



Mahāsalilam--A vedāṅga text on astral sciences (Vṛddhagārgīya Jyotiṣa 24th Aṅga): Critically edited and translated by RN Iyengar, New Delhi: Central Sanskrit University, 2024. ISBN: 9788197400124, Pp. xlvii + 324

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The vast corpus of the ancient and medieval Indian astronomical literature has attracted the attention of serious scholars, for nearly two centuries now; sporadically in the nineteenth century, but systematically and steadily in the twentieth century, and upto the present times. In these scholarly studies, the major focus has been on the treatises of mathematical astronomy, or the *siddhāntas*, beginning with the *Āryabhaṭīya* of Āryabhaṭa (499 CE) and the *Pañcasiddhāntikā* of Varāhamihira (around 530 CE). This is understandable to some extent, as the topics like the determination of the directions and the time, accurate computations of the positions of the celestial objects, their diurnal and relative motions, eclipses etc. (positional astronomy in short) are discussed in the *siddhāntas* only. This is because all these need a good understanding of trigonometry, which originated and developed in the *siddhāntas* texts, and not earlier.

However, astronomy in India has a far more ancient past, with several references to astronomical facts in the *Vedic* literature in the *saṃhitās*, *brāhmaṇas* and *āraṇyakas*. There are passages describing the sky, the Sun, the Moon, stars and planets, day and night, the notion of the ecliptic, the northern and southern motion of the Sun along it (*uttarāyaṇa*, *dakṣiṇāyaṇa*), solar and lunar months, eclipses, spherical nature of the Earth, and so on. These are all based on naked eye observations and constituted the science of astronomy of those days (*nakṣatravidyā*). This was qualitative, and neither ‘systematic’, nor ‘mathematical’. The astronomy in the *Vedic*-period-proper has received some attention, though there is scope for far more detailed studies. The *Vedāṅga* texts which are considered as ancillaries

of the *Vedas* followed the *Vedic* period. The *Vedāṅga Jyotiṣa* of Lagadha (VJL) is one such text available in *Rg* and *Yajur* versions, composed between 1150 to 1300 BCE, and which has been studied in some detail. In this text, we have a five year *yuga*-system, the concepts of ‘*tithi*’ and ‘*nakṣatra*’ and several algorithms related to the positions of the Sun and the Moon along the ecliptic at any time. We also have a formula for the duration of the day-time (sunrise to sunset) on any day in the year (which is reasonably accurate for a latitude of around 28°). It is a mathematical astronomy text (arithmetical astronomy, really), which does not discuss planets.

There is a broad tendency to divide the Indian astronomical literature into two periods, namely the pre-*siddhāntic* and post-*siddhāntic* ones. This is true, for instance, in the famous book on *Bharatīya Jyotiṣa-śāstra* in two volumes by S.B. Dikshit. Regarding the pre-*siddhāntic* period, we have studies on references to astronomical phenomena in the *Vedic* literature, and then the *Vedāṅga Jyotiṣa* of Lagadha with only brief mentions of astronomical references in *Mahābhārata*, *Smṛtis* and other sources. One would get the impression that there is nothing very significant between the *Vedas*-proper and the VJL.

This is what is challenged by Prof. R.N. Iyengar, who has studied several varieties of post-*saṃhitā* / *Brāhmaṇa* texts and other sources, including *purāṇas*. Some of these astronomical references appear as quotations in texts, which belong to a much later period. For instance, there have been extensive references to the statements of Parāśara pertaining to *Jyotiṣa*, including the astrology of the omens in the *Brhatsaṃhitā* of Varāhamihira, which was composed in the early sixth century. Iyengar has reconstructed a text, ‘*Parāśaratantra*’ (PT) based on the references to Parāśara in the *Brhatsaṃhitā* and commentaries on that. Parāśara’s astronomy is dated to be around 1400 BCE based on the astronomical references attributed to him. According to Parāśara also, the winter solstice was at the beginning of the

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Śraviṣṭhā nakṣatra as in the VJL. PT discusses the visibility cycles of the planets. From the visibility cycle of Mercury, it can be concluded that its synodic period is between 104 and 122 days, compared with the modern value which is nearly 116 days. Venus has a visibility cycle of 595 days, compared with the modern synodic period which is nearly 584 days. Saturn's sidereal period is nearly 28 years, the modern value being 29.45 years. Similarly, according to the text, Jupiter covers nearly $2\frac{1}{4}$ *nakṣatras* in a year implying a sidereal period of 12 years, close to its modern sidereal period. The motion of Mars is discussed all too briefly in the text. Apart from these, the motions of the Sun and the Moon across the zodiac, and eclipses are also described, though the text does not give the sidereal or the synodic period of the Moon. Observations of comets generally called *ketu* are also discussed in some detail. Surely, these are all significant astronomical observations. So, it stands to reason that the *Parāśaratantra* should also be considered as a *Vedāṅga Jyotiṣa* text. It should be noted that *Jyotiṣa* here includes astrology also. It is interesting that PT discusses the motions of planets, though it is slightly earlier than the VJ of Lagadha.

Even before Parāśara's *Jyotiṣa*, there was a school of tradition of astral sciences called the *Vṛddhagārgīya Jyotiṣa* (VGJ) that was initiated in antiquity by a sage called Garga. This spanned several centuries. Iyengar and his team collected 25 manuscripts with titles *Vṛddhagarga Saṃhitā* or *Garga Saṃhitā*. Eleven of them have been taken up/ being taken up for detailed studies by the team, as they seemed to be the most relevant ones. The eleven manuscripts are broadly identical in their chapter contents, and it was found that the manuscript material is made up of about 4300 verses/passages, and additional prose text equivalent to 720 verses of 32 syllables. According to R.N. Iyengar, the author of the present work on *Mahāsalilam*, "early foundations of scientific astronomy and related topics of historical importance that can be aptly called '*Vedāṅga Jyotiṣa*' are found in these manuscripts." From the matter pertaining to the motion of the Sun and the description of the correspondence between the seasons and the *nakṣatras*, VGJ descriptions mostly pertain to a time-span of several centuries (1300 BCE to 300 BCE). The 24th *āṅga* of the VGJ is the '*Mahāsalilam*' which belongs to an even earlier period, namely 1800–1600 BCE.

There are 108 passages in the *Mahāsalilam*, including the concluding two verses. These are in the form of a long list of questions by Mahārṣi Viśvāmītra in 29 verses to the sage Āṅgīrasa, that is Garga, who answers/explains them in the rest of the passages. The discussions are about cosmogony and cosmology- creation of the universe and the celestial objects, that is, the Sun, Moon, planets and the stars, as also the Earth and its geographical features like the various types of water bodies (sea, rivers), hills and mountains, clouds,

the phenomenon of rainfall, the creation of living beings, and so on. Also discussed are the phenomena of day and night, seasons, motions of celestial objects, their brightness and sizes, various time units, and astrology-related matter (the effects of the positions of the Moon and the *grahas* among the *nakṣatras*). Finally, it indicates a calendar, which is the same as in the VJL, though it does not give the number of civil days in a 5-year *yuga*. Here it must be remembered that the *Mahāsalilam* is many centuries earlier than the VJL. So, the contents of the *Mahāsalilam* are quite different from those of the *siddhāntas* and even the VJL, except a subset of passages.

The great sage Garga gives the answers in the sequential order. There is a description of the primordial creation in the very beginning of the answer-sequence, in the passage 32: '*aṇḍam-tamah* is the primordial state of the dark-matter, out of which all creation including the celestial bodies emerged. The egg split in two. The lower bowl was widened, and that is the *pṛthivī*. That which stayed at the top is the vault of the sky (*dyauh*). That which is seen in between the two as an intermediate domain is the '*antarikṣam*'; all material aggregates (*bhūtagrāmāḥ*) disintegrate there.' The creation process is elaborated in some of the succeeding verses.

Of particular interest are the creations of the *soma* (Moon) and the *arka* (Sun) in the ocean of the universal consciousness by the mind of the Brahman. The Sun and the Moon follow each other clockwise. All the innumerable celestial objects revolve in their own specially measured orbits. *Meru* stands at the north of all the three continents. A fixed light (*dhruvam jyotiḥ*) without motion (*acalam*) exists at the head of the *Meru*. Linked to this is the wheel of the celestials which revolves continuously. This describes the diurnal motion of the celestials around the north celestial pole. Iyengar remarks that *Mahāsalilam* appears to have inherited its cosmological model from a remote past. There is an interesting statement in passage 60 that *Rāhu* (later understood as the ascending node of the Moon) comes up at the same time (relatively) in the six-monthly *parva*. In the notes to this passage, it is remarked that the six-monthly appearance attributed to *Rāhu* must be the result of observation of lunar-eclipse- events for a considerable length of time.

There are passages describing the relative brightness of the five planets in units of 'bright colored rays': *Śukra* (Venus) -16; *Bṛhaspati* (Jupiter) -12; *Āṅāraka* (Mars) -9; *Śani* (Saturn) -5; *Budha* (Mercury) -7, as observed from the Earth. This may not be unrealistic.

There are also 'measures' of the planets. These appear to be the angular diameters. The relative measures are given to be

Venus : Jupiter : Mars : Saturn : Mercury :: 10 : 9 : 8 : 7 : 5.



Now it is known that the angular diameter of each planet as observed from the Earth, varies considerably, as its distance from the Earth varies. Even then, if we take the average angular diameters as observed from the Sun as the measures,¹ then using the heliocentric angular diameters,

Venus : Jupiter : Mars : Saturn : Mercury : : 10 : 15.5
: 2.6 : 7.0 : 7.5.

Now, Mercury and Venus are always near the Sun (directionally). If we take them to be at nearly the same distance from the Earth (as might have been conjectured in those days), Venus: Mercury : : 10: 4, in contrast with 10: 5 in *Mahāsalilam*. So, the relative angular measures as stated in the text may be based on observations, however qualitative.

The story of Soma (Moon)’s marriage to the 27 daughters of Prajāpati Dakṣa is also recounted in some detail. The end of the story is significant: Soma should spend equal amounts of time with the 27 daughters. This is closely related to the sidereal period of the Moon being close to 27 days, and the Moon covering a 27th part of the ecliptic (13° 20′ segment of the ecliptic) called a ‘*nakṣatra*’, each day. The 27 *nakṣatras* close to the ecliptic have been described in the *Vedic* literature even earlier than *Mahāsalilam*. However, it appears that the concept of the solar zodiac with a 27-fold division into equal *nakṣatra* segments beginning with the *maghā* was crystallised in this text.

In the final substantive passage (106) we have a calendar with 5 *yugas*, that is, ten *ayanās* of the Sun and 67 sidereal months (134 *ayanās* of the Moon). The number of days is not specified. This is clearly the origin of the calendar in the *Vedāṅga Jyotiṣa* of Lagadha, which also specifies the number of civil days in the 5 year *yuga* as 1830 (that is, there would be 366 civil days in a sidereal year). Here, it should be mentioned that according to the second *aṅga* of the VGJ on the *Candramārga*, there are 1828 days in a five-year *yuga* (10 *ayanās* of the Sun) which has 62 synodic or lunar months.² This means that the sidereal year has $\frac{1828}{5} = 365.6$ days (compared to the worse value of 366 days in VJL), and the lunar month has $\frac{1828}{62} = 29.4839$ days (compared to the slightly better value of $\frac{1830}{62} = 29.5161$ days in VJL). Apart from this there are discussions of several kinds of observations of the Moon in this *aṅga* of VGJ, including the variation of the brightness and the phases of the Moon. The date of composition of this *aṅga* is not clear.

The last passage (107) of the *Mahāsalilam* reads thus: ‘This is the limb called *Jyotiṣam* from the start of

the great *Salila*, and the creation of life. Hence, this subject is “*Mahāsalilam*”’. From all of these, it is clear that ‘*Vṛddhagārgīya Jyotiṣa*’ (VGJ) of which *Mahāsalilam* is the most ancient and also one of the very important parts, should be considered as a *Vedāṅga Jyotiṣa* text. The VJ of Lagadha cannot be considered as the sole VJ. Iyengar and his team should be congratulated for very sustained and fruitful work on the broader and more general *Vedāṅga Jyotiṣa* tradition.

However, the VJL differs in one important aspect from the VGJ. The VJL is a mathematical (arithmetical) astronomy text which gives explicit algorithms, or rules for finding the positions of the Sun and the Moon along the ecliptic at any instant after the beginning of a 5-year cycle. These would determine the *tithi* and the *nakṣatra* at that instant. A different kind of rule is the one for finding the duration of the day-time (sunrise to sunset). It is an elementary positional astronomy text which is not very accurate. This is because the Sun and the Moon do not come back to the same point on the ecliptic after a 5-year *yuga* actually, their motions are not uniform and the values for the sidereal year and the sidereal month in the text differ from the actual values. It does not discuss the motion of the planets at all. Even then, it seems to be the first *Jyotiṣa* text in the *sūtra* format, and is algorithmic. The *siddhāntic* texts which came much later are primarily this type, that is, algorithmic. They are of course far more mathematical and accurate (with trigonometry which is essential for describing non-uniform motion in their arsenal, and more accurate values of the planetary parameters like the sidereal periods), and with many more topics (spherical astronomy results, eclipses, conjunctions of planets etc., apart from the computations of the true positions of the Sun, the Moon and the planets using epicycle models).

The *Vedāṅga Jyotiṣa* of the Vṛddhagarga school, Parāśara and possibly others may not have much of the algorithmic positional astronomy which developed later, but are broader in scope. They tell us about the actual naked-eye observations relevant for the science of astronomy and cosmology in the ancient times.

The book has a Foreword by Prof. M.D. Srinivas which summarises the contents of the *Mahāsalilam* aptly and points out its importance as “the scientific precursor of the rest of the VGJ, and also of the PT and the VJL.” It also has a ‘*Purovāk*’ in Sanskrit by Prof. Veerananarayana Pandurangi which emphasises its importance as a text in the Vedic tradition which deals with the creation of the universe. The first chapter is a comprehensive introduction by the author which provides the necessary background to appreciate the text, its summary and details about the manuscripts of the VGJ. The second chapter is on ‘*Mahāsalilam*, the *Vedāṅga*’. The third chapter is the core of the book: the text with the 108 passages, translation and notes. The fourth chapter is the critically edited text with all the details of the variant readings in the 11 manuscripts. The fifth chapter has the facsimiles of

¹ For the exterior planets (Mars, Jupiter and Saturn), this may not be a very bad measure as the planet-Sun distance may be conceived as an average of the varying planet-Earth distances.

² as communicated by Prof. Iyengar to me.



two of the important manuscripts among the eleven of them. There are three appendices which present some parts of the other *aṅgas*, which are helpful in a better understanding of the present book.

Where did the *siddhānta* texts get their revolution numbers and other planetary parameters from? They do not discuss any observations on which they are based. *Parāśaratantra* discusses some observations related to the

motions of Mercury, Venus, Jupiter and Saturn from which some rough values for their synodic/sideral periods can be inferred. It is possible that there are quantitative discussions of the motion of planets in the other *aṅgas* of the VGJ. The study of the remaining *aṅgas* of the VGJ, and sustained work on the general *Vedāṅga Jyotiṣa* tradition would throw light on these issues.

