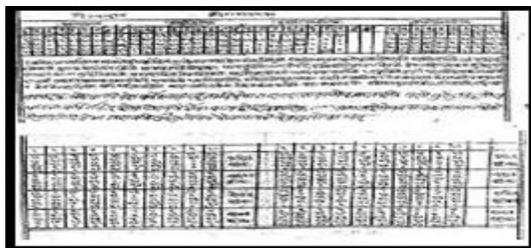


Mathematical analysis of Astronomical Tables



MRP(S)-0403/13-14/KABA084/ UGC-SWRO DATED 28-3-2014

Principal Investigator

Prof. SHAILAJA.M

Assistant Professor

Department of Mathematics

Government First Grade College

Vijayanagara, Bangalore-560104



SUMMARY

The astronomical tables play a very pivotal role in the development of astronomy world over. Each civilization has their own astronomical tables, which were preserved for computational purpose or for the prediction of planetary positions, eclipses and other phenomenon.

In Babylonian civilization planetary positions were recorded periodically in the form of tables and preserved for posterity in the form of cuneiform tablets. Based on these recordings the Babylonian astronomers built up computational models for predicting the planetary positions, eclipses and other phenomenon.

A similar practice was there among the ancient Egyptian and Greek astronomers too, in the central Asian Culture. In the medieval period Arabic and Persians astronomers, based on their contemporary observations, created astronomical tables called “Zij”

In Indian Context, many astronomical tables belonging to different *pakṣas* (schools) are popular in different regions. These astronomical tables are named differently from region to region as *sārinis*, *padakas*, *koṣṭakas* and *vākyas*. The major genres of these Indian astronomical tables belong to different *pakṣas* are namely

- 1) *Saura pakṣa*
- 2) *Ārya pakṣa*
- 3) *Brāhma pakṣa*
- 4) *Gaṇeśa pakṣa* etc

These compositions of tables are based on the major treatises by the great authors of *Sūrya siddhānta* (Author of this text is not known), *Āryabhaṭīyam* of Āryabhaṭa (499 CE), *Brahma spuṭa siddhānta* of Brahmagupta (628CE) and *Grahalāghava* of Gaṇeśa Daivajña (1520CE).

The large numbers of tables are found based on *Sūrya siddhānta* because *Saura pakṣa* tables are very popular in Andhra Pradesh and Karanataka among the compilers of *pancāṅga*. So we find many tables based on *Saura pakṣa* namely,

Makaranda sāriṇī (MKS) of Makaranda

Gaṇakānda (GNK) of Sūrya

Mahādevi (MH) of Mahādeva

Pratibhāgi padakas and *Tyagarti graha padakas* (These two manuscripts are from Karnataka)

Sūrya siddhānta (SS) is one of the most popular Indian astronomical treatises. Infact, one of the five systems in Varahamihira's (505 CE) *pañca siddhāntika*, is also called *Sūrya siddhānta*. But the one we are referring is not that so to distinguish between Varahamihira's and this we are calling Varaha's composition as *Saura siddhānta*. The popular *Sūrya siddhānta* is traditionally believed to be of the knowledge revealed to one Mayāsura by the Sun god himself !!

The major table belonging to *Ārya pakṣa* is *Vākyakaraṇa* by a legendry astronomer named Vararuci, *Vākyakaraṇa* is followed in Kerala and Tamilnadu.

Brahmatulya sāriṇī and *Karaṇakuhūla sāriṇī* belong to *Brāhma pakṣa* of Brahmagupta but compiled based on Bhāskara-II's *Karaṇa kutūhala*.

Tithi cintāmaṇi and *Grahalāghava* tables are based on *Grahalāghavam* of Gaṇeśa Daivajña belong to *Gaṇeśa pakṣa* and it is most popular in Maharashtra, North-Karnataka and also in some parts of northern India.

These astronomical tables are prepared by using the *siddhāntic* or the *karāṇa* texts, composed mainly for the sake of *pancāṅga* makers to calculate astronomical phenomena's easily without following the lengthy procedures given *siddhāntic* texts.

Earlier *pancāṅgas* were prepared by using *siddhāntic* texts in which the beginning of the creation was considered as an epoch. Later *tantra* and *karāṇa* texts came into existence to reduce the work. In *tantra* texts the beginning of *kaliyuga* i.e.3102BC was considered. Where as in *karāṇa* texts some date of author's period was taken as an epoch to calculate *ahargaṇa* for any required date.

In Hindu Society, the *pancāṅgas* (almanacs) play a very important role in socio-religious observances. The computations of the almanacs are generally based on the above said astronomical tables, since the direct application of the major text in computing the positions of planets etc is difficult and tedious. So to make the computation simpler and handy the *karāṇa* texts were composed, later these texts were followed by astronomical tables. From time to time these tables were revised by changing the parameters so that the table gives the values that match with the observation of the position of a planet or a star or with the instant time of the occurrence of the phenomena such as eclipses, transits and occultation.

In such astronomical tables most often the mathematical model and related algorithms are not provided, the author of the tables incorporates the data based on the actual observations of his time. In our present research work on this project, we tried to select a table from each *pakṣa*, viz *Makaranda sārīṇī* from *saura pakṣa*, *Vākyakarāṇa* from *ārya pakṣa*, *Brahmatulyasārīṇī* from *brāhma pakṣa* and *titicintāmaṇi* from *gaṇeśa pakṣa*. But we could procure only tables on *saura pakṣa* and *ārya pakṣa* to study in detail. Later we procured *Karaṇakutūhala sārīṇī* based on *brāhma pakṣa* from BORI, Pune. So we made detailed study on these tables, understood the procedures involved in composition and computation. The positions of heliacal bodies including the Sun (*Ravi*), the Moon (*Candra*) and five planets namely, Mars (*Kuja*), Mercury (*Budha*), Jupiter (*Guru*), Venus (*Śukra*) and

Saturn(*Śani*) are computed by using these tables and listed to compare the values with modern ephemeris. Later our research work extended to obtain the exact positions of these planets for the present date by suggesting some corrections to improve these tables as to match with the present ephemeris values.

Still so many astronomical tables are found in our India by many eminent astronomers, their main purpose was to simplify the calculations for the preparation of *pañcāṅga*. In this project we have studied mainly *Makaranda sārīṇī* from *saura pakṣa*, *Vākyakaraṇa* from *ārya pakṣa*, *Karaṇakutūhala sārīṇī* from *brāhma pakṣa* . But we did an extensive work on *saura pakṣa* tables and *ārya pakṣa* table. Apart from *Makaranda sārīṇī* from *saura pakṣa* , we have also studied *Mahādevi* tables and *Gaṇakānanda* based on *saura pakṣa*.

We in our project sincerely tried to understand, analyzed and suggested the corrections. This effort has done because we see some particular festival or event occurs on two different days. If *tithi* is based on the motions of the Sun and the Moon, then how can this happen? so as to overcome all these confusions we have proposed some corrections in previous chapter and one has to take initiative in combining these tables and *pañcāṅgas* into one that matches with modern astronomy.

We sincerely thank UGC, South Western Regional Office, Bangalore for providing us an opportunity to do research work on astronomical tables and sanctioning the grants for undertaking the research project.
