different syzygies in a five-year cycle also exhibit their trends towards skilled observation of the celestial phenomena.[32]

10. Astronomical Instruments

Besides gnomon, some sort of clepsydra (water-clock) and star-clock such as acronical risings of stars used in the determination of seasons etc. might have also probably been used. Description of construction of a water clepsydra is mentioned in Viṣnu Purāṇa[33] and Jyotiṣa Karaṇḍaka[34] (a Jaina non-canonical work).

Here it is worthy of note that in the absence of knowledge of Jaina astronomy (the astronomy as expounded in Jaina canonical texts), a confusing link between Vedāṅga Jyotiṣa and Paitāmaha Siddhānta due to certain similarities between them[35] has often been disillusioning. Our findings in pre-Āryabhaṭian Jaina School of astronomy have opened up many new vistas of research in this field and thus the task of bridging the gap between Vedāṅga Jyotiṣa and Siddhāntic astronomy has been initiated in its true perspectives. The role of pre-Āryabhaṭiyan Jaina School of astronomy in the development of Siddhāntic astronomy has been dealt with in a separate paper.[36] Consequently D. Pingree's views about Mesopotamian origin of ancient Indian Mathematical astronomy become questionable.

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लेखसार

जैन गणित ज्यौतिष का अध्ययन

वेदांगोत्तर पूर्व-सिद्धांती भारतीय गणित ज्यौतिष

सज्जन सिंह लिशक और एस. डी. शर्मा
भौतिकी विभाग, पंजाबी विश्वविo, पटियाला

वेदांग ज्योतिष का समय1300 वर्ष ईसा पूर्व माना जाता है जबकि सिद्धान्त ज्योतिष का अभ्युदय काल 300-400 ईस्वी माना जाता है। इस बीच के लगभग 150) वर्ष का समय भारत का अन्धकार युग माना जाता है। इस समय के बीच विकसित ज्यौतिष का अध्ययन नगण्य ही हुआ है।

सूर्यप्रज्ञप्ति, जंबूदीप प्रज्ञप्ति के समान जैन ग्रन्थों से इस युग के गणित ज्यौतिष पर पर्याप्त प्रकाश पड़ता है। इन लेखकों ने सर्वप्रथम इस क्षेत्र में कार्य किया है और उससे निष्पन्न तथ्यों से भारतीय ज्यौतिष की प्रतिष्ठा में श्रीवृद्धि की है।

प्रस्तुत निबंध में उपरोक्त ग्रन्थों में वर्णित समय और लंबाई के यूनिटों, विश्व-रचना के सिद्धान्तों, छाया के आधार पर समय और दिन या ऋतुओं के मापनों, ग्रहों की गतियों, पंञ्चांगों, सूर्य और चन्द्रग्रहण के विवरणों तथा आकाशीय पिंडों के परिमाणात्मक निरीक्षणों का संक्षेपण किया गया है। कुछ प्रकरणों में वर्तमान मान्यताओं से विसंगतियां भी प्रदर्शित की गई हैं। यह भी बताया गया है कि उस समय जल-घड़ी (ज्यौतिष्करण्डक) का उपयोग विभिन्न प्रकार के मापनों में किया जाता था।

इन अध्ययनों से यह प्रकट होता है कि जो विद्वान् भारतीय ज्यौतिष को वाह्यस्रोती मानते हैं, उनके कथन पर पुनर्विचार व परीक्षण की आवश्यकता है। ■