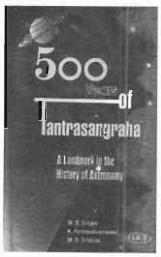
500 years of Tantrasangraha – A Landmark in the History of Astronomy

B S Shylaja



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M S Sriram, K Ramasubramanian and M D Srinivas
Inter-University Center,
Indian Institute of Advanced Study,
Shimla, 2002.

All students of astronomy undergo a rigorous training in spherical trigonometry, which forms the basis of the fundamental computational formulae and techniques of positional astronomy. However, one will still be left with many questions regarding the physical universe leafing through the pages of the history of science. The turning point in our understanding of the heavens has been traced to the Copernican Revolution that took place in the sixteenth century. From the knowledge procured in the undergraduate levels, one would understand the implications of replacing the Earth with the Sun at the centre of the solar system. Only a deeper insight will reveal the difference between Ptolemy's (geocentric) model and the Copernican (heliocentric) model.

It is well known that even prior to the Copernican era astronomers were able to determine the positions of the planets and predict the eclipses quite precisely. One had to use different sets of formulae for the inner and the outer planets. This was especially significant for the calculation of latitudes of the planets. The struggle of the astronomers of the yesteryears and the ingenuity of people like Ptolemy, Copernicus and Kepler become evident in this context. Nilakantha Somayaji of Kerala belongs to this category. Although it was known that the Kerala group of astronomers were quite active in the 16th and 17th centuries, we were deprived of a detailed study of their work till the last few decades. It is a remarkable achievement that a model which appears as a transition from the geocentric to the heliocentric version, was arrived at, in those years. It is unfortunate that such an important development was completely lost and had to be worked out all over again by Nicolas Copernicus.

The monumental work of Nilakantha called 'Tantrasangraha' was published in the year 1500. Its five hundredth anniversary was celebrated in Chennai during March 2000, by the Indian Institute of Advanced Study, Shimla. The occasion was very aptly used to publicise the details of Nilakantha's model, as well as to enlighten the commoners about the life and achievements of the person.

The book under review gives a comprehensive outlook on the works of Nilakantha Somayaji. It is a compilation of the papers presented at the conference. K V Sarma, well known for his contribution to the history of Indian astronomy and mathematics has described the life and works of Nilakantha Somayaji in great detail. It has been possible to fix the period, during which Nilakantha lived, quite

precisely as 1444-1545. His works include Golasara Siddhantha Darpana (two volumes), Candrachaayaganitha and Vyakhya, Tantrasangraha, Aryabhatiyabhashya, Sundararaja Prasnoththara, Graha Parikshakrama and Jyotirmimamsa. K V Sarma has scrutinized all the manuscripts and his painstaking efforts have shown that a Sanskrit work by name Yukthibhashya is actually a translation from Malayalam to Sanskrit. (He even points out that the translation was done by a non-technical person!) Prof. Sarma has described his difficulties he faced in tracing the originals because of the non-availibility of cross-references and the incompleteness of the manuscripts.

The traditional method of teaching prevalent in India during the days of Nilakantha suffered a setback like it happened in all other fields, with the advent of colonisation and the eventual emergence of the British Empire. One of the many adverse effects was the loss of this heritage of astronomical calculation. Over the last couple of centuries, the tradition had been forgotten. Therefore, to understand the technique of Nilakantha, we constantly need to refer to the methods we learn today. This happens to every student who is keen on understanding the traditional techniques. In this context the book comes as a handy tool to review the methods in the language of the day.

The paper by M S Sriram presents a comparative study of Nilakantha's methods deciphered in modern textbook language. Although the first half reads like a chapter from a textbook of spherical astronomy its presence is justified. As one proceeds to Nilakantha's methods, one needs to turn back the pages constantly to decipher the various technical terms. The words in italics for example, Seegrochcha, Manda Sanskara, etc. sound strange to us, exposed as we are to only the modern (western) mathematical terms. Further, the formulae are written down as verses. Here is an example (p. 76-77): "The sine of the difference in the longitudes of the nodes and the mandasphutagraha of Mars, etc. multiplied by the inclination of their orbits and divided by the iteratively obtained hypotenuse, gives the latitude of the planet at the desired instant". This transforms into a formula

$$\beta = \frac{iR \sin(\lambda_m - \lambda_n)}{\text{karna}}$$

This example demonstrates that precise transliteration is very essential for a good comprehension. This paper, therefore, provides the vital link to a forgotten past and enables us to appreciate the mathematical skill of Nilakantha.

The next paper by K Ramasubramanian continues the trend with a parallel explanation of the original text in modern language. The figures, which are perhaps absent totally in the original, are drawn quite appropriately to match the explanation. The need for the model is very clearly explained. It appears that this model fills the link needed between the Tychonic model and the Copernican

model. It may be recalled here that a complete heliocentric model was created (in Europe) almost 100 years after the Copernican revolution.

The use of the model to describe the motion of the interior and the outer planets constitutes the next paper by M D Srinivas. The difference in the procedure is explained. In fact it is the same technique used today to predict the geocentric coordinates of a newly discovered comet or asteroid or any other solar system body.

The other papers in the volume are of interest to astronomers who are serious about calculations. The determination of longitudes of planets is discussed by S Balachandra Rao (with Padmaja Venugopal and S K Uma), choosing the Moon as an example. The need for the determination of constants in the equations of motion by observations has been emphasized as suggested by Nilakantha himself.

The attempt to introduce the elliptical orbits has been described by S Madhavan. This is a new revelation since all along it was believed that the calculations were done with epicycles. The associated difficulties with the use of elliptical orbits are explained and suggested as a possible reason for abandoning the technique. At this juncture, one naturally wonders, how things would have changed only if a communication existed with the Europeans!

The heritage and tradition of these mathematical skills were lost gradually and the last member of this school was Samantha Chandrashekhara (1835-1904). Prof. Satpathy describes his works and achievements as an observational astronomer.

The other papers in the volume include mathematical treatises of Nilakanta (V Madhukar Mallaya and J K John) on the summation of series. The astronomical tables of Indian origin have been traced in Iran by Farid Ghasemlon and Negar Nadei of Iran. Prof. S M R Ansari describes the influence of Islamic Astronomy.

The book provides a very valuable guide to those who are not content with a superficial knowledge of our heritage in mathematical skills. One may pull out a pencil and paper and verify the formulae. Thus they do not remain as 'black boxes' any more.

While going through the book, I had to compile my own cross-reference list for the technical terms in Sanskrit. A glossary to this effect and an index would have added to the value of the book.

The occasion of the conference provided an opportunity to honour Prof. K V Sarma, whose contributions to this field are very well known. The citation presented to him is given at the end of the book. The language used is very simple and I hope there would be a wide readership to go through it and enjoy the flavour of a lost tradition.

B S Shylaja, BASE, J N Planetarium, Bangalore.

One comment on â€œ500 YEARS OF TANTRASANGRAHA- A LANDMARK IN ASTRONOMYâ€. Sanatan Dharm and Hinduism. May 4, 2016.Â Reported on the 27th of August, 2016.As reported by Crop Circle Connector A huge crop circle in the shape of a swastika has been spotted in the Wiltshire countryside.The symbol, which has been cut into a huge field in Beckhampton, near Avery, Wiltshire, is roughly 150 to 180 ft wi [â€¦] UFO are real- Navy Pilot video from Pentagon leaks. 500 Years of Tantrasangraha A Landmark in the History of Astro-nomy. M. S. Sriram et al. (eds). Indian Institute of Advanced Studies, Rashtra-pati Nivas, Shimla 171 005. 2002. 182 pp. Price Rs 300.Â Jyotirmimansa clearly states that astronomy is an observational science which needs to be updated from time to time by modifying the theory, if it con-flicts with observations. Tantrasangraha is an example how this was achieved by him by introducing new ideas in the ear-lier Siddhantic framework. Nilakanthas revision of the traditional Indian planetary model is clearly explained in two articles by K. Ramasubramanian and M. D. Srinivas. It makes the planets Mercury, Venus, Mars, Jupiter and Saturn.