SOMASIDDHĀNTA

Critically edited text, transliteration, notes and explanation in English

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Pratapanand Jha

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Critically edited text, transliteration, notes and explanation in English

Editor and Translator

Somenath Chatterjee

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॥ विज्ञानमुपास्व ॥
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Foreword

Knowledge related to astronomy has been prevalent in India since the Vedic period. Vedas especially Ṛk and Yajus along with Brāhmaṇas are testimony to this fact. As an example, Ṛg Veda verse 1.83.5 indicates the apparent motion of the Sun which is the cause of life, cause of creation. In the great epic, Rāmāyaṇa, there are more than five hundred references of positions of planets starting from the Bāla-kāṇḍa where the birth of Shri Rama was described. Astronomical references to planetary positions in the great war of Mahābhārata clearly point to this. Bhīṣma-Parva, Śalya-Parva and Udyoga-Parva abound with references of celestial phenomena.

Gradual discoveries related to astronomy contributed to its rich heritage and they are recorded in writing during first to sixth century C.E. Astronomer of India observed, systematically analysed and recorded the positions of planets with the passage of time. And thus the old Sūryasiddhānta was composed in 400 C.E. which was widely accepted and followed throughout India. Later in the seventh century, a modified version of old Sūryasiddhānta was composed.

The present publication, 'Somasiddhānta' is contemporary of the new Sūryasiddhānta. The name of the author of the Somasiddhānta is not known till date. The uniqueness of this Siddhantic text lies in its encompassing all aspects of astronomy in a compact form.

Shri Somenath Chatterjee, an independent researcher on history of science and astronomy, has done a commendable job by preparing the critical edition of the Somasiddhānta. He has also explained the text in English along with the diagrams, wherever necessary for easier understanding of the content.

I am sure researchers and persons interested in astronomy all over the world, will be benefitted by this publication. The Mission hopes this edition will encourage more researchers to work on other manuscripts on astronomy for publication in future.

Prof. Pratapanand Jha
Director
National Mission for Manuscripts

Key to Transliteration

VOWELS

अ a	आ ā	इ i	ई ī	उ u	ऊ ū
(but)	(palm)	(it)	(beet)	(put)	(pool)
ऋ* ṛ	ॠ* ṝ	लृ* ḷ	ए e	ऐ ai	ओ o
			(play)	(air)	(toe)
	औ au				
	(loud)				

CONSONANTS

Guttural	क ka	ख kha	ग ga	घ gha	ङ ṅa
	(skate)	(blockhead)	(gate)	(ghost)	(sing)
Palatal	च ca	छ cha	ज ja	झ jha	ञ ña
	(chunk)	(catchhim)	(john)	(hedgehog)	(bunch)
Cerebral	ट ṭa	ठ ṭha	ड/ड़ ḍa	ढ/ढ़ ḍha	ण ṇa
	(start)	(anthill)	(dart)	(godhead)	
Dental	त ta	थ tha	द da	ध dha	न na
	(path)	(thunder)	(that)	(breathe)	(numb)
Labial	प pa	फ pha	ब ba	भ bha	म ma
	(spin)	(philosophy)	(bin)	(abhor)	(much)
Semi-vowels	य ya	र ra	ल la	ळ* ḷ	व va
	(young)	(drama)	(luck)		(vile)
Sibilants	श śa	ष ṣa	स sa	ह ha	
	(shove)	(bushel)	(so)	(hum)	

अं (—) *ṁ* or *ṃ amusūra* like *saṁskṛti/or soṃskṛti*

अः *visarga= ḥ*

ऽ *Avagraha* indicate elision of short vowel *a,* has no phonetic value.

*No exact English equivalents for these letters.

Introduction

Development of Astronomy in Classical Age (Āryabhaṭa to Jñānarāja)

The one-thousand-year history and development of Indian astronomy is quite fascinating, especially to the researchers and students of astronomy. Vedānga Jyotiṣa (VJ) is the first astronomical text found in India (1370 BCE) and no other reliable evidence other than Jain texts is found up to Paitāmahasiddhānta (80 CE approx.), which can throw light to the development of astronomical knowledge.

Varāhamihira is the first scholar who felt the importance of astronomical manuscripts and compiled them in the first half of the sixth century. Till date, the best evidence of ancient astronomical knowledge of India contains in the Pañcasiddhāntikā of Varāhamihira i.e. Pauliśasiddhānta, Romakasiddhānta, Vasiṣṭhasiddhānta, Sūrya-siddhānta and Paitāmahasiddhānta. It is no doubt a great work indeed and Pt. G. Thibaut and Sudhākara Dvivedi translated this whole work with an elaborate introduction which was published in 1889. After this no such work is found based on original manuscript. S.B. Dikshit introduced a new idea of modern Pañcasiddhāntikā. He included Somasiddhānta and Brahmasiddhānta of Śākalyasaṁhitā excluding Pauliśasiddhānta and Paitāmahasiddhānta. Dikshit said, "The Pañcasiddhāntikā included all the siddhāntas excepting Soma-siddhānta." "... these Śiddhāntas and those which are to be considered now, are different, and this fact will be further corroborated by the discussion which will follow. The Siddhāntas whose study is going to be made now are extant and different from those belonging to the Pañcasiddhāntikā group; and that is why the epithet 'modern' has been applied to them. Although there is no definite evidence to show that there existed or still exist two Somasiddhāntas, still it is completely similar to the other four, and it is desirable to study it (i.e. Somasiddhānta) along with them."[1]

The Pañcasiddhāntikā was compiled by Varāhamihira when classical age (siddhāntic era) started. The development of Indian astronomical thought started in regular manner from Āryabhata (b.476 CE). He completed his master-piece Āryabhatiya when he was only 23 years old. He divided his book containing 121 verses into four chapters: (i) Gitikā-pāda (13 verses): (ii) Ganita-pāda (33 verses); (iii) Kālakriyā-pādā (25 verses) and (iv) Gola-pāda (50 verses). Āryabhata was the follower of Brahama School of Indian astronomy.[2] Bhāskara I, commentator or Āryabhatiya, says, "This Acarya worshipped God Brahmā by severe penance. So, by his grace was revealed to him the true knowledge of the subjects pertaining the true motion of the planets. It is said "Āryabhata who exactly followed into the footsteps of (Vyāsa) the son of Parāśara, the ornament among men, who by virtue of penance, acquired the knowledge of the subjects beyond the reach of the senses and the poetic eye capable of doing good to others."[3]

Āryabhata started alphabetical system of numerical notation effective in expressing numbers briefly in verses, like khyughṛ means 43,20,000 (Vs. 2. Gitika-pāda). He also determines the value of circumference-diameter ratio independently and called this value only 'approximate'. It is very interesting that at Kusumpur, a remote village near Patuliputra (Patna), a student makes the table of sine-difference which was unknown to Indian mathematicians at that time. He has also stated geometrical and theoretical methods for constructing sine-tables. (Gaṇitapāda. V 11-12). The geocentric concept was not changed by Āryabhata but he added that the earth rotates about its axis and stars are fixed in space. Āryabheta observed the period of one sideral rotation of the carth is 23 h 56 m 4.1 s (Gaṇitapāda, V-3). The corresponding modern value is 23 h 56 m 4 s.091. The accuracy of Āryabhata is remarkably high. Another feature of Āryabhatiya is difference of astronomical parameters from other astronomers. To him, Time is endless. (anādi and ananta). Time division which was present in Suryasiddhānta or like astronomical texts are modified by Āryabhata. At present it is difficult to think that a young man has so much profound knowledge on astronomy by which he modified exisitng time division.

To explain the theory of planetary motion. He imagined, (i) in his Gitikā-pāda chapter (Verse – 4) that in the beginning of current yuga, which occurred on Wednesday, 32,40,000 years before the commencement of the current-Yuga, all the planets together with Moon's apogee and the Moon's ascending node were in conjunction at the first point of the asterism Aśvinī (Piscium)[4].

This assumption was revolutionary at that age. If the precision of this hypotheses is not considered then also Āryabhata taught how to think to explain an event. His innovative mind, keen observation, mathematical aptitude make him extra-ordinary. Previous astronomers performed four correction in the case of superior planets (Mars, Jupiter and Saturn) and as many as five corrections in the case of inferior planets (Mercury and Venus) in order to obtains true positions. Aryabhata reduced the number of corrections from five to three.

The development of thought of finding planetary distances are—

According to Suryasiddhanta

$$\text{Planetary distance} = \frac{\text{mandakarṇa} + \text{śīghrakarṇa}}{2}$$

According to Āryabhatia,

$$\text{Planetary distance} = \frac{\text{mandakarṇa} + \text{śīghrakarṇa}}{R}$$

These characteristics of Āryabhatiya initiates a new school of astronomy called Āryabhata School. Disciples of Āryabhata taught this text with great 'respect', claiming higher accuracy.

Bhāskara I was the first scholar who wrote a commentary on Āryabhatiya and threw light on astronomical theories and methods of Āryabhata I and his earlier followers.

This commentary was the pioneer for propagating astronomy school of Āryabhata. Bhāskara I wrote two books following Āryabhatiya; (i) Mahābhāskariya and (ii) Laghubhaskariya. Mahābhāskariya starts paying homage to God Śiva, planets and stars. In the first chapter Bhaskara I gives the explanation of ahargaṇa, various methods to obtain mean longitude of a planet. This text was written following Āryabhatiya but a few formulae were separately known to Bhāskara in the verses (13-19), Bhaskara gave a method to calculate mean lougitudes of the Moon and the Sun without the use of the ahargaṇa. "Reduce the years (elapsed since the beginning of Kaliyuga) to months and add to them the elapsed months (of the current year). Then multiply that (Sun) by 30, and add the product to the number of (lumar) days elapsed since the beginning of the current month. Multiply that (Sun) by the number of intercalary months (in a yuga) and divide by the number of solar months in a yuga reduced to days. The quotient denotes the number of intercalary months (elapsed). Delete the divisor and divide the remainder (called adhimāsaśeṣa) by the number of lunar months (in a yuga); then multiply the (complete) intercalary months elapsed by 30 and to the product add the number of solar days (elapsed since the beginning of Kaliyuga); then multiply that (Sun) by the number of omitted lunar days in a Yuga and divided by the number of lunar days (in a yuga); the remainder obtained is called āhnika (the residue of the omitted lunar days i.e. the ayamāsaśeṣa). Then multiply the ayamāsaśeṣa by the number of intercalary months (in a yuga) and divide by the (in a yuga). Add the resulting quotient to the adhimāsaśeṣa, next multiply the ayamāsaśeṣa called āhnika by 60 and divide by the number of civil days in a yuga; the result is in minutes, seconds. The number of months elapsed are to taken as signs, and the number of lunar days elapsed as degrees. From thirteen times and from one time then subtract severally the degrees, minutes etc., corresponding to the adhimāsaśesa: the remainders are stated by the wise astronomers to be the mean longitude of the Moon and the Sun respectively conforming to the teachings of Āryabhata".[5]

Bhāskara I implemented his new idea and used new astronomical terms like āhnika, grahatanu etc. The very interesting parts of this text is the deduction of fraction of the intercalary month in mean lunar months and mean solar months, similarly fraction of the omitted lumar day. These calculations help to increase precision of astronomical thought. The eighth chapter is most important and interesting in Indian astronomy because for its approach to implement the knowledge of astronomy.

Laghu-Bhāskariya[6] is the smaller work of Bhāskara I. The number of verses is 214, just half of Mahabhaskariya. Laghu-Bhārkasiya is divided into eight chapters. The first chapter is devoted to the detailed treatment of longitude-correction. The second chapter contains 41 verses and devoted to the calculation of the true longitudes of the planets. Another feature of this text is making a rule for finding the Sun's altitude and Zenith distance, the midday shadow of the gnomon with the help of the Sun's declination and the local latitude (V-27, 28; ch 3). Laghu-Bhāskariya (LB) is the complement of Mahā-Bhāskariya, a summary of Mahā-Bhāskariya and it rejects unnecessary rules given in Maha-Bhaskariya. These two texts have been elaborately commented by Parameśvara, Sūryadeva yajavana. The LB has been commented by Śankaranārāyana (869 CE), Udayadivākara (1073 CE) etc.

Soma-siddhānta was compiled at that time when modern Sūrya-siddhānta had already copied. Its proof is also in the Ranganātha's commentary on Sūryasiddhānta. It mentions the number of years elapsed from creation up to the beginning of the present Kaliyuga and directs us to "add the desired number of years elapsed from the present Kaliyuga".[7] The real date is not known but the statement proves that this text was compiled in 6th century CE.

Brāhmasphuṭasiddhānta of Brahmagupta (b.598) exerted great influence in the astronomical thought of western and modern India.[8] Āryabhaṭa started to think about mathematical astronomy, observational astronomy, astronomical instruments and mathematics. Brahmagupta started his works criticising Aryabhata. According to S B Dirshit, 'there is no harm in saying, on the whole, that all the branches of the system which go to make the science of astronomy in our country, appear to have been completely established in the time of Brahmagupta'.

On the path of development of astronomical thought Brahmagupta is another milestone after Āryabhata. Brāhmasphutasiddhānta is a text book of astronomy containing 24 chapters. First 10 chapters contain usual astronomical knowledge but next chapters are progressive and these are innovative like gaṇitādhyāya, golādhyāya, yantrādhyāya etc. This is the new look on astronomy. Aryabhatia is the basic text to construct panchānga by the vaisnavas in the south. Brahmagupta criticized Āryabhatiya but wrote his another book Khaṇḍakhādyaka, on the basis of Aryabhatia. So, development of astronomical thought in (approximate) 200 years, Āryabhat to Brahmagupta, is vividly clear if we assume two peaks of Indian astronomy hill.

If we back to the Vedic age and after, we get there are so many hints of astronomical knowledge in Vedic literature and thereafter.

1. Taittiriya Saṁihitā and Śatapatha Brāhmaṇa (SB) are the two books of veda and Brāhmaṇa where readers can get the rudiments of astromony. These two texts included the introduction of the planets, twenty-four nakṣatras, cycles of seasons, concept of leap year, the dimensions of yoga, solar and lunar years.[9]

Astronomical knowledge in the Śatpatha Brāhmaṇa was studied by many scholars. It is very interesting that Indians of vedic age began to try to connect mathematics with astronomy. A considerable part of SB deals with the alter construction in the agnicayana rite. 'Agni' is the year; therefore, this rite is about a representation of the reckoning of the year. This twelve-day agnicayana rite takes place in a large trapezoidal area, called the mahāvedi.

Agnicayana alters are supposed to symbolize the universe. Gārhapatya represents the earth (SB 7.1.1.13) the dhiṣṇya represent space (SB 7.1.2.12) and the āhavanīya alter represents sky (SB 8.2.1.2). Āhavanīya was made in 5 layers. The first layer represents the earth, the third the space and the fifth the sky.[10] The second layer represents the joining of the earth and space, whereas the fourth layer represents the joining of space and sky. Time is represented by the metaphor of a bird. The months of the year were ordinarily divided into six seasons unless the metaphor of the bird for the year was used when hemanta and śiśira were lumped together. The year as a bird had the head as vasant, the body as hemanta and śiśira, the two wings as śarad and grīṣma and the tail as varṣā (Taittirīya Brāhamaṇa 3.10.4.1, SB 10.4.5.2).[11] The Ursa Major, Seven Rsis were identified in vedic age. Rsis are not named in the Rgveda.

There is a mention of Viśvāmitra as being God-born. The significant point is that the puranic reckoning system with a cycle of 2700 years, called Saptarṣi era. It is known that Saptarṣi era might have been known during Śatapatha Brāhmaṇa times. The alter is made in an area 7½ times that of one puruśa. With 360 years considered one divine year, 27oo years equal to 7½ divine years. This theory led to the popularity of the system of 27 nakṣatras. It is also significant that the epoch of 6676 BCE is exactly 3600 years earlier that the starting point of 3076 BCE for the Saptarṣi era as accepted by the present scholars. Hence it is clear that at the time of Mauryas, the cycles of the Saptarṣi were counted back to 6676 BCE, it appears that the new count that goes back to 3076 BCE.

It is well-known that Prajāpati is a metaphorical representation of time. It is also the year (SB5.1.1.1). So, time was represented by the constellations in the sky or the process of life and death in the world. The year was represented by the vedic stanza brhati, which consists 36 syllables forming four verses (śloka) (S.B.6.4.2.10). It is stated that by using 15 gāyatrī letters, one obtains the days of the year.[12]

It is clearly stated that the precession of the earth's axis caused to change slowly with time was expressed with the help of mythological concept. Due to precession of the earth, prajāpati, the year, marked by the Sun rising in Onion at the vernal equinox, had moved towards Rohini, his daughter.

To understand the astronomical knowledge in Śatapatha Brāhmaṇa, it is essential to study reference texts. The Ṛgveda described five planets as gods, the Moon's path was divided into 27 equal parts and the Moon took $27\frac{1}{3}$ days to complete the path. Each of these parts was called nakṣatra. Naksatras were mentioned in Taittirīya Samihitā also. In later literature, the list of nakṣatras was increased to 28.

A lunar day was reckoned from one moonrise to another and it was called a tithi. The lunar or synodic month was measured from full Moon to full Moon or from new Moon to new Moon (TS 7.5.6.1). Twelve lunar months constituted a lunar year. To preserve correspondence between lunar and solar years intercalary months were inserted at regular intervals (RV 1125.8). For reference, the following facts from modern astronomy are:

Solar year = 365.25636 solar days

Moon's sidereal period = 27.32166 solar days

Lunar month = 29.530588 solar days = 30 tithis

Lunar year = 354.367 solar days

Tithis in a solar year = 371.06239

The Śatapatha Brāhmaṇa is a compilation having knowledge about astronomy, like time, Space, and Direction; the connection of alters with astronomical explation etc. In fact, the main elements of the astronomy of Vedānga Jyotiṣa are already contained is Śatapatha Brāhmaṇa. Śatapatha Brāhmaṇa never tells the motion of planets which are found in Siddhāntic age.

2. Vedānga Jyotisa (VJ) is the first astronomical text in India, belongs to the late vedic age. Lagadha was the complier. Evidences allow that this book was complied in 1370 BCE (approx). It is the text where astronomical calculations are initiated. Observational inferences are compiled nicely; like increase in days and night in the ayanas, omission of tithis, unit of time, solar & lunar year, divisions of a sāvana day and length of day in two ayanas etc. The names of the Moon's asterisms (27) were known and used to indicate day. This type of knowledge improved with time. The solar year was known to have 365 days and a fraction more, though it was roughly spoken of as having 360 days, consisting of 12 months of 30 days.

The system of VJ is the same as that taught in the Gargasaṁhitā. The influence of VJ lasts up to Paitāmaha siddhānta compiled in 80 CE condensed in the Pañcasiddhāntika. VJ gives the five-year Yuga of 1830 days with 62 synodic months in it. It states in detail that in a yuga there are 5 solar years, 67 lunar sideral cycles, 1835 sidereal days, 180 tithis, 135 solar nakṣatras, 1809 lunar nakṣatras and 1768 risings of the Moon. It also mentions that there are 10 ayanas and viṣuvas and 30 ṛtus or seasons. The astronomical calculations were performed mentally day by day. According to VJ, the day is divided into 124 parts. So that the ending moments of the parvas and tithis can be given in whole units. The day is again divided into 603 units called kalās, so that the duration of the lunar nakṣatras is given in whole units as 610 kalās.

Accuracy of VJ is remarkable and it can be examined. The VJ states that 1830 civil days in a yuga, in which there are five solar sidereal years and 62 synodic months. This gives 366 days for the year which is really $365\frac{1}{4}$ days. 62 Synodic months, almost a day more than the 1830 given, because at the end of one Yuga, the amāvāsyā (new Moon) must have been observed to occur on the day next to the 1830th. Astronomers observed the last day of yuga and Moon would have been observed in the sky at sunrise, showing the day to be caturdaśī.

The 1830 days period is divisible by 5, giving 366 days for the year. This is divisible by 6, giving 61 days for each reason. The ayana has 183 days. The two intercalay months, one at the end of the 5th ayana and the other at the end of 10th. Here correction is needed. A day could have been added to the yuga and not counted in the calculation, to make up 62 Synodic months. H. Krishna Sastry Godbole, in his writing on Vedic calendar suggested the correct result for religions calendar is essential. So, he allowed to accumulate one day before correction, some suggest that the uncounted day might have been placed at the end of the 5th ayana.

Sir William Jones and Colebrooke were interested on VJ for its application to determine Vedic chronology. Capt. Jervis investigated the Indian measurement of Time and Prof. A Weber edited this test with the different readings from the manuscripts available to him. G. Thibaut interpreted the verses which was very difficult because the terms used over there are not easy to understand. S. B. Dikshit, M.M. Sudhakara dvivedi interpreted it in their own way. B. G. Tilak wrote his asticle 'Notes on the interpretation of the vedārga Jyotisa; Criticisms and suggestions' in 1914 when he was staying in jail in Burma.

There are so many errors in translating the verses yet it is good drive to interpret the verses as per their own observation. Pt. Kupanna Sastri pointed out that B. C. Tilak, in verse Y-VJ 19, committed a simple mistake of taking 'Udvapet' to mean 'should be added', instead of 'should be taken away'.[14] Hence interpretation was misleading. Present edition of VJ of both recensions have been approved by scholars and a map of astronomical knowledge of late vedic period has been cleared.

3. Varāhamihira (VM) is the popular mort astronomer throughout India. As an astronomer, his contribution is only the compilation of

five siddhāntic taxts or systems of astronomy. These are Paitāmaha, Vaśistha Romaka, Pauliśa and Sūrya. As regards its importance, he gives the first place to the siryasiddhantc, and places the Romaka and panlisa next, and declare that the remaining two definitely are inferior to the former texts. It is the first compilation ever discovered and it is the only compilation which indicates the state of Indian astronomy in classical era. The Suryasiddhānta as summerized by Varahāmihira in his Pañcasiddhāntikā differes from the system prescribed by the Sūryasiddhānta now available. Hence, two versions of Sūryasiddhānta are now available, Sūryasiddhānta is the most popular text throughout India for the preparation of pañchanga.

The modern Sūryasiddhānta consists of fourteen chapters and has an authentic notes of Parameśvara.

Modern Sūryasiddhānta: an analysis:

Modern Sūryasiddhānta (ss) explains Indian astronomical knowledge in a good sequence. First two chapters have no titles, but first chapter having 69 verses explains the mean longitude of planets and second chapter having 68 verses explains true motion and true longitude of planets which are the basic elements of Pañcāṅga. The special characteristics of PS are the description of those which are most important and/or general nature. The whole text of the SS is finished in 500 verses much less than other important texts, Brahamasphuta Siddhānta – 10008 verses, Siddhānta Sekhara – 890 verses and Siddhāntaśiromaṇi – 962 verses. It is a compilation, different from Suryariddhānta of PS, of a period when Āryabhatiya and Brāhmasphuṭasiddhānta had already become popular. But modern Sūryasiddhānta undoubtedly is the most popular book on astronomy in India. A large member of works has been published based on Suryasiddhānta. K.S. Shukla has brought out a list, though incomplete, but scholars get an idea about the influence of SS.

4. Brahmagupta; Brāhmasphuṭasiddhānta: a new look

Originality in thought process is proved in Āryabhatiya and then Brāhmasphuṭasiddhānta (Brh.s). Brahmagupta and Bhāskara I was contemporaries. Both of them developed their systems in the earlier part of the seventeenth century. Brāhmasphuṭasiddhānta was written in 628 CE and the commentary of Āryabhatiya by Bhāskara I was composed in 629 CE.

The classification of the contents of astronomy in adhikāras appears to be the original concept of Brahmagupta. The contents are divided in 24 chapters containing mathematics and astronomy. According to Brahmagupta's statement, 1008 verses are included in this text but M M Sudhakara Dvivedi edited consulting manuscripts and added 14 verses.

Another compilation of Brahmagupta was Khaṇḍakhādyaka. It was written by the author in his matured age. Here Brahmagupta didn't criticise Āryabhata. Here he wrote, 'having made obesiance to God Mahādeva, who is the great cause of creation, existence and destruction, I shall disclose the Khaṇḍakhādyaka which will yield the same results as the great astronomical treatise of Āryabhyata'.

In the Brahmasiddhānta, Brahmagupta accepts the astronomical day to begin with the sunrise at Lankā, and the calculation of days, months, years, yugas, and kalpas all begin from the first tithi of the bright-half of the Moon and the first day is regarded as Sunday.[15]

caitrasitāderudayādbhānordinamāsavarśayuga kalpāḥ /
sṛṣtayādan lankāyaṁ samaṁ pravṛttaḥ dine'rkasya //

The ardharātrika concept of Āryabhata was adopted in Khaṇḍa-khādyaka. Varāmihira, when compiled his PS, edited some parts of the text, like in Sūryasiddhānta. Here he also adopted the ardharātrika system.[16] In the first part of Khandakhādyaka, the astromomical constants are same as Āryabhatiya but other topics are almost same as Brāhmashuṭasiddhānta.

Khaṇḍakhādyaka (KK) has two parts Pūrva (first) and Uttara (Second). This text was studied by many scholars and there are many differences in editions. Pt. Babua Misra edited Khaṇḍakhādyaka with the commentary called Vāsana-bhāshya by Āmaraja declared that its first part consists of 115 verses but S. B. Dikshit states that the first part consists of 9 chapters which contain 194 couplets.

The KK has adopted the length of the year 365 d 15 h. 3.1 m up to given by the modern Sūryasiddhānta. The epoch in KK is 663 CE and the first lunar day of the light half of vaiśākha falls on Sunday in that year. KK agrees with the SS with respect of epochal positions. In the second half of KK, according to Varuna, the commentator, Brahmagupta has declared that he was going to compile a work as good as that of Āryabhata. He did not agree in all items with Āryabhatiya due to mismatch of the calculations with observations. He has borrowed some important items from Āryabhatiya; the length of the year, mean motions of planets, epochal positions and the moment of the beginning of yuga. Brahmagupta did not accept the system of Āryabhatiya but has simplified it in the Khaṇḍakhādyaka proper. In the Uttara-khaṇḍakhādyaka, he further corrected some of the results, given earlier in the Khaṇḍakhādyaka proper. As for example, in the Khaṇḍakhādyaka, Brahmagupta assigns to the longitudes of the Sun's apogee the value 80°, whereas in the Uttara-Khaṇḍkhādyaka he corrected it to 77°.

Na sphuṭamāyyabhatoktaṁ yastastatau vakshe /
bhānumati mandocca rāśidvayanaṁśakāśca saptadaśa //

The accuracy of Brahmaguta is more than Āryabhata.

Bhāgāśītirinoccani śaśinah pādonakrta śarakṛtonād /
Bhaganāḍi dvitriradairvasunava yama nava guṇaih sakalaṁ // KK I.13

The longitude of Sun's apogee is 80°, inocca means mandocca of the Sun. It we compare it with the present value, we get the longitude of Sun's apogee in 499 CE was 77 deg 19 min 44 sec. Brahmagupta in the Uttara Khaṇḍakhādyaka, gave the near value of this modern value but Āryabhata gives this value 78° which is less correct. In the Khandakahādyaka, Barhmagupta gave the equations of the Sun and the Moon at the interval 15° of arc of the mean anomaly, for the first time in the history of mathematics, the improved rules for interpolation by using the second difference.[18] The rule applies to the case of all functions hitherto considered in the Khaṇḍakhādyaka, which are tabulated at the difference of 15° of arc of the argument.

The arguments are -

a) the tabular differences of the Sun's equation
b) the tabular differences of the Moons equation.
c) the tabular differences of the 'sines'.

5. Bhāskarāchārya and his Siddhāntaśiromoṇi:

Now, we go through the works of Bhārkavāchārya or bhāskara II, to get more accurate results of mathematical astronomy. Āryabhata gave a table of 24 sines in a quadrant, which is alluded to be Lalla in words.

Bhārkarāchārya follows the works of Brahmagupta and Śripati but his own contribution is great. His master-piece Siddhāntaśiromaṇi is a milestone in Indian astronomy. The Siddhāntaśiromaṇi (SS) is divided into four main parts and each part is also divided into chapters. The first part is termed as 'Līlabati' (pāṭigaṇita) consists of 278 verses. The next consists of vījagaṇita. The last two parts are devoted to astromony; golādhyāya and gaṇitādhyāya. Golādhyāya treats of all subjects related to planetary calculations. It consists a chapter describing astronomical instruments for observations. A short chapter, 'description of seasons' was written by the author with great care. Actually, Bhāskarāchārya has a great poetic feeling which is expressed in his works. The part, known as 'golādhyāya' and gaṇitādhyāya' are devoted to astronomy and mathematics essential to astronomy. Golādhyāya consists of all subjects related to planetary calculations and gaṇitādhyāya deals with mathematics related golādhyāya, instruments of observation etc. Bhārkarāchārya has adopted from the Brahmasiddhānta the number of revolutions and the other elements related to astronomy but the work, Siddhāntaśiromaṇi has reached a high degree of excellence on account of explanation of planetary theory covering all subjects related to astronomy.

The period from Āryabhata I to Bhāskarāchārya is regarded as the most brilliant period so far as the development of Indian astronomy is concerned. It is during this very period that the khaliphs of Bagdad in their days of prosperity invited astronomers from India, got the Indian works translated into Arabic and Latin.

In this period the problem of 'ayana' motion was fully studied. Bhāskarāchārya was not savvy in observational astronomy. He concentrated on mathematical astronomy but his works contain nothing new. He focussed on explanation of old theories. His study gives a new approach on calculation of astronomy.

Karaṇakutūhala is a Karana work which Bhāskarāchārya had adopted 1181 CE as the epoch year. Bhāskarāchārya regards his work comparable to Brahmasiddhānta after the corrections recommended by Rājamṛgānka were incorporated. Karaṇakutahala contains ten adhikāras and 139 verses.

Ganeśa Daivajña was a very famous astronomier of 15th century CE. His work Grahalāghava states how the planets agree with the positions calculated from ancient works.

Saurorkopibidhuccamāṁkakalikonābjo gurusatvāyajo'sṛgrāhu ca kujajñakendrakamarthāyaḥ seṣubhāgaḥ śaniḥ /
Śauktacaṁ kendramjājyamadhyagamitīme yanti dṛktualyatāṁ //

- Madhyamādhikāra, Grahalāghava

The speciality of the Grahalāghava is that it has away with the use of sines and arcs. But the result found from this Karaṇa work is less accurate than earlier Karaṇa works. Gaṇeśa observes that the places of planets calculated from previous works tally with these observed places on application of certain corrections.

After that the last astronomer of classical age, Jñānrāja, son of Nāganātha was born 1507 (1508) CE. Jñānrāja has written a work on astronomy called Siddhānta-sundara which has two main parts, golādhyāya and gaṇitādhyāya. Jñānrāja states directly that the Siddhānta-sundara follows the previous astronomy book Brahmariddhānta. Its auxiliary part, found as bījagaṇitādlyāya. The Ph.D paper of Toke Lindegaad Kundson shows the study of six chapters but it is a detail study. According to Pingree, Siddhāntasundara covers all the contemporary topics on astronomy and following modern Sūryasiddhānta it is compiled as a hand book or Karaṇa work. It gives the epochal positions of planets and annual rates of motion for finding the true places of planets. These positions and the rate of yearly motion of the planets, completely follow the modern Sūrya-Siddhānta. This journey of astronomy of Siddhantic age ends at Jñānrāja. After him, the works were not remarkable and nothing new. So, the evolution of Indian astronomy ends in 16^{th} century CE and again it becomes flourished in assimilation with modern astronomy.

Somasiddhānta

Somasiddhānta is an astronomical text following Sūryasiddhānta, the great popular Siddhānta till the classical age in India containing ten chapters and 335 verses. It is referred in Ranganatha's commentary on Sūryasiddhānta and also in Kamalākara's Siddhāntatattvaviveka. As usual the astronomical texts before Āryabhata, are all divine, and so is Somasiddhānta.

This book starts from a conversation style between Candra and Śaunaka. According to date of compilation it can be assumed easily that it existed before Brahmagupta, because a few verses of Brahmasiddhānta are similar as Somasiddhanta. Again, in Somasiddhānta we get the name Romaka, so it is later than Romakasiddhanta. Another example of reference is Latacharya's own work which is similar to Somasiddhanta.

Manuscripts references:
Bhanderkar Oriental Research Institute – 208/A 1883 – 84 ff 10, Nagari (B1)
Benaras – p 257, 171, ff 15 (B2)
Printed version - edited by Divedi, S., Jyotiṣ Siddhānta Saṁgraha, Benaras Sanskrit Series, No. 152, Benaras 1912

A short note on resource

Two manuscripts (B1 & B2) and a printed matter in Sanskrit series BSS 152 have been collated to determine this critical text. These manuscripts have many variations. Pt. Vidyesvari Prasad Dvivedi noted a text on Somasiddhānta written by Mayurabhatta, resident of Varanasi. Pt. Dvivedi did not clearly mentioned the address of the manuscript. David Pingree, in his renowned work, Census of Exact

Sciences in Sanskrit noticed that Somasiddhānta was found from Bhanderkar Oriental Research Institute, Pune. Kamalākara Bhatta in his work Siddhāntatattvaviveka noticed this text. Pt. S. B. Dikshit suggested Somasiddhānta as a part of new Pañcasiddhāntikā as a follower of Sūryasiddhānta. The editor has collected manuscripts from Bharderkar Oriental Research Institute, Pune.

This text consists of 335 verses as the following:

No of chapters	Name of chapters	No. of verses
1	Madhyamādhikāra	53
2	Spastādhikāra	47
3	TripraŚnadhikāra	35
4	Candrārkayoh grahanāyanādhyāya	29
5	Parilekhanādhyāya	12
6	Nakshtragrahayogasamāgamādhyāya	35
7	Grahodayāstamānādhikāra	20
8	Sṛṅgonnatyadhyāya	08
9	Patādhyāya	11
10	Golādhyāya	85
Total		335

The first chapter starts with the dialogue between Candra and Śaunaka. Candra starts with the knowledge of time and mean positions of planets. In the verse eight a term gurbakshara is present which is not found in sūryasiddhānta. In the verses 8 and 9, time division is found;

10 gurbakṣara = 1 prāṇa
6 prāṇa = 1 vināḍi
60 vināḍi = 1 nāḍi
60 nāḍi = 1 day

The advantages of this time division are that, one prāṇa is how much division of a day, one kalā is how much division of a circle. One day is equal to 21600 prāṇa, 360 parts of a circle and 60 kalās in a part. Therefore 21600 kalās are in a circle. Vināḍi is called pala and nāḍi is ghaṭika. The day and nights of the gods and of the demons are mutually opposed to each other. Six times sixty ahorātra make a year and twelve thousand of these divine years and denominated a quadruple age (chaturyuga). According to Somasiddhānta mean motions of planets are like this:

Planet	Number of revolutions in 4320000 years	Numberof revolutions in 1080000 yrs
Sun	4320,000 (verse 21)	1,080,000
Mercury	17,937,060 (verse 23)	4,484,265
Venus	7,022,376 (verse 24)	1,735,594
Mars	2,296,832 (verse 22)	574,208
Jupiter	364,220 (verse 23)	91,055
Saturn	146,568 (verse 24)	36,642

The ancient Indian astronomers introduced certain corrections, bīja, on planetary elements as explained below.

Mean motions of the planets are as corrected below:

Sun	0	4320,000	1,080,000
Mercury	–16	17,937,044	4,484,261
Venus	–12	7, o22,364	1,755,591
Mars	0	2,296,832	574,208
Jupiter	–8	364,212	91,053
Saturn	+12	146,580	36,645

Examining the elements given in the first chapter of Somasiddhānta, it can be concluded that there are concepts of intercalary months, the omitted lunar days, the sidereal, lunar and civil days. Verse 30 gives the number of revolutions in a kalpa. From verse 31 to the rest verse 53 discuss the revolution of Sun's apsis, the revolution of Moon's apsis and node etc.

Chapter two, deals with the method of computing true places of the planets from their mean positions. The mean positions of the planets are readily calculated by knowledge of their mean motions and the number of days (ahargaṇa) that have elapsed from a particular epoch at which their mean positions are known. Verse 25 discusses the rectifications of mean positions of five planets by two equations known as mandaphala and śīghraphala. The Indian astronomers were aware about the epicycle theory (nichocchavṛtta) and they introduced this theory to calculate the two corrections. Āryabhata (verse 19-20, kālakriyā) explained "All the planets undoubtedly move with mean motion on the circumference of the epicycles. A planet when faster than its ucca moves clockwise on the circumference of its epicycle and when slower than its ucco moves anticlockwise on its epicycle." It means that a planet moves clockwise on its manda epicycle and moves anticlockwise on its śīghra epicycle. According to Somasiddhānta the dimensions of epicycles are like this: (V 15-16)

Epicycles of the Apsis (Mandaparidhi)						
Sun	Moon	Mars	Mercury	Jupiter	Venus	Saturn
14	32	75	34	33	12	42

Epicycles of the Conjunction (Śīghraparidhi)						
Sun	Moon	Mars	Mercury	Jupiter	Venus	Saturn
0	0	235	133	70	262	39

(All data are in degree)

It is observed that the dimensions of the epicycles at the end of odd quadrants are smaller than those at the end of even quadrants with the exception of Jupiter and Saturn. With the help of the dimensions of the epicycles at the end of even or odd quadrants given in the above table, correct epicycle of any intermediary place can be found. The last portion of this chapter discusses i) calculation of sine and versed sine of declination, radius, etc., ii) calculation of day and night of the planet etc. , iii) calculation of dates etc.

Chapter three deals with three problems; dik, deśa and kāla i.e. direction, position and time with respect to a celestial body. The astronomical instruments play an important role for determining different values of three, dik, desa and kāla.

Verse 2 of this chapter discusses the application of gnomon, shadow. The square root of the sum of the squares of the gnomon and shadow is the hypotenuse. If from the square of the hypotenuse the square of the gnomon be subtracted, the square root of the remainder is the shadow. This is a simple rule similar to Pythagoras i.e. in a right-angled triangle the square of the hypotenuse is equal to the sum of the squares of the other two sides. The triangle produced by the gnomon as perpendicular, the shadow as base and the line drawn from the top of the gnomon to the extremity of the shadow, as hypotenuse.

Verse 28 explains the conceptual basis of agrajyā which is known as agrā. It is defined as the difference any given shadow and the viṣuvadhāgragā. Verse 9-10 explains karaṇī; 'if from the square of the radius, the square of the sine of amplitude be subtracted and the remainder multiplied by twelve, and again multiplied by twelve, then further divided by the square of the equinoctial shadow increased by half the square of the gnomon-the result obtained is called surd (karaṇī).

Fourth Chapter

It is very important chapter in Somasiddhanta. It deals with eclipse with geometrical concept how eclipse occurs, determination of time of obscuration etc.

Fifth Chapter

Valana, the deflection of the ecliptic from the eastern point on the horizon of the eclipsed body is discussed in detail. Valanāgra, the points marked on the circle of deflection, is another tool of this chapter. To explain eclipse, marking of extremities of the latitude for the contact and separation are very essential. In lunar eclipse the extremities of the latitude should be marked opposite to their proper directions. In the lunar eclipse, if the direction and latitude of the deflection is the same, the deflection should be marked on the eastern side of the north-south line. This is considered a very good observation of Indian astronomers.

Sixth Chapter

The Somasiddhānta has used two terms for almost same meaning; Yuddha, samāgama. Sūryasiddhānta used astamāna in this respect but in author's view, in Somasiddhānta, setting (astamāna) is not used in same sense. The five planets which are known at that time have samāgama or yuddha with one another but with respect to Moon it is only samāgama. The spot of conjunction, the time of conjunction are determined in a clear method. Following Sūryasiddhānta this text is very lucid in treatment.

Seventh Chapter

Interestingly, Somasiddhānta did not concentrate on any particular heavenly event, as a text book all astronomical phenomena are discussed here. This chapter deals with grahodayāsta i.e. helical rising and setting of these heavenly bodies. When a planet or star comes into close proximity of the Sun it becomes invisible. This phenomenon is known as astamāna. The knowledge base at the time of such astronomical texts is modern enough these are comparable to any naked eye observation through out the world. Very nicely it is discussed that to determine the helical rising and setting of a particular planet it is necessary to know the interval to go under such a stage. The difference between the visibility limit of time-degrees and the calculated time degrees should be divided by the difference of daily motions of the Sun and the planet. The result will be the interval of days before or after helical rising or setting.

Eighth Chapter

It is an excellent feature of Indian astronomical text. Śṛngonnaty-adhikāra deals with daily rising and setting of the Moon, determination of phases of the Moon. A very small chapter, only eight verses are there but important in astronomical perspective.

Ninth Chapter

Astronomy is in true sense a subject which requires a cognitive knowledge i.e. not only mathematics or physics or any other subject, but a totality of knowledge. Pāta is a term which is translated by Burgess as 'to fall' but it is used in Indin astronomical text as in different mode. In Sūryasiddhānta this chapter consists of twenty-two slokas but in Somasiddhānta it is eleven. Swami Vijnananda truly explains in his Sūryasiddhānta that pāta is occurred when the Krānti of the Sun and the Moon becomes same.

Tenth Chapter

This chapter is very fascinationg. In all Indian classical astronomical texts golādhyāya is full of questions, an approach of question and answers. This treatment reached at highest peak at the time of Bhāskarāchārya. Somasiddhānta is not the exceptional. It starts with questions about cosmology. It contains eighty-five verses most of the verses are author's question bank. The expert tried to explain with a typical approach but this chapter in the later age deals with spherical geometry. The approach of this book is slightly different from Sūryasiddhānta. Somasiddhānta starts with a curiosity about the mystry of this creature—how to create natural illumination, how to construct our earth etc.

Explanation of a few Astronomical terms according to Somasiddhānta: 1

Somasiddhānta, an astronomical text followed by Sūryasiddhānta discusses the concept of time and its divisions in the first chapter. Like other ancient Indian astronomical texts Somasiddhānta starts with mean daily motions of the planet (madhymādhikāra). The astronomical terms included in this chapter are explained below.

Metaphysical Units of Time: Divine and Demoniacal Day and Year (verse 10); The day and nights of the gods and demons are opposite to each other. The combination of day and night (ahorātra) is designated as the day. The divine day consists of twelve solar months and three hundred and sixty divine days constitute a divine or a demoniacal year. A divine year is equal to 360 solar years or 360 * 360 = 129600 solar days.

Caturyuga (verse 12 -13): It is the amount of period consisting of 43,20,000 solar years divided into four sub periods known as

Kṛtayuga, Tretāyuga, Dvāparayuga and Kaliyuga. The measurement of each sub-period is obtained by dividing the entire period of a yuga by ten and multiplying the quotient by four, three, two and one respectively i.e. caturyuga components are in the proportion 4:3:2:1.

Thus the measurements of sub-periods are as follows:

Kṛta	(4320000 × 4) ÷ 10 = 1728000 years
Treta	(4320000 × 3) ÷ 10 = 12,96,000 years
Dwapara	(4320000 × 2) ÷10 = 8,64,000 years
Kali	(4320000 × 1) ÷ 10 = 432000 years

Life of Brahmā (verse 20): Total span of the life of Brahmā is stated as 100 Brahma years. One Brahma year contains 360 Brahma days. One day and night of Brahma is constituted by two kalpas. One kalpa = 14 Manu, 1 Manu = 71 yuga, 1 yuga = 4320000 years. (Manu = Manvantara)

Bhagaṇa (verse 20): One which moves faster (śīghragāmi) passes through the asterisms in a short time; one which moves slowly (mandagāmi) passes through them in a long time. According to the text the planets and asterisms move constantly from east to west at a high velocity. The planets are stated faster or slower depending on the smaller or larger routes they have to take according to their relative position in the sky.

Śīgrocca (verse 21): It means apex of fastest motion. The speed of a planet is fastest at conjunction.

2

Trijyā: Angles are measured in Indian system in rāsis. A rāsi consists of 30 degrees. Trijyā is the short form of trirāsijyā, so it consists of 90 degree. In astronomical texts trijyā is measured in terms of kalās. 3438 kalās are in trijyā.

Kojyā: It is the short form of koṭijyā (cosine). It is the jyā of the complementary angle in a quadrant.

Lambajyā: It is the term used to denote the koṭijyā of the latitude.

Manda Kendra and śīghra Kendra (verse 24 - 26) The circular difference between the mandocca and the mean planet is called mandrakendra. The difference between the śīghrocca and the mean planet is known as śīghrakendra.

Mandaphala and śīghraphala (verse 25): The radius of the mandaparidhi or the śīghraparidhi is equivalent to the sine of the arc representing the greatest difference between the mean and actual positions of the planet. If the difference in the positions of the mean and true planet is due to mandocca, the epicycle is known as mandaparidhi, and the difference as mandaphala. If the difference is due to śīghrocca, the epicycle is known as śīghraparidhi and the difference as śīghraphala.

3

Chāyakarna (verse 17): The hypotenuse of the gnomonic triangle whose two sides are gnomon and its shadow.

Karani and phala (verse 29 - 31): To find the angle of the cone of the Sun lying in the intermediate direction, one formula is deduced.

Angle of the cone (konośanku) = square-root of the addition of square of the karani and phala ± phala

Positive sign is used for the Sun has north declination and negative sign is used for the Sun has south declination.

This chapter deals with sufficient mathematical treatment as the other Indian astronomical texts.

4

Chādaka is used here as the grāhaka, the body to be obscured. The term chedyaka comes from the word split, it is used as divisor. The knowledge of projection is necessary to understand precisely the eclipsed portion of the disc. The projection is directed to be made upon a plane surface of the earth where the midpoint is identified.

Grāsa is used for obscuration or eclipse which is implied as the old concept of eclipse as eating etc.

Pragraha and Mokṣa are appropriately used for 'seizing upon', or first contact and the later is used for separation.

Nimilana means the total disappearance of the eclipsed body within or behind, the eclipsing body and the first reappearance is called unmilana.

The theory due to account of projection of eclipses, that three minutes of arc at the horizon, and four at the zenith, is equal to the excess of above three minutes of the equivalent of a digit at the zenith, being one minute.

5

Assuming that the observer's position is in the north side while looking straight southward. Comparing the different phases of the eclipses, the mid-circle can be drawn taking its outermost point for deflection. "Valana" means deflection. The problem is to identify those points. At what point eclipse begins and what point it ends. Valana gives the angle between the ecliptic and prime vertical.

It is required to represent the deflection of the ecliptic; an east-west line is drawn on the part of greatest obscuration. The deflection (in this moment) is determined by a secondary to the ecliptic, drawn from north and south point.

In the lunar eclipse, if the direction of the deflection and the latitude is the same, the deflection should be marked on the eastern side of the north-south line. If the latitude is north, the defection should be marked east or west from the southern point. When it is south, the deflection marked from the northern portion is obscured. When the latitude is north, the southern portion of the eclipsing body is obscured, and vice-versa. In the eclipse diagram, the centre of the eclipsing body is supposed to be on the great circle, and for the mid-eclipse, the latitude of the Moon is to be marked on the line joining the centre and the point of deflection. The rule formed to mark the deflection from the northern or southern point corresponding to the opposite direction of the latitude. The cause of marking the deflection in the eastern side, if the direction both of the latitude and the deflection is the same, in such a situation, the centre of the eclipsing body lies on the western side of the N–S line of the eclipsed body.

6

This chapter is mainly occupied with such a definition of the positions of the asterisms – to which are added those few of the more prominent among the fixed stars. The text here assumes that the names of the asterisms and the order of the succession. The identification of the asterisms is founded upon the positions of their junction stars. The number and configuration of the stars forming the groups are not stated in this text.

7

Helical rising and setting of the heavenly bodies are precisely the same with those employed to denote their rising and setting. The degree of visibility, if multiplied by 1800 and divided by udayāsu gives the result kṣhetrāṁśas.

8

This chapter employs that the method of finding the interval from sunset to the rising or setting of the Moon, method of determining the Moon's relative altitude and distance from the Sun at sunset. To determine the illuminating part of the Moon's disc from the new Moon to the full Moon when the motion is less than 180 degree from the Sun and when the excess of the longitude is more than 180 degree.

9

This chapter deals with the description of the malignant character of the times when the Sun and Moon are in equal declination, upon the same or opposite sides of the equator. This chapter is less important in Indian astronomical texts. Burgess noticed in his translation and commentaries on Sūryasiddhānta that this chapter in this text is not explained properly.

10

This chapter is full of queries and answers. It tries to explain the creative agencies, of the elements, form and disposition of the stellar and planetary systems. It describes the form, structure and divisions of earth, varying phenomena of night and day in different latitudes and zones, revolutions of stars and planets, dimensions of the planetary and stellar orbits.

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Word Numerals

0 = ambara, kha, biyat, byoman, śunya, ākāś, gagana, abhra, navas, pūrṇa
1 = indu, ku, candra, niśākara, rūpa, bhū, śaśāṅka, prāleyaraśmi, ahṇa, śaśin, mahī
2 = akṣi, aśvin, dasra, netra, yama, yamala, locana, pakṣa, kara, yugala, yugma
3 = agni, guṇa, jbalana, banhi, śikhin, hutāśa, dahana, rāma, hotra, puṣkara, pābaka
4 = abdhi, arṇava, kṛta, veda, Āśrama, caturmukha, aṅghri, jala, jaladhi, lavaṇada, jaladhara, yuga
5 = artha, iṣu, bāṇa, margaṇa, akṣa, indriya, bhūta, viṣaya, śara, prāṇa, sāyaka
6 = ṛtu, rasa, aṅga,
7 = adri, turaṅga, naga, parvata, bhūdhara, bhūmidhara, muni, aśva, svara, acala, kṣitidhara, kṣoṇīdhara, Samudra, sāgara, divicara, dhātridhara, bhubhṛt, śaila
8 = kunjara, gaja, vasu, bhujaṅga, sarpa, prakṛti, dvipa, nāga, ahi
9 = aṅka, go, chidra, randhra, nanda, naraka, svargati, khecara
10 = dis, āśā, kukabha, paṅti
11 = īśa, īśara, rudra, śankara, bhava, śiva, bharga
12 = arka, sūrya, śaṅku, bhāskara, ravi, bhānu
13 = viśva, atidvādaśa
14 = indra, manu,
15 = tithi, dina

number	Sūryasiddhānta	Pañcasiddhāntikā	Mahābhāskariya	Khaṇḍakhadaka
16	aṣthi	aṣthi, bhūpa	aṣthi	aṣthi
17	------------	atyaṣti	----------	----------
18	dhṛti	dhṛti	dhṛti	dhṛti
19	atidhṛiti	-------------	------------	----------
20	nakha	nakha	nakha	nakha

Except these numbers,
27 = trighana, 49 = tana, 225 = tithivarga, 10000 = ayuta
are found.

To understand mathematical astronomy in Indian context these figures will be helpful.

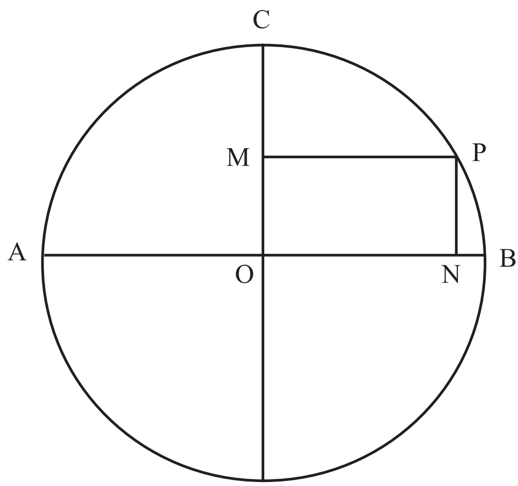


Fig. 1:

PN = jyā of PB arc
ON = koṭijyā of PB arc
BN = utkramajyā of PB arc

Jyā = sine × radius
Koṭijayā = cosine × radius
Utkramajyā = versed sine × radius.

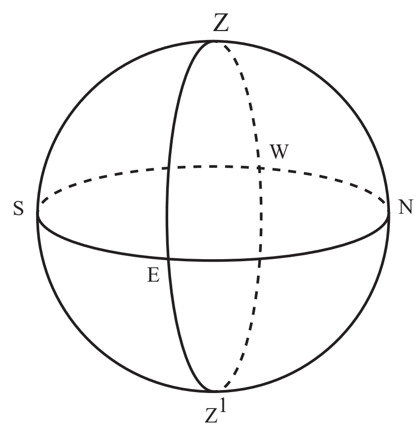


Fig. 2:

Yamyottaramaṇḍala	(Celestial meridian)
	= Z S Z/ N Z
Samamaṇḍala	(Prime vertical)
	= Z E Z/ W Z
Samaprota	(Horizon)
	= S E N W S
Khamadhya	(Zerith) = Z
Samacinha	(North Point) = N

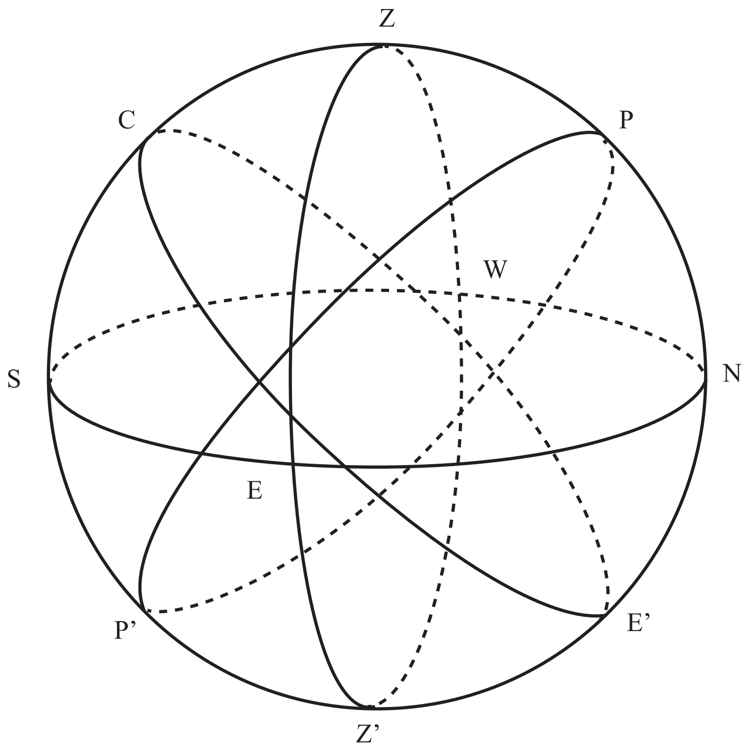


Fig. 3:

Yamyottaramaṇḍala (Celestial meridian)	=	Z S Z/ N Z
Samamaṇḍala (Prime Vertical)	=	Z E Z/ W Z
Samaprota (Horizon)	=	S E N W S
Nāḍimaṇḍala (Celestial equator)	=	C E E/ W C
Dhruvaprota (Secondary to celestial equator)	=	PE P/ W P
Dhruva (Pole of the celestial equator)	=	P

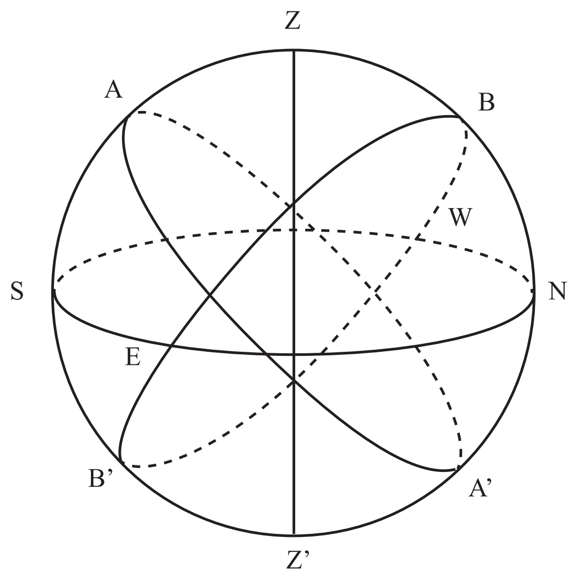


Fig. 4:

Krāntivṛtta (ecliptic) = A A /Ka

Kadamvaprota (Secondary to ecliptic) = B B / B

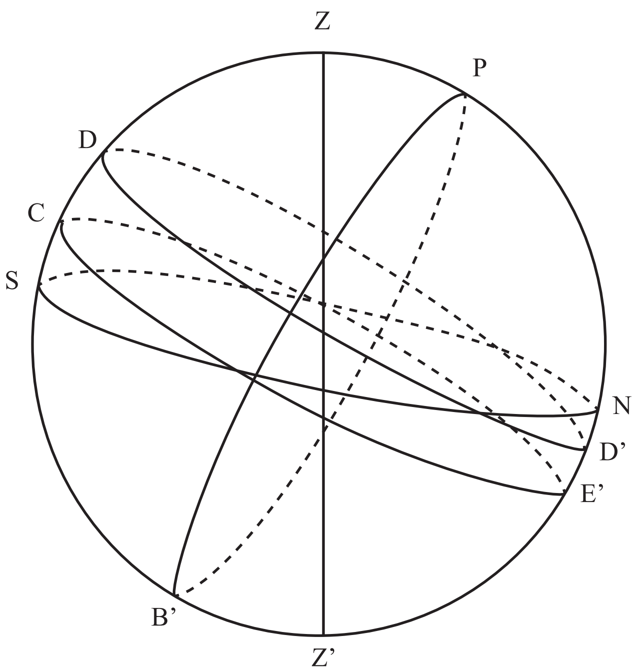


Fig. 5:

Kṣitijā (Horizon)	=	S E N W S
Ahorātravṛtta (Diurnal circle)	=	D F D/ G D
Unmaṇḍala (Elevation)	=	P F P/ G P

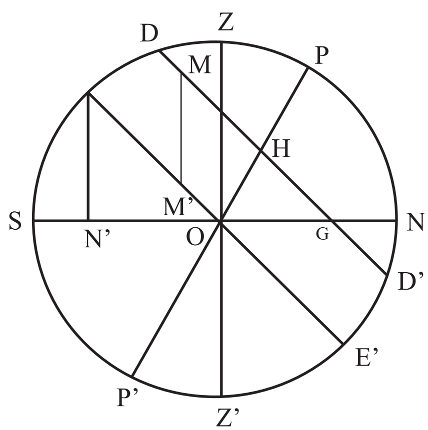


Fig. 6:

Akṣāṁśa (elevation of the POK) = CZ
Lambāṁśa (Colatitude) = SC
Lambajyā (Rsine of colatitudes) = N/C
Krāntijyā (Rsine of declination) = OH
Agrā (Rsine of the amplitude) = OG
Śaṅ ku (Distance of projection of a heavenly body on the plane of the celestial horizon from the planets rising and setting) = MM
/Śaṅkutala = N /G

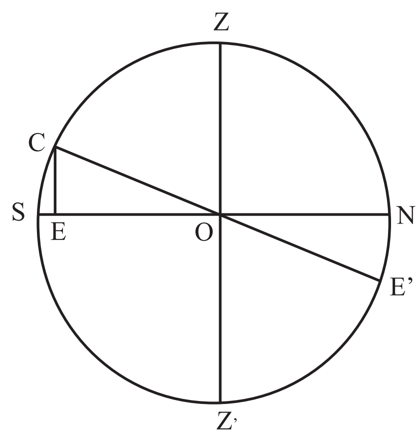


Fig. 7:

Akṣāṁśa (elevation of the pole)	=	Z C
Akṣajyā (arc of latitude)	=	OE
Lambāṁśa (colatitudes)	=	S C
Diameter of the horizon	=	S O N
Diameter of the celestial equator	=	C O E/

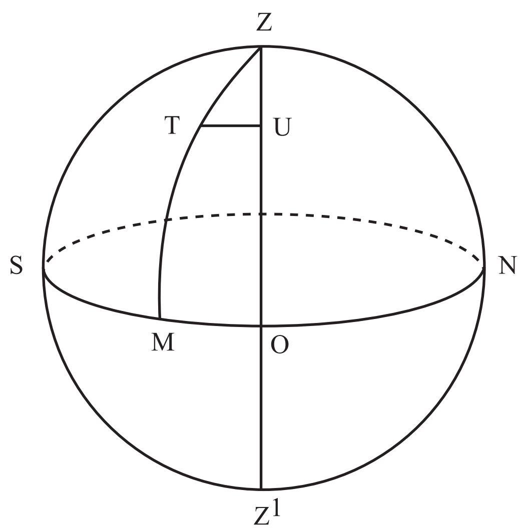


Fig. 8:

Natāṁśa (Rsine of Zenith distance)	=	a r c Z T
Natāṁśajyā	=	jy(a)¯Z T
Unnatāṁśa (900 less Zenith distance)	=	arc TM
Unnatāṁśajyā	=	j y ā T.M

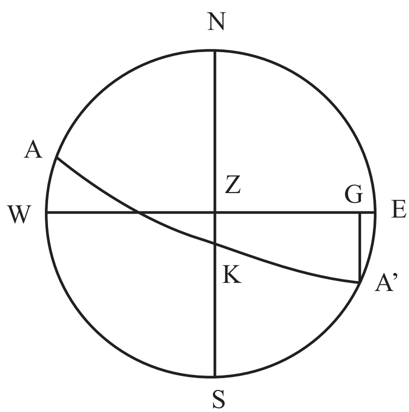


Fig. 9:

Udayajyā (orient-sine; Rsine of the amplitude of lagna from the last) = G A/

Madhyalagna (Meridian ecliptic point) = K

Madhyajyā (Rsine of the Zentith distance of the meridian ecliptic point) = Z K

Khamadhya (Zenith) = Z

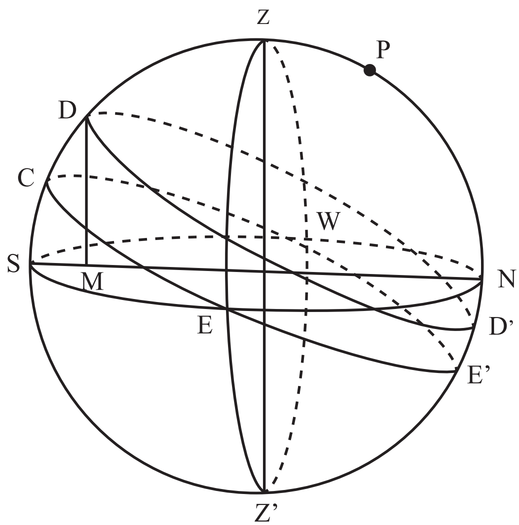


Fig. 10:

dinārdhasaṅku (length of the perpendicular) = D M
kṣitija (Horizon) = S N S
ahorātravṛtta (Diurnal circle) = D D/ D

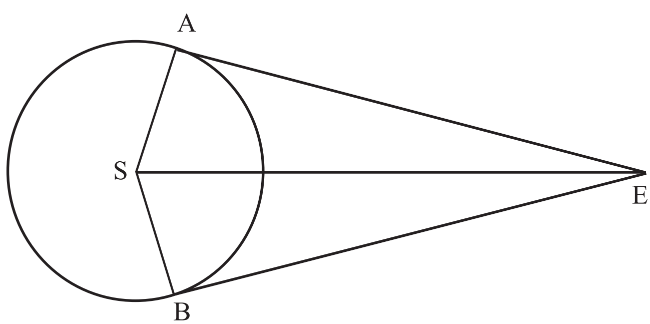


Fig. 11:

ravikarṇa (Distance between earth's centre and the Sun) = S E
ravivyāsārdha (Radius of the Sun) = S A
ravivimbamāna (Angular diameter of the Sun) = A E B

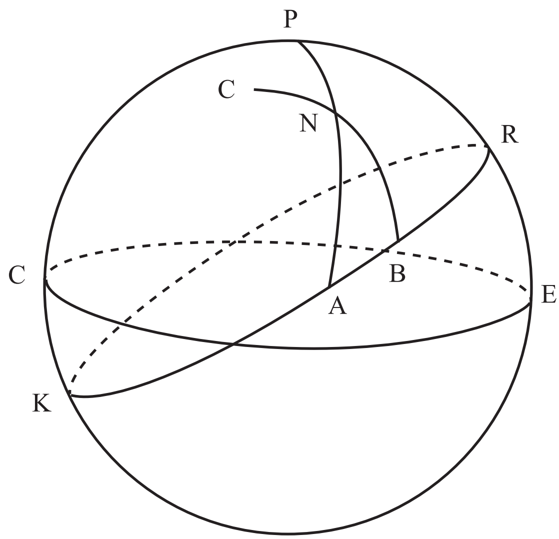


Fig. 12:

ayanakalā = A B
ayanagraha = A
krāntivṛttameru = c

सोमसिद्धान्तः

श्री गणेशाय नमः

प्रथमोऽध्यायः

मध्यमाधिकारः

बृहस्पतिसुतं शान्तं सुखासीनं प्रियेच्छणम्।
अभिवन्द्यं मुनिर्धीमान् शौनकः परिवृच्छति॥ १॥

भगवन् सर्वशास्त्रज्ञ सर्वभूतहिते रत।
कथं ग्रहस्थितिर्यावल्लग्नकालविधाः क्रमात्॥ २॥

उपरागश्च खेटानां योगश्चारग्रहाः क्रमात्।
ग्रहर्क्षःस्वोदयः पातस्तत्रापि ग्रहरूपिणः॥ ३॥

शृंगोन्नतिर्जगत्सृष्टिस्थितिसंहृतयोऽपि च।
एतन्मे संशयं छिन्धि भगवन्नौषधीपते॥ ४॥

श्रुत्वा चैतत् त्रिलकेशश्चन्द्रमाः शौनकोदितम्।
प्रत्युवाच महाभाग इदं वचनमादरात्॥ ५॥

महर्षे त्वं समर्थोऽसि ज्ञातुमेतदशेषतः।
श्टणु शौनक वच्यामि शास्त्रं परमदुर्लभम्॥ ६॥

वेदांगमखिलं श्रेष्ठं यत्पृष्टोऽहं त्वया मूने।
दशगुर्वक्षरः प्राणः षड्भिः प्राणैर्विनाडिका॥ ७॥

तत्षष्ठया नाडिका प्रोक्ता नाडीषष्ठया दिवानिशम् ।
तत्त्रिंशताऽर्क्षमास: स्यात् सावनोऽर्कोदयैस्तथा ॥ ८ ॥

तयैन्दवस्तत्तिथिभि: संखान्त्या सौर उच्यते ।
तथा द्वादशभिर्मासैर्दिननाडी विनाडिका: ॥ ९ ॥

षष्टिर्मधुवसन्ताद्यैर्वत्सरास्तु ऋतुर्भवेत् ।
सुरासुराणां तद्दिव्यमहोरात्रं विपर्ययात् ॥ १० ॥

तत्षष्टि: षड्गुणा दिव्यं वर्षमासुरमेव च ।
चतुस्त्रिह्येकगुणितं पूर्वोक्तं दिव्यसंख्यया ॥ ११ ॥

द्वादशाब्दसहस्रं तु युगवर्षमिति क्रमात् ।
शतं तादृक् समं तेषामादौ सन्ध्याभिधीयते ॥ १२ ॥

सन्ध्यांशास्ते च तत्पूर्वापरधर्मे प्रवृत्तय: ।
सन्ध्यांसन्ध्यांशसहितं विज्ञेयं तच्चतुर्युगम् ॥ १३ ॥

कृतदीनां व्यवस्थेयं धर्मपादव्यवस्थया ।
चतुर्युगानां सैका स्यात् सप्तति र्मनुसम्भव: ॥ १४ ॥

सन्धीकृतमितस्यान्ते धात्रीपिण्डजलप्लव: ।
ससन्धयस्ते मनव: कल्पे ज्ञेयाश्चतुर्दश ॥ १५ ॥

कृतप्रमाण: कल्पादौ सन्धि: पञ्चदश स्मृत: ।
इत्थं युगसहस्रेण भूतसंहारकारक: ॥ १६ ॥

कल्पो ब्राह्ममह: प्रोक्तं शर्वरी तस्य तावती ।
परमायु: शतं तस्य तयाहोरात्रसंख्यया ॥ १७ ॥

सर्वेषामेव जीवानां शतमेवायुरुच्यते ।
तत्तच्छ्वासप्राणकालस्तमशेषविनिर्णय: ॥ १८ ॥

विकलानां कला षष्ठया तत्षष्ठया भाग उच्यते।
तत्रिंशता भवेद्राशिर्भगणो द्वादशैव ते॥ १९॥

प्राक्चरास्ते ग्रहास्तुंगाः पाताः प्रत्यक्चराः स्मृताः।
प्रत्यक्षभगणस्तेषां पौष्णान्ते भगनस्तथा॥ २०॥

कुजार्किगुरूशीघ्राणां सूर्यंज्ञोशानसां युगे।
पुर्णाम्बरनभोव्योमरद्वेदा भसञ्चयः॥ २१॥

रसाग्निसुरबाणाद्रिशैलार्थाः शीतगोस्तथा।
दंताष्टरसनन्दाभिनयनानि कूजस्य च॥ २२॥

ज्ञशीघ्रस्य नभस्तर्कखागत्र्यंकनगेन्दवः।
बृहस्पतेः खदस्राश्विवेदषड्वह्नयस्तथा॥ २३॥

शुक्रशीघ्रस्य तर्काद्रिवह्नाकृतिनभोऽद्रयः।
शनेर्भुजंगषट्पञ्चतर्काब्धिसितरश्मयः॥ २४॥

इन्दूच्चस्य त्रिकृत्यष्टभुजंगमपयोधयः।
नागाग्नियमदृग्वह्निहस्ताः पातस्य शीतगोः॥ २५॥

भूसावनदिनार्कस्य उदयादुदयास्तथा।
अष्टनेत्राष्टशैलेन्दु गोशैलाद्रिशरेन्दवः॥ २६॥

भानामष्टाक्षिसर्पाद्रित्रिद्विह्यष्टशरेन्दवः।
प्राग्यायिभगणोनास्ते यूगे तस्योदयः स्मृतः॥ २७॥

शशिमासा भवन्त्येव सुर्येन्दुभगणान्तरम्
चान्द्राः खाष्टखखव्योमखखाग्निव्योमषट्धराः॥ २८॥

षट्वह्नित्रिहुताशांकतिथयश्चाधिमासकाः।
तितिक्षया यमार्थाक्षिहृष्टव्योमशराश्विनः॥ २९॥

सहस्रगुणितं कल्पे यय्युगे तत्प्रकीर्त्यते ।
सूर्यमन्दस्य भगणाः कल्पे सप्ताष्टवह्नयः ॥ ३० ॥

कौजस्याब्धिनभोनेत्रा बौधास्याष्टर्तुवह्नयः ।
जीवस्य खखरन्ध्राणि शौक्रस्यार्थगुणेषवः ॥ ३१ ॥

गोग्नयः शनिमन्दस्य पातानामथ कीर्त्यये ।
कौजस्य मनुनेत्राणि बौधस्याष्टाष्टसागराः ॥ ३२ ॥

जीवस्य कृतशैलेन्दु शौक्रस्य त्रिनभोनव ।
शनिपातस्य भगणाः कल्पे यमरसर्तवः ॥ ३३ ॥

कल्पादौ खखवेदाद्रिकृतै र्यद्दिव्यहायनैः ।
सृज्यते विधिना विश्वं तङ्गेयादब्दसञ्चयात् ॥ ३४ ॥

अथ माहेश्वरासुख्यो दिवसे ब्रह्मणोऽधुना ।
सप्तमस्य मनोर्याता द्वापरान्ते गजाश्विनः ॥ ३५ ॥

खचतुष्कभुजंगाष्टशररन्ध्रनिशाकराः ।
सृष्टेरतीताः सूर्याब्दा वर्तमानात् कलेरथ ॥ ३६ ॥

मासीकृताब्दाश्चैत्राद्यैर्गतमासैर्युताः पृथक् ।
अधिमासहताः सूर्यमासैर्लब्धाधिमासकैः ॥ ३७ ॥

युक्ता दिनीकृता युक्तास्तिथिभिर्निहताः पृथक् ।
क्षयाहैश्चन्द्रमासाप्ता विशोध्यावमवासराः ॥ ३८ ॥

सावनो द्युगणः सूर्यादित्थं योऽसौ नगैर्हृतः ।
सूर्याद्यौ वासराधीशो लंकायामर्द्धरात्रिकः ॥ ३९ ॥

सिद्धपुर्यां तु मध्याह्ने यमकोट्यामिनोदये ।
वारप्रवृत्तिः सन्ध्यायां रोमकायामिति स्थितिः ॥ ४० ॥

राव्यर्द्धपरतो वाच्या प्रवृत्तिः पूर्वदेशजाः।
लंकायामन्यथा पश्चात्तद्देशान्तरकालतः ॥ ४१ ॥

वारप्रवृत्तेर्घटिका द्विघ्न्यो वाण हृताः क्रमात्।
पञ्चभिः खखदिनपातक्षेपावारादिभिः स्मृताः ॥ ४२ ॥

प्राक्पञ्चोद्धतशेषार्द्धे कालहोरेति नाडिकाः।
द्युगणस्त्रिंशता षड्घ्नषष्ट्या द्वित्रिहते फले ॥ ४३ ॥

सैके सप्तविशेषे ते मासवर्षपती क्रमात्।
यथा खभगणघ्नाहा भगणादिग्रहाकुहैः ॥ ४४ ॥

द्युगणो भगणाभ्यस्तो भगणादि कुवासरैः।
भगणेभ्यस्तथा भुक्तिः पातश्चक्राद्विशोधिताः ॥ ४५ ॥

गुरोरतीतभगणा द्वादशघ्ना गृहैर्युताः।
वर्तमानैर्गतेभ्योब्दा विजयाद्याः खषट्हृताः ॥ ४६॥

लंकामेर्वन्तराभ्यस्ताः काञ्ची लोहितकं सरः।
अवन्तीवत्सगुल्मौ च तत्परीतेन्दुतेग्रहाः ॥ ४७॥

उन्मीलनादतीताद्वा दृक्सिद्धं गणितागतात्।
यदा तदा मध्यगस्य स्वस्थानं प्रत्यागन्यथा ॥ ४८ ॥

देशान्तरघ्नाः षष्टिघ्नाः स्वभूपरिधिना हृताः।
तन्नाडिका स्यात्तद्द्यात्ताभ्य एव तदन्यथा ॥ ४९ ॥

तालवर्गो महीकर्ण स्तद्वर्गाद्दशताडितात्।
मूलं भूपरिधिस्थोऽयं लम्बज्याघ्नस्त्रिभाज्यया ॥ ५० ॥

भक्तः स्वकस्तेन भुक्तिर्देशान्तरहता हृता।
लिप्तादि प्रागृणं पश्चात् स्वंगते स स्वकः स्मृतः ॥ ५१ ॥

स्वदेशजा ग्रहास्तेपि मध्यरात्रिभवा: स्वके।
इष्टनाडोहता भुक्ति: षष्टया स्वर्णं गतैष्ययो: ॥ ५२ ॥

वक्रिण: फणिपा: पश्चात्प्राग्यायी व्योमग: स्वक:॥ ५३ ॥

इति श्रीसोमसिद्धान्ते चतुर्थे शौनकप्रश्ने मध्यमाधिकार: प्रथम: ॥

द्वितीयोऽध्याय:
स्पष्टाधिकार:

भचक्रात् षसावत्यंशा: समभूया च सैव हि।
आद्याग्रखण्डद्वीपार्द्धे पिण्डज्या तद्दलाभिधा ॥ १ ॥

प्रथसज्याप्तखण्डेन खण्ड: खण्ड: परस्य च।
अन्यापरज्योत्यखण्डा ज्याश्चतुर्विं शतिश्च हि ॥ २ ॥

उत्क्रमात् पिण्डका: खण्डा उत्क्रमज्याप्तपिण्डका:।
यदोत्कमेण ज्योनान्त्या ज्यार्द्धपिण्डा: क्रमादमी ॥३॥

तस्यनेत्राणि गोब्ध्यब्धिस्तथारूपनगर्तव:।
खांकाष्टौ बाणशून्येशा: शरचन्द्रगुणेन्दव: ॥ ४ ॥

कृतिवाणेन्दवो गोभूमहीधरहिमांशव:।
दिगंकचन्द्रास्त्रिनवनखा: सप्तर्त्तुदृक्करा: ॥ ५ ॥

चन्द्रानलाब्धियमला बाणनागशराश्विन:।
अष्टाश्विनगनेत्राणि नन्दपञ्चभगाश्विन: ॥ ६ ॥

नागाद्रिनवनेत्राणि कृताष्टगगनानला:।
सप्तात्यष्टिगुणास्तर्कपञ्चनेत्रहुताशना: ॥ ७ ॥

प्रकृतित्रिदश नेत्रमुनिदेवा यथाक्रमाः ।
नवाम्बराब्धिबहुला रूपाग्निकृतपावकाः ॥ ८ ॥

इभत्रिगत्यवस्थाश्चोत्क्रमज्यां प्रब्रवीस्यथ ।
शैला नवाश्विनस्तर्करसा मुनिपिनाकिनः ॥ ९ ॥

द्विधृतिः क्ष्मोत्कृतिर्वेदार्थत्रि पूर्णरसाब्धयः ।
गोड्र्यर्था दिक् नगास्त्र्यर्थद्वीपाः शैलवियद्दिशः ॥१०॥

क्ष्मात्यष्टिचन्द्रा बाणाब्धिविश्वेऽष्टाश्विशरेन्दवः ।
अतिधृत्यद्रिशशिनो धृतिनन्दनिशाकराः ॥ ११ ॥

त्रिहस्तशशिनेत्राणि देवपावकवाहवः ।
अष्टाब्धितत्त्वं शैलर्तुभान्यंकाष्टनवाश्विनः ॥ १२ ॥

गुणचन्द्रद्विदहना वसुत्रिकृतवह्नयः ।
ग्रहं स्वतुंगात् संशोध्योच्छिष्टं केन्द्रं पदे समे ॥ १३ ॥

गम्या दोर्ज्या गतात्कोटिरोजे पादेऽन्यथा भवेत् ।
लिप्ता हृता तत्त्वयमैः शिष्टजान्तरयोर्वधात् ॥ १४॥

तत्त्वाश्विभिः फलं योज्यं गतज्यायां कलादिकम् ।
रवेर्मन्द परिध्यंशा मनवो यमलाग्नयः ॥ १५ ॥

अर्थादयो वेदगुणाः सुराः सूर्या नवार्णवाः ।
कुजादीनामथो शैघ्र्या विषयानलदस्रकाः ॥ १६ ॥

गुणविश्वे खशैलाश्च ह्युत्कृतिर्नवपावकाः ।
षट्तन्विन्दुहृता दोर्ज्या ज्ञेया वृत्ता कूजस्य तु ॥ १७ ॥

अर्केन्द्वोर्मनुवह्न्याभ्रशशांकैश्च त्रिभज्यया ।
अन्येषां ज्ञोच्चमान्देऽथ शैघ्र्ये शुक्रे ज्ञभूभुवाम् ॥ १८ ॥

एकज्यया ऋणं शैघ्र्ये जीवाक्योस्तद्धनं भवेत् ।
स्फुटवृत्तहते वाहुकोटिज्ये भगणांशकैः ॥ १९ ॥

फलज्यो मन्दजो चापं भुजात् फलकलाः स्मृताः ।
मृगकर्क्यादिजस्वर्णव्यासआर्द्धे शीघ्रकोटितः ॥२०॥

फलज्यातो दोःफलज्या वर्गैक्याद्यत् पदं श्रुतिः ।
दोःफलज्या त्रिजीवाघ्नी श्रुत्याप्तं स्यात्तु तद्धनुः ॥२१॥

शैघ्र्यं तद्दोःफलं प्रोक्तं चापानयनमुच्यते ।
आसन्नज्याथवा शिष्टं शिष्टं तत्त्वाश्विभिर्हतम् ॥ २२ ॥

शुंगाशुंगज्यान्नराप्तं शुंगज्यासंख्यया हतैः ।
तत्त्वाश्विभिः समायोज्यं धनुर्लिप्ताः प्रकीर्त्तिताः ॥२३॥

स्वर्णं वाहुफलं केन्द्रे मेपजूकादिके ग्रहे ।
शीघ्रार्द्धमन्दार्द्धखगे फलार्द्धं कृतसञ्ज्ञकः ॥ २४ ॥

मध्ये शैघ्राफलस्यार्द्धं मान्दमर्द्धफलं तथा ।
शैघ्यार्द्धं मध्यगे मन्दे मान्दं शीघ्रफलै क्रमात् ॥ २५॥

भौमादीनामयं मार्गो मन्दकर्मैकमन्ययोः ।
भानुबाहुफलाभ्यास्ता ग्रहभुक्तिः समुद्धृता ॥ २६ ॥

लिप्ताभचक्रलिप्ताभिरर्कवत् खचरेऽपि तत् ।
नात्यन्तरादृग्ग्रहयोः षष्टिघ्नं शेषलिप्तिकाः ॥ २७ ॥

तद्युतं केन्द्रभुक्तेर्वा ग्रहवन्मन्दकर्मणि ।
यत् फलं कर्किनक्रादौ स्वर्णं तज्ज्योतिषां गतौ ॥२८॥

शीघ्रकेन्द्रगतिस्त्रिज्याज्ञुस्मा कर्णोद्धृता ऋृणम् ।
शीघ्रोच्चभुक्तेः स्याद्भुक्तिर्वक्रभुक्तिर्विपर्यये ॥ २९ ॥

तद्गुणं मध्यभूक्तिश्च हित्वा शीघ्रोच्चभूक्तितः ।
शेषार्द्धमध्यभूत्यैक्यं शीघ्रार्द्धगतिरुच्यते ॥ ३० ॥

युगे च षट्शतैकत्वे भचक्रं प्राक् च लम्बते ।
तद्गुणो भूदिनैर्भक्तो द्युगणोऽयनखेचरः ॥ ३१ ॥

तच्छुद्धचक्रदोर्लिप्ता द्विशत्याप्तायानांशकाः ।
संस्कार्या जूकमेषादौ केन्द्रे स्वर्णं ग्रहे किल ॥ ३२ ॥

तत्संस्कृतग्रहात् क्रान्तिलग्नमप्युन्नतिः स्फूटा ।
हरिनकालभागाश्च लग्नं यस्तं तु साधयेत् ॥ ३३ ॥

ग्रहदोर्ज्याद्रिगोविश्वैर्हता त्रिज्योद्धृता धनुः ।
तस्याः क्रान्तिरूदग्याम्या तत्पूर्वापरभागजा ॥ ३४ ॥

क्रान्त्यन्तक्षेपमानेन ग्रहाणां सञ्चरं कियत् ।
तुलाभिन्नककुप्क्रान्तिक्षोपयोगान्तरं क्रमात् ॥ ३५ ॥

शुक्रज्ञपातयोर्मान्दं फलं मान्दं तृतीयकम् ।
चतुर्थं ग्रहवच्छैघ्र्यं पातेष्वर्काङ्गिरोसृजाम् ॥ ३६ ॥

पातान् ग्रहेभ्यः शीघ्रोच्चात् प्रोह्य दोर्ज्या ज्ञशीतयोः ।
चन्द्रात् खतारकैः खांकैः खार्कैः षष्टया स्वभास्करैः ॥३७॥

नभोर्कैस्ताडयेदन्त्यचलकर्णै स्वकैर्भजेत् ।
विज्ययेन्दोः फलधनुर्विक्षेपः क्रान्तिवत्ककुप ॥ ३८ ॥

क्रान्तिज्या विषुवद्भाघ्नी त्रिसप्तशरसंगुणा ।
क्रान्तेः कोटिज्यया भक्ता द्विघ्नं यातरहासवः ॥ ३९ ॥

तच्चापं स्वादिनाब्धांशे स्वर्णं याम्येऽन्यथोत्तरे ।
क्षेपा दिनार्द्धे क्रमशो भानामपि विजिस्त्रयम् ॥४०॥

ग्रहोदयप्राणहता राशिलिप्ताहृता गतिः ।
स्वाहोरात्रासुभिः स्वर्णं चक्रासुर्त्र्कृजुवक्रितः ॥ ४१ ॥

अर्कोनचन्द्रलिप्ताभ्यस्तिथयो नखपर्वतैः।
गतगम्या च षष्टिघ्ना नाडयो गत्यन्तरोद्धृताः ॥ ४२ ॥

ध्रुवाणि शकुनं चैव चतुष्पान्नागमर्द्धं तः ।
किंस्तुघ्नं कृष्णभूतायाश्चत्वारि करणानि च ॥ ४३ ॥

ववादीनां ततः सप्त चराख्यकरणानि तु ।
मासेऽष्टकृत्त्व एकैकं करणानां प्रकल्पयेत् ॥ ४४ ॥

तिथ्यांगभोगं सर्वेषां करणानां प्रकल्पयेत् ।
गतगम्यगताराशेर्गत्या हानिस्तु संक्रमे ॥ ४५ ॥

संस्कृतायनभागार्कसंक्रमस्त्वयनं किल ।
स्नानदानादिषु श्रेष्ठं मध्यमं स्थानसंक्रमः ॥ ४६ ॥

ग्रहलिप्ताष्टशत्या भं गम्याहानिगतैष्यकम् ।
तथार्केन्दुयुतेर्योगो गत्यैकन दिनानि तु ॥ ४७ ॥

इति श्रीसोमसिद्धांते स्पष्टाधिकारो द्वितीयः ॥

तृतीयोऽध्यायः
त्रिप्रश्नाधिकारः

छाया वैषुबती या सा नाम माध्याह्निकी च सा ।
तथार्केण हिते त्रिज्ये विषुवत्कर्णभाजिते ॥ १ ॥

अक्षज्यालम्बजीवे तच्चापे याम्येक्षलम्बने ।
शङ्कुच्छायाकृतियुतेर्मूलं कर्णोऽन्यथापि वा ॥ २ ॥

तुल्यभिन्नदिगक्षांशक्रान्त्योर्विश्लेषणं नतम् ।
तद्दोस्तिज्ये हते सूर्ये कोट्या च हरभाश्रुती ॥ ३ ॥

सौम्याक्षोना यदाक्रान्तिरक्षज्या द्वादशाहता ।
क्रान्तिज्याप्ता श्रुतिर्भानौ प्राचीरेखां समागते ॥ ४ ॥

सममण्डलकर्णाप्ता एतद्द्वादशसंगुणा ।
सममण्डलशङ्कु स्यादक्षज्यागुणिता नरः ॥ ५ ॥

परमापक्रमज्याप्ता भुजज्या तद्धनू रविः ।
क्रान्तिज्येष्टश्रुतिघ्ना च लम्बाप्ताग्राङ्गुलादिका ॥६॥

विषुवत्या तद्धनर्णं याम्ये स्यादुत्तरे भुजे ।
अन्यथा वा भुजोऽनेन दिशां संसाधनं ब्रुवे ॥ ७ ॥

क्रान्तिज्याविषुवत्कर्णबधोर्कैरग्रमौर्विका ।
त्रिज्यावर्गार्द्धतोग्रज्यावर्गोनाद् द्वादशाहतान् ॥ ८ ॥

पुनर्द्वादशनिघ्नाच्च लभ्यते यत्फलं बुधैः ।
शङ्कुवर्गार्द्धसंयुक्तविषुवत्कर्णभाजिता ॥ ९ ॥

लब्धं तु करणी नाम तां पृथक् स्थापयेत्तु सः ।
विषुवच्छायार्कबधादग्रज्यासंगुणात्तथा ॥ १० ॥

भक्ता फलाख्यं तद्वर्गसंयुक्ताकरणीपदे ।
फलेन हीनसंयुक्तं दक्षिणोत्तरगोलयोः ॥ ११ ॥

याम्ययोर्विदिशोः शङ्कुरेव याम्योत्तरे रवौ ।
उदक्चरति तस्यार्के शङ्कुस्तूत्तरयोस्तु सः ॥ १२ ॥

तत्त्रिज्यावर्गबिश्लेषान्मूलं दृग्ज्याभिधीयते ।
स्वशङ्कुना विभज्याप्ते दृक्त्रिज्याद्वादशाहते ॥१३॥

छायाकर्णौ तु कोणेषु यथा स्वं देशकालयो: ।
कोणप्रभागकृतिदलं यं हत्वा त्रिभज्यया ॥ १४ ॥

क्रान्तिज्याकोणकर्णाप्तं तच्छायामानकं भवेत् ।
दृग्ज्या स्यात्कृतितस्त्यक्ता त्रिज्याबर्गात्पदं च यत् ॥ १५ ॥

उदक्चरज्यया युक्ता त्रिज्यया याम्ययोनिता ।
नतोत्क्रमज्यया हीना क्रान्ते: कोटिज्यया हता ॥ १६ ॥

त्रिज्याप्ता द्वादशगुणा विषुवत्कर्णभाजिता ।
शङ्कु: पूर्ववदेवादिछायाकर्णौ स्वकाधिके ॥ १७ ॥

अभीष्टच्छाययाम्यस्ता त्रिज्या तत्कर्णभाजिता ।
दृग्ज्या तत्प्रतिलोमेऽधो नतज्याद्योदयोनता: ॥ १८ ॥

तदुत्क्रमधनु:पूर्वापरज्यास्युर्नतासव: ।
मध्यच्छाया मध्यभुजा त्रिज्याप्ता तच्छ्रवोद्धृता: ॥ १९ ॥

नतज्या स्यान्नतबधस्तत्तथाहोप्रतिस्थिता ।
तत्सूर्यनभलिप्ताश्च तदीयक्रान्तिलिप्तिका: ॥ २० ॥

दिक्मेदे मिश्रिता: साम्ये विशिष्टाश्चाक्षलिप्तिका : ।
तज्जयाकोटिभुवे जीवे अक्षलम्बनमौर्विके ॥ २१ ॥

अक्षज्यार्कहता भक्ता लब्धं या विषुवत्प्रभा ।
भिन्नतुल्यवधाक्षैक्यविश्लेषज्याक्रमाभिधा ॥ २२ ॥

त्रिज्याप्ता मुनिगोविश्वेधनुभाकजिभत्रयो: ।
कर्क्यादौ प्रोह्य चक्रार्द्धात्तुलादौ भार्द्धसंयुते ॥ २३ ॥

तुलादौ प्रोह्य भगणान्मयमेषादिनायकै: ।
प्राक्चक्रं चलितं हीना छायार्कात् करणागतात् ॥ २४ ॥

पश्चादितगवास्वर्णं चलांशास्तद्दिनान्तरा ।
छायार्कगतसंशुद्धं छायार्कोमयलिप्तिका: ॥ २५ ॥

देशान्तरकलाभानामनुपातात्तथोत्तरा ।
छायादो:कृतिविश्लेषान् मूलं शङ्कुस्तथा विधौ ॥ २६ ॥

शङ्कुच्छाया समस्थाने कल्प्यमाद्वादशाङ्गुलम् ।
तच्छयाग्रं भुजव्यस्ता दिशं शङ्कुभुजाश्रयो: ॥ २७ ॥

स्थूलशङ्कुश्च प्रसार्ये मध्ये तत्तलशङ्कुना ।
प्राचीरेखां विलिख्येदं वृत्तं तस्माच्च मध्यत: ॥ २८ ॥

तिमिना याम्यसौम्या च विदिग्रेखे च युक्तित: ।
चतुरस्रं बहि: कुर्यात् सूत्रैर्मध्याद्विनि:सृतै: ॥ २९ ॥

तथा दिशं भुजा: प्राची रेखार्द्धैश्च सामाहता: ।
वाहुद्वयान्तरे यत्स्यादयातयुतिवद्धनु: ॥ ३० ॥

बिन्दुत्रयस्पृक्सूत्रेण स्फुटच्छायाभ्रमं सदा ।
खागाष्टयोऽर्थगोगैका: शरत्यंकहिमांशव: ॥ ३१ ॥

क्रमोत्क्रमादध:स्थाप्य मेषाल्लंकोदयासव: ।
स्वदेशचरखण्डोना मृगाद्या: कर्कटादय: ॥ ३२ ॥

स्वदेशचरखण्डान्या: स्वोदयादनुपातत: ।
लग्नमेतैर्मध्यलग्नं नतैर्लंकोदयासव: ॥ ३३ ॥

लग्नग्रहान्तरप्राणा विज्ञेया: कालसाधने ।
सूर्यादूने निशाशेषाल्लग्नार्कादधिके दिवा ॥ ३४ ॥

भचक्रार्द्धयुता भानोरधिकास्तमानात् परम् ॥ ३५ ॥

इति श्रीसोमसिद्धान्ते त्रिप्रश्नाधिकारस्तृतीय: ॥

चतूर्थोऽध्याय:
चन्द्रग्रहणाध्याय:

योजकानां पञ्चषष्टि: शतघ्ना भास्करस्य तु ।
विष्कम्भो मण्डलस्वेन्दो: साशीति चतु:शती ॥ १ ॥

मध्यगत्या हृता स्पष्टगतिघ्रा व्यासकौ स्फुटौ ।
स्फुटार्कमण्डलकला सोमस्वभगणाहता ॥ २ ॥

स्यादाजभागणैर्भक्ता इन्दो: षष्टिस्तदाननम् ।
भास्वदासकलाश्चन्द्रकक्षायां तिथियोजनै: ॥ ३ ॥

स्फुटार्कभुक्तिर्भूव्यासगुणिता मध्ययोद्धृता ।
लब्धं सूची महीव्यासस्फुटार्कश्रवणान्तरम् ॥ ४ ॥

मध्येन्दुव्यासगुणितं मध्यार्कव्यासभाजितम् ।
विशोध्य लब्धं सूच्यास्तु तमो लिप्तास्तु पूर्ववत् ॥ ५॥

भचक्रोर्द्धो भवेद्धृता तथार्केण प्रचलिता ।
उरगे ग्रहणं यद्वा क्रियाभार्द्धाधिकोनेके ॥ ६ ॥

छादकोऽर्कस्य शीतांशुरध:स्थो घनवद्भवेत् ।
भूच्छायाच्छादकश्चन्द्रश्चाद्येन्यत्र परिस्थित: ॥ ७ ॥

पर्वान्तकेन्दुविक्षेपं प्रोह्य भुभाशशांकयो: ।
मानैक्यार्द्धाद्ग्रहणं स्यादन्यथा मध्यकालकम् ॥ ८ ॥

पक्षान्तं दोर्मध्यकालं यथार्कस्य तथा नहि ।
मासान्तर तद्बिम्बं मध्यस्थाकाशदर्शनात् ॥ ९ ॥

प्राक्पश्चाल्लम्बनेनोनयुक्तं मासान्त एव तत् ।
मध्यकालस्तु तद्वच्च स्पर्शमोक्षेति चारणात् ॥ १० ॥

किम्भाहराङै सुर्येन्द्वोर्दक्षिणोत्तरसंस्थयो: ।
बिम्बमध्यगतं व्योम नहि लम्बनकारणम् ॥ ११ ॥

पूर्वापरस्थयोर्विम्वमध्ययोररन्तरापरम् ।
कालहेतुरतो लग्नं ज्या न्त्यापक्रमसंगुणा ॥ १२ ॥

लम्बज्याप्तोदयज्येष्टमध्यलग्ननतज्यया ।
हता त्रिभज्यया भक्ता वर्गयोश्च न तज्ययो: ॥ १३ ॥

बिश्लेषान्मूलमुच्येत दृक्क्षेप इति संस्कृतिम् ।
प्रोह्य त्रिज्याकृतेर्मूलं टृग्गतिज्यानया हर: ॥ १४ ॥

एकज्यामध्यतोवर्गलग्नार्कान्तरतोशुभ: ।
छेदेन भक्तो नाडयादि लम्बनं चण्द्रसूर्ययो: ॥ १५ ॥

असकृत् कर्मणानेन मध्यकाले स्थिरीकृते ।
दृक्क्षेपात् सप्तवर्गघ्नात् त्रिज्ययावनतिर्भवेत् ॥ १६ ॥

मध्यलग्ननतांशाक्या दिक्तुल्येन्तरदृकया ।
नत्या तत्क्रान्तिरित्येतच्चन्द्रे क्षेप: स्फुट: स्मृत: ॥ १७ ॥

तत्प्रोह्यर्केन्दुमानैक्यदलाच्छन्नं विवस्वत: ।
ग्राह्यग्राहकमानैक्यविश्लेषार्द्धकृते: पदम् ॥ १८ ॥

विक्षेपवर्गहीनाद्यत्षष्टिघ्नं चन्द्रसूर्ययो: ।
भुत्त्यन्तरेण स्थित्यर्द्धं विमर्दार्द्धं क्रमेण च ॥ १९ ॥

तदूनपक्षमासान्तात् स्पर्शनं च निमीलनम् ।
अर्कदारसकृच्चैव मोक्षोन्मीलनमन्यथा ॥ २० ॥

भानोस्तल्लम्बनेनैव कला: स्पष्टा: स्युरेव हि ।
मध्येन या तया स्पष्टस्थित्यर्द्धं स्पर्शसोक्षयो: ॥ २१ ॥

इष्टमध्यान्तरा नाड्या ताडिता रविचन्द्रयो: ।
गत्यन्तरेण षष्टयाप्ता: कोटिलिप्ता रवेस्तु ता: ॥ २२ ॥

मध्यस्थित्यर्द्धगुणिता स्पष्टस्थित्यर्द्धभाजिता: ।
स्फुटस्थिरे क्षेप वर्गैक्यान्मूलं कर्णोत्तरे पदम् ॥ २३ ॥

मानयोगार्द्धत: प्रोह्य ग्रासस्तात्कालिको भवेत् ।
इष्टग्रहणकालस्तु व्यत्ययो नोक्तमार्गत: ॥ २४ ॥

अक्षभाघ्रा नतज्याक्षकर्णाप्ता तस्य कार्मुकम् ।
वेलांशास्तस्य याम्यो स्ते पूर्वापरकपालयो: ॥ २५ ॥

सत्रिराशिग्रहक्रान्त्या युतोनास्तुल्यबिम्बयो: ।
दिशोजविमला प्राग्वत्त्वङ्गुलान्यभखादिभि: ॥ २६ ॥

दिनार्द्धप्राण एकोनधृत्या तच्छन्नलिप्तिका: ।
बिम्बक्षेपादिलिप्ताश्च भवन्त्येवाङ्गुलानि तु ॥ २७ ॥

स्वच्छत्वाद् द्वादशांशोपि ग्रस्तश्चन्द्रस्य दृश्यते ।
लिप्तात्रयमपि ग्रस्तं तीक्ष्णत्वान्न विवस्वत: ॥ २८ ॥

सूर्योदयास्तसमये युक्तच्छन्नोपि भास्करः ।
पितृभक्तिविहीनानां तीक्ष्ण सन्तति लापयेत् ॥ २९ ॥

इति सोमसिद्धान्ते चतुर्थप्रश्ने चन्द्रग्रहणाध्यायः ॥

पञ्चमोऽध्यायः
परिलेखाध्यायः

छेद्यकेत विना यस्मान्न ज्ञेयो यदुपप्लवे ।
विशेषोत्र प्रवक्ष्यामि छेदकज्ञानमुत्तमम् ॥ १ ॥

समस्थले न्यस्तविन्दुः समः स्वर्णाङ्गुलेन तु ।
विम्बयोगार्द्धमानेन ग्राह्यार्द्धेन यथाक्रमम् ॥ २ ॥

लिखेद्वृत्तत्रयं कोष्ठे यथोक्तं साधयेदपि ।
प्रागिन्दोर्ग्रहणं पश्चान्मोक्षोर्कस्य विपर्ययात् ॥ ३ ॥

प्रागर्द्धाधिकस्य वृत्तस्य बलनं तद्यथादिशम् ।
प्रत्यगग्रेन्यथा रेखे मध्ये तद्वलनाग्रतः ॥ ४ ॥

नीत्वा रेखामध्यवृत्तयोगात् क्षेपं यथादिशम् ।
रवीन्द्वोर्विवरान्तस्तं मध्यसूत्रे तदग्रतः ॥ ५ ॥

तत्सूत्रे ग्रहसंयोगाङ्गासमोक्षौ विनिर्दिशेत् ।
वलनक्षेपदृक्तुल्यबलेन प्राङ्मुखं नयेत् ॥ ६ ॥

भेदे पश्चान्मुखं राज्ञ स्तदर्कस्य विपर्ययात् ।
तदग्रान्मध्यगे सूत्रे मध्यक्षेपं तदग्रतः ॥ ७ ॥

ग्राहकाद्धेन तद्बिम्बेनोपरागस्य मध्यमः ।
ब्यपक्षेपत्रयाग्रे तु यत्तदा ग्राहकः शशी ॥ ८ ॥

मानैक्यार्द्धेष्टग्रहणं शेषतुल्यशलाकया।
ग्राहकमध्यादस्य मार्गे निर्दिष्टस्थानतोऽनुय: ॥ ९ ॥

छाया ग्राहकबिम्बेन ग्रहणं स्फुटमादरात्।
सर्वदा भास्करच्छन्नं कृतं त्वर्यान्तु शीतागो: ॥ १० ॥

धूम्रं कृष्णं कृष्णताम्रं कपिलं पदशो भवेत्।
रहस्यमेतद्देवानां सुशिष्याय प्रदीयते ॥ ११ ॥

पटोपरि लिखितज्ञांस्तद्धरयथादिशम्।
दिशोर्यान्ति तथा काष्ठां कल्पायेदिति मे मतम्॥ १२ ॥

इति श्रीसोमसिद्धान्ते चतुर्थे प्रश्ने परिलेखाध्याय: ॥

षष्ठोऽध्याय:
नक्षत्रग्रहसमागमाध्याय:

भवन्त्यतीतधिष्ण्यानां भोगलिप्तायुता ध्रुवा: ।
अष्टाब्धयो वियद्वेदा: शरतर्का: मुनीष व: ॥ १ ॥

इभार्था गोब्धयोष्टांगा: षडश्वा: श्रुतिभूमय: ।
वेदार्था: सागररसा: शून्यबाणा: भोरसा: ॥ २ ॥

चत्वारिशद् युगनगा: गजागा: सारारर्त्तव: ।
मनवश्च षट्श्रुतयो वैश्वमाप्यर्द्धभोगगम् ॥ ३ ॥

आप्यस्यैवाभिजित्प्रान्ते वैश्वान्ते श्रवण: स्थित: ।
श्रवणस्यान्त्यपादो वा श्रविष्टाया: स्वभोगत: ॥ ४ ॥

नभोनागाश्च षड्वर्गो द्विद्विका नगपर्बता: ।
क्रान्ते: क्षेपलवास्तेषां दश द्वादश पञ्च च ॥ ५ ॥

उदमास्ये पञ्चदश नव सौम्ये रसानभः ।
साम्येन्दव उदग्भागे वियत्सूर्यास्त्रयोदश ॥ ६ ॥

याम्ये रुद्राश्च यमलाः सौग्यभागे नगाग्नयः ।
याम्येध्यर्द्धत्रयो वेदा नव सार्द्धेषव शराः ॥ ७ ॥

उदक्षष्टिः खाग्नयश्च षट्त्रिंशदथ दक्षिणाः ।
अध्यर्द्धभागः सौम्यायां चतुर्विंशतिरूत्कृतिः ॥ ८ ॥

खं चागस्त्याशीतिभागैर्याम्ये क्षीणे यमाङ्गतः ।
साखेवैर्यमविंशाशे मृगव्याधस्तु दक्षिणे ॥ ९ ॥

हुतभुक् ब्रह्महृदयं वृषे द्वाविंशभागगौ ।
अष्टभिस्त्रिंशता चैव विक्षिप्तावुत्तरेण तौ ॥ १० ॥

पूर्वास्यां ब्रह्महृदयादंशकैः पञ्चभिः स्थितः ।
प्रजापतिर्वृषान्ते तु सौम्येष्टत्रिंशदंशकैः ॥ ११ ॥

अपांवत्सस्तु चित्राया उत्तरे शैस्तु पञ्चभिः ।
बृहत्किञ्चित् ततो भागैरापः षड्भिस्तथोत्तरे ॥ १२ ॥

इति तारग्राहाणां स्युर्ध्रुवसंख्यानमेव हि ।
प्रयोजनविशेषोस्ति न जाने तत्र गण्यते ॥ १३ ॥

वृषे सप्तदशे भागे यस्य याम्योंशकद्वयात् ।
विक्षेपोभ्यधिको भिन्द्याद्रोहिण्याः शकटं तु सः ॥ १४ ॥

ताराग्रहाणामन्योन्यं युद्धे वाथ समागमः ।
समागमं चन्द्रधिष्ण्यैः सूर्येणास्तमयः सह ॥ १५ ॥

मन्दशीघ्राधिकानेता संयोगे गतगम्ययोः ।
कालयोर्वक्रिणोर्व्यस्तं प्राग्यायिन्योधिको गतः ॥ १६ ॥

भुत्यन्तरेण भुक्तिघ्ना ग्रहान्तरकलाहृता।
एकस्मिन् भुक्तियोगेन वक्रिण्यस्तु समेधिका: ॥ १७ ॥

ग्रहान्तरकलास्तद्वद्भुक्तयोगदिनानि हि।
विक्षेपो विषुवद्धाग्र: सूर्याप्तो नतसंगुण: ॥ १८ ॥

दिनार्द्धाप्त उदक्क्षेपे स्वर्णं पश्चिमपूर्वयो: ।
दक्षिणा: प्राक्प्रतीच्यास्ते तद्दृक्कर्म ग्रहस्तु सः ॥ १९॥

सबिम्ब ग्रहजक्रान्तिक्षेपघ्नास्त्रिज्यया हृता।
षट्कृत्याप्ता ध्रुव: स्वर्णं भादिशोर्भिन्नतुल्ययो: ॥ २०॥

द्वितीयमेतद् दृक्कर्म केचिन्नेच्छन्ति सूरय: ।
समलिप्त्यो: पुनः कार्यावेतौ दृक्कर्मयुग्ग्रहौ ॥ २१ ॥

एतयोर्भिन्नतुल्यांशाक्षेपैक्यान्तरतोधिके।
मानैक्यार्द्धे भवेतां तु तुल्यस्पर्शेन्यथान्यथा ॥ २२ ॥

भागान्यं परितो लब्धघ्नाश्विवृत्यांशाविरश्मय: ।
ग्रहान्तरैकविक्षेपे भागे तस्मिन् समागम: ॥ २३ ॥

युद्धमंशुविमर्दाख्यं परव्यासमतोनके।
एकोत्र चेदणुर्द्वौचेदत्र स्थूलौ समागमौ ॥ २४ ॥

अंशाधिके तौ प्रवलौ यदि स्यातां समागमौ।
अंशाधिके तु तौ स्वल्पौ विध्यस्तौ कूटविग्रहौ ॥ २५ ॥

स्थूलो जयी रश्मिमांश्च जितो यो गुरुदीप्तिमान्।
उदक्स्थो दक्षिणस्थो वा भार्गव: प्रायशोजयी ॥ २६ ॥

वेदोग्रयो ह्यष्टयोष्टा षष्टिर्गजाब्धय: ।
विष्कम्मश्चन्द्रकक्षायां भौमादीनां यथाक्रमम् ॥ २७ ॥

एकज्याघ्नाश्चतुर्घ्नास्ते द्विचतुष्कर्णभाजिता: ।
स्फुटव्यास: पञ्चदशविभक्ता मानलिप्तिका: ॥ २८ ॥

एकज्याद्विगुणास्तेंशा भुक्ता वा बिम्बबोजनम् ।
भौमादीनां तु मार्गोयमेवानुक्ते: पुनः स्फुट: ॥ २९ ॥

स्वदृष्टनतानतस्थाने यथा दिक्भ्रमणं समे ।
शङ्कुद्वये स्थापिते तच्छायामार्गान्तरं गत: ॥ ३० ॥

छायादिशि स्वशक्तग्रे दर्पणस्थं मुखं यथा ।
तथा पश्येद् ग्रहं ताराविक्षेपान्तसमन्विते ॥ ३१ ॥

फाल्गुन्योर्भादपदयोस्तथैवाषाढ़योर्द्वयो: ।
विशाखाश्विनिसौम्यानां योगतारोत्तरा स्मृता ॥ ३२ ॥

पश्चिमोत्तरतारायां द्वितीया पश्चिमे स्थिता ।
हस्तस्य योगतारासौ श्रविष्ठायाश्च पश्चिमा ॥ ३३ ॥

ज्येष्टाश्रवणमैत्राखां वार्हस्पत्यस्य मध्यमा ।
भरण्याग्नेयपिल्याणां रेवात्याश्चैव दक्षिणा ॥ ३४ ॥

रोहिण्यादित्यमूलानां प्राची सर्पस्य चैव हि ।
यथा प्रत्यवशेषाणां स्थूला स्याद्योगतारका ॥ ३५ ॥

इति श्रीसोमसिद्धान्ते चतुर्थे नक्षत्रग्रहयुद्धसमागमाध्याय: षष्ठ: ॥

सप्तमोऽध्याय:
ग्रहोदयास्तमानाधिकार:

अथार्कांशुसमाक्रान्तमूर्तीनामल्पतेजसाम् ।
उदयास्तगते यौ तत्परिज्ञानं प्रकीर्त्यते ॥ १ ॥

अवक्रिणादे: सूर्यादिभादिका: शीघ्रगस्ततः ।
पश्चाद्यान्त्युदयं प्राच्यामूनमस्तं परेन्यथा ॥ २ ॥

सूर्यास्तकालिकौ पश्चात्प्राच्यामुदयकालिकौ ।
दिवाकरग्रहौ कुर्याद् दृक्कर्माथ ग्रहस्य तु ॥ ३ ॥

उभयोरन्तरप्राणा: षष्टया कालांशकाहृता: ।
सषड्भयो: प्रतिच्यां तु मार्गोयं ज्योतिषामापि ॥ ४ ॥

अस्तांशाश्चन्द्रभौमाद्या: अत्यष्टिमुनिरीश्वरा: ।
आशास्थितिं क्रमात्प्रोक्ता: सूर्याद्ये कालजास्त्विमे ॥ ५ ॥

ज्ञशुक्रयोर्महत्त्वात्ते सूर्यो अष्टौ च व क्रिणौ ।
स्वात्यगस्त्यमुनिर्व्याधाच्चित्रा ज्येष्ठा पुनर्वसू ॥ ६ ॥

अभिजिद् ब्रह्म हृदयं त्रयोदशभिरंशकै: ।
हस्तश्रवणफाल्लुन्य: श्रविष्टा रोहिणी मधा ॥ ७ ॥

चतुर्दशांशकैर्दृश्या विशाखाश्विनदैवतै: ।
कृत्तिकामूलमैत्राणि सार्परौद्रर्क्षमेव च ॥ ८ ॥

दृश्यन्ते पञ्चदशभिराषाढाद्वितयं तथा ।
भरणीतिष्यसौम्यानि सौक्ष्म्यात् चि:सप्तकांशकै: ॥ ९ ॥

शेवाणि सप्तदशभिर्दृश्यादृश्यानि भानि तु ।
कालांशै रधिकैरेभ्यो दृश्यान्यल्पैरदर्शनम् ॥ १० ॥

कालेष्टांशान्तर: काल: कला गत्यन्तरोद्धृता: ।
गतियोगेन वक्रिण्याप्तास्तु वारादिकं फलम् ॥ ११ ॥

यल्लग्नाद्यत्र कालांशास्तल्लग्नासुहता गति: ।
राशिलिप्ताहृता स्यातां कालभूक्ती तयोरूभे ॥ १२ ॥

यद्वा राशिकलाभ्यस्ता हृता सा स्वोदयासुभि: ।
क्षेत्रांशा भास्करे स्वर्णं पश्चात्प्राक्स्वास्तभास्कर: ॥ १३ ॥

अस्तार्कक्रान्तिसंख्या ये ग्रहसत्वरदर्शनात् ।
उदयास्तमेव कुर्वन्त्यस्तार्कक्षादिभि: कला: ॥ १४ ॥

कार्यं द्वितीयं दृक्कर्म नृणां प्रत्यक्षकारकम् ।
शास्त्रीयव्यवहारे तु लोकं निष्फलयोजनम् ॥ १५ ॥

अभिजिद् ब्रह्महृदयं स्वालीवैष्णववासवा: ।
अहिर्वुह्नामुदक्स्थत्वान्न लुप्यन्ते ऽर्करश्मिभि: ॥ १६ ॥

सूर्योसूर्याधिकेन्यस्मिन्नपि षड्भानि निक्षिपेत् ।
सूर्यास्तकालिकौ कुर्यात्तौ च सूर्यास्तताडितौ ॥ १७ ॥

इतरान्तस्थयान्याभिर्धनर्णं तत्फलं तथा ।
भूयो नाडयो मुहूर्ता चेदसकृत्ताभिरस्तत: ॥ १८ ॥

अस्तार्कमानतः पश्चादन्यस्तद्दिवस्रो भवेत् ॥
सषड्भार्कदिनेन्यस्मिन्न षड्भानि विनिक्षिपेत् ॥ १९ ॥

अन्यत्मर्थं प्रकुर्वीत राशिरूर्ध्वमधस्ततः ।
उदेत्यन्य इति प्रोक्त उदयास्तविनिर्णय: ॥ २० ॥

इति श्रीसोमसिद्धान्ते ग्रहोदयास्तमानाधिकार: सप्तम: ॥

अष्टमोऽध्याय:
श्रृंगोन्नत्यधिकार:

अर्केन्द्वो: क्रान्तिविश्लेषो युतिस्तुल्याऽन्यथादिशो: ।
तन्मौर्विकार्काद्यश्रेन्दुस्तदिच्छा गुणितोऽनया ॥ १ ॥

मध्याह्नश्चन्द्रमाकर्णस्तत्स्थादिक्त्वादवागुदक् ।
द्वादशघ्राक्षजीवायां स्वर्णं लम्बज्यया भुजः ॥ २ ॥

पदं तच्छङ्कुवर्गैक्यात् कर्णः कोटिस्तु भास्करः ।
भास्करोनेन्दुकालिकाश्चन्द्रविम्बाङ्गुलाहताः ॥ ३ ॥

भचक्रार्द्धकलाभक्ता शुक्लकृष्णविमण्डली ।
बाहू यथादिशं काष्ठां मध्यविन्दोः प्रसारयेत् ॥ ४ ॥

वामं कृष्णं ततः पश्चान्मुखीकोटिकृतं तयोः ।
मध्ये लिखेच्चन्द्रबिम्बं कोटिकर्णयुतेः स्फुटम् ॥ ५ ॥

कर्णसूचेण दिक् शुद्धा बिम्बापरदिशाश्रितम् ।
शुक्लं वा कृष्णसूचेण नीत्वा तन्मुखमत्र च ॥ ६ ॥

याम्योत्तरदिशोश्चापं लिखेच्छृङ्गोन्नतिं वदेत् ।
आदौ चन्द्रस्य दृक्कर्म कर्तव्यं दिग्विपर्ययः ॥ ७ ॥

उत्तरे च यथायोग्यमित्याहुः शास्त्रयोगिनः ॥ ८ ॥

इति श्रीसोमसिद्धान्ते श्रृंगोन्नत्यधिकारोऽष्टमः ।

नवमोऽध्यायः
पाताध्यायः

यथा तिग्मांशुचन्द्रौ स्त एकायनगतौ तयोः ।
योगे चक्रे क्रान्तिसाम्यं पातः स्यात् स च वैधृतः ॥ १ ॥

भिन्नावनगतौ भाखच्छीतगू तद्युतौ यदा ।
भचक्रार्द्धे क्रान्तिसाम्यं मुख्यपातस्तदा भवेत् ॥ २ ॥

सूर्याचन्द्रमसौ यावदन्योन्याभिमुखं यदा ।
संघट्टनोद्भबो वह्निर्व्यतिपात इति स्मृत: ॥ ३ ॥

यच्छुभानां विनाशाय नन्दतीव पतत्ययम् ।
व्यतिपात: प्रसिद्धोऽत्र संज्ञाभेदेन वैधृत: ॥ ४ ॥

स कृणो दारूणवपुर्लोहिताक्षो महोदर: ।
सर्वारिष्टकरो रौद्रो भूयो भूय: प्रजायते ॥ ५ ॥

संस्कृतायनभागार्कचन्द्राभ्यां यत्तदीदृशम् ।
लक्षणं भवति प्राहुर्मुख्यपातस्ततोऽपि च ॥ ६ ॥

संस्कृतायनभागार्कचन्द्रयोराशिसंयुतौ ।
भार्द्धत्ये भगणत्वे व. क्रान्तिसाम्योदितायने ॥ ७ ॥

यतो द्वितीयसंक्रान्तिर्ग्रहक्रान्तिगते गति: ।
क्रान्तिसाम्ये मध्यकालस्तद्भुक्तौ ज्यान्तरेण च ॥ ८ ॥

स्थित्यर्द्धमानयोगार्द्धं तेनाद्यन्तं यथोचितम् ।
विष्कम्भादौ सप्तदश तृतीयोंशश्च यद्भवेत् ॥ ९ ॥

योगेशौ च व्यतिपात: प्रज्वलञ्चलनाकृति: ।
व्यतिपातोऽत्र यो घोर: सर्वशोभननाशन: ॥ १० ॥

स्नानदानजपश्राद्धव्रतहोमादिकर्मभि: ।
प्राप्यते सुमहत्पुण्यं तत्कालज्ञानतस्तथा ॥ ११ ॥

इति श्रीसोमसिद्धान्ते चतुर्थे पाताध्यायो नवम: ॥

दशमोऽध्याय:
गोलाध्याय:

अमृतांशुश्च भगवान्मानसालोच्य यज्जगत् ।
दृश्यते सर्वमेवैतदिदं वचनमब्रवीत् ॥ १ ॥

अहमेव परं ब्रह्म परमात्माजरामर: ।
अव्यक्तो निर्गुण: साक्षी कूटस्थो यो निरञ्जन: ॥ २ ॥

अनादिपुरुषो ऽनन्तो ह्यवाङ्मनसगोचर: ।
सत्य एव परं ज्योतिरद्वितीयश्च केवल: ॥ ३ ॥

आनन्दकायकरणविहीनो निर्भय: शिव: ।
अणोरणीयान् महतो महीयान् ज्ञानविग्रह: ॥ ४ ॥

मनस: सलिलं जातं तन्मे सर्वं प्रतिष्ठितम् ।
मय्येत्र लीयते सर्वं नात्र कार्या विचारणा ॥ ५ ॥

अनादिर्मम पीयूषा प्रकृतिर्विश्वकारणम् ।
प्रोक्तमप्याकृतिर्नाम्ना स्नानसन्यासमदद्भुतम् ॥ ६ ॥

नो भिन्नं नाप्यभिन्नं च कुतश्चिद्भिन्नमेव न ।
भिन्नाभिन्नं च नो येषां वयं वा न भवानपि ॥ ७ ॥

नीभयं केवलं स्वच्छं ब्रह्मात्मैकत्ववादग्रही ।
तमो नोहारकल्पान्ते नहि वेत्ति स्फुटास्फुटम् ॥ ८ ॥

व्योम शब्दवती मात्रा भिन्नं तच्छब्दमात्रत: ।
स्पर्शतन्मात्रानिलोभूद्रूपतन्मात्रपावक: ॥ ९ ॥

रसतन्मात्रकादापो गन्धतन्मात्रभूरत: ।
तत्तत्सम्बलिता मात्रा एतय मर्वं प्रजायते ॥ १० ॥

अवञ्चीकृतभूतेग्य एतेग्य: सोत्र पञ्चकम् ।
वाक्पञ्चकं च चैकं स्यादेकैकं जायते पुनः ॥ ११ ॥

तच्च पञ्चमहाभूतसंयुक्तो ज्ञानशक्तित: ।
क्रियाशक्तिर्मन: प्राणश्चासीच्चैतच्चतुर्विधम् ॥ १२ ॥

प्राणो दशविध: सप्तदशभि: शब्दपूर्वकै: ।
लिङ्गं सुक्ष्मप्तभूत् तेन भक्तार्तो वर्त्तते यदा ॥ १३ ॥

अपञ्चीकृतभूतानि समाश्रित्य पर: पुमान् ।
आकाशवायुतेजोम्बुभूमिरेवं ससर्ज्ज सः ॥ १४ ॥

परेषां दशमे चैकं ततद्दण्डमषड्मुखम् ।
मयि पञ्चीकृतं भूतं स्वल्पकार्यगुणान्वितम् ॥ १५ ॥

अन्ये गुणैकवृद्धि: स्वान्महत्त्वात् करणस्य च ।
करणात्सांशकार्यस्याध्यल्पत्वादिति निर्णय: ॥ १६ ॥

अन्तरं तु समुत्थानां प्रोक्तानीया तथा मही ।
भीमरूपात् ससृक्षित्वा ब्रह्मात्माशिशसूपदम् ॥ १७ ॥

हैमानामण्डकादीनां सर्वमन्तस्तमो मत: ।
हिरण्यगर्भोहं नाम्ना तत्राग्रेसचरन्महान् ॥ १८ ॥

पञ्चाननमहङ्कारं ब्रह्माणं सृष्टवान् विभु: ।
वेदान् वरासने तस्मिन् सर्वलोकपितामहे ॥ १९ ॥

स च स्वयंभू: सर्वात्मा तत्र गत्वा वनं समा: ।
स्वयमेवात्मनो ध्यानं तदण्डमकरोद् द्विधा ॥ २० ॥

ताभ्यां स शकलाभ्यां च यावद्भूमिं च निर्ममे ।
मध्ये दिशोन्तरिक्षं च शाश्वतं स्थानमव्ययम् ॥ २१ ॥

चक्षुषोग्निर्दिवानाथं मनसा चन्द्रमा अपि ।
तेजोभूखाम्बुवातेभ्य: क्रमादङ्गादरकादिकम् ॥ २२ ॥

स सर्वं बिभिदे व्योम पुनर्द्वादशधा क्रियात् ।
चकार नामानमात्मानमहंकारो भरूपिणम् ॥ २३ ॥

विभज्य कृतवान् सूक्ष्मं ततो विश्वं चराचरम् ।
निर्ममे देवपूर्वं तु गुणकर्म तदादिकम् ॥ २४ ॥

समन्तादण्डमध्ये ऽस्मिन् भूगोलो व्योम्नि तिष्ठति ।
तदन्तरे पुटा: सप्त ज्ञेया: पातालभूमय: ॥ २५ ॥

निरयास्तदधोधो वा अष्टाविंशतिकोटय: ।
तदूर्द्ध्वं षट्भुवर्लोका: शोभन्ते तस्य पार्श्वत: ॥ २६ ॥

ग्रहतारादिलोकास्ते तत्र तत्र स्वरादय: ।
तिष्ठन्त्याधारशक्त्या च तत्तदर्हजनान्विता: ॥ २७ ॥

भूगोलमध्यगो मेरूरूभयत्र विनिर्गत: ।
मन्विन्द्रवेदमुनय ऊर्ध्वा: स्रोतस उत्तमा: ॥ २८ ॥

ऊर्ध्वाष्टाङ्गे वसन्त्येते मध्याष्टाङ्गे महासुरा: ।
अध: श्रोतस एवान्ये मध्यश्रोतस्थितो गिरि: ॥ २९ ॥

लवणाब्धिर्गा परित्य स्थितोस्या मेखलेव हि ।
तन्मध्ये यमकोष्टिश्च पुरी लंका च रोमका ॥ ३० ॥

पूर्वाद्या च सिद्धपुरी भूपादान्तरिताश्च ता: ।
पुरीमेवान्तरं विद्धि भूपादं विद्धि शौनकम् ॥ ३१ ॥

सर्वेष्यूर्ध्वस्थिताकाशादल्पकायाश्च भूतलम् ।
पश्यन्ति चक्राकारं तु न कपित्थोपमं मुने ॥ ३२ ॥

उपर्यात्मानमपरे तिर्यगन्ये महीतले ।
अधोगात्रं कल्पयन्ति तेषां क्कोर्ध्वं क्क चाप्यधः ॥ ३३ ॥

उत्तानां विषुवत्यूर्ध्वं पुराः खेटा व्रजन्त्यमी ।
न तासु विषुवच्छाया व्यक्षदेशः स तु स्मृतः ॥ ३४ ॥

ततः स्थानाद् ध्रुवो मेरोरूर्ध्वस्थोपी च लक्ष्यते ।
स्थिताविव प्रतीयेते मेरोस्तद्वद्भमण्डलम् ॥ ३५ ॥

ध्रुवोन्नतिं भचक्रस्य नतिरक्षमितिः परा ।
लम्बतुल्यात्वभिमुखं यावद्विद्धि तदुन्नतिम् ॥ ३६ ॥

भचक्रधुबयोर्मध्ये प्रक्षिप्ताः प्रवहानिलैः ।
ब्रजन्त्यजस्रं सन्नद्धा ग्रहकक्षा यथाक्रमम् ॥ ३७ ॥

पश्चाद्व्रजन्तोऽतिजवान्नक्षत्रैः सततं ग्रहाः ।
जीयपानास्तु लम्बन्ते तुल्यमेब स्वमार्गगाः ॥ ३८ ॥

प्राग्गतित्वमतस्तेषां भगणैः प्रत्यहंगतिः ।
परिणाहवशाद्भिन्नास्तद्वशाद्भानि भूञ्जते ॥ ३९ ॥

सव्यं भ्रप्रति देवानामपसव्यं सुरद्विषाम् ।
उपरिष्टाद्भगोलोऽयं व्यक्षे पश्चान्मुखः सदा ॥ ४० ॥

चुम्बकोभ्रमिन्यायेन उच्चपाता अदर्शनाः ।
ग्रहा नानागतिं कुर्युर्देवता भगणाश्रिताः ॥ ४१ ॥

प्रवहः श्वसनश्चेतान् स्वोच्चाभिमुखमीरयेत् ।
एवं यत् प्राङ्मुखं यान्ति तद्धनं ऋणमन्यथा ॥ ४२ ॥

दूरस्थितः स्वशीघ्रोच्चाद्ग्रहः शिथिलरश्मिभिः ।
सव्येतराकृष्टतनुर्भेवद्वक्रगतिस्तदा ॥ ४३ ॥

नृपंषड्वर्गपञ्चाशदत्यष्टीषुरसैः कुजात् ।
अन्त्यकेन्द्रांशनीचांशैर्वक्रिणो यान्ति पातवत् ॥ ४४ ॥

वक्रानुवक्रा कुटिला मन्दा मन्दतरा समा ।
तथा शीघ्रातिशीघ्राख्या ग्रहाणाप्रष्टधा गतिः ॥ ४५ ॥

मन्दादिपञ्चसंज्ञाश्च वक्रे चान्यैः प्रकीर्तिताः ।
पातोपभोगः खेटानामुत्तराभिमुखं नयेत् ॥ ४६ ॥

ग्रहाः प्राग्मगणार्द्धास्था दक्षिणाभिमुखं तथा ।
पाताभ्यामपकृष्यन्ते शीघ्रोच्चं बुधशुक्रयोः ॥ ४७ ॥

तच्छीघ्राकर्षणात्तौ तु विक्षिप्येते यथोक्तवत् ।
अस्ते ग्रहस्य क्षेपान्ते स्वक्रान्त्यन्तात्प्रसार्यते ॥ ४८ ॥

भूवृत्तं क्रान्तिभागघ्नं भगणांशविभाजितम् ।
अवाप्तयोजनैर्व्यक्षादुपरिस्थो ग्रहो ब्रजेत् ॥ ४९ ॥

मेषादावुदितः सूर्यस्त्रीन् राशीनुदगुत्तरः ।
सञ्चरन् प्रागहर्मध्यं पूरयेन्मेरूवासिनाम् ॥ ५० ॥

कर्क्यादीन् सञ्चरं स्तद्वदहः पश्चार्द्धमेव सः ।
तुलादींस्त्रीनदमृगादीस्त्रींस्तद्वदेव भुरद्विषाम् ॥ ५१ ॥

अतो दिनक्षये सायमयनान्तो विपर्ययात् ।
व्याक्षोद्गमं च तिर्यक्त्वात्त्रिंशता च क्षपाप्यहः ॥ ५२ ॥

पुरतो भूचतुर्थांशंस्वस्थानाद्वासयद्रवि ।
ततद्दिग्भ्यां तत्तद्दिशामूखं सञ्चरयन्नपि ॥ ५३ ॥

तत्तत्पश्चिमभूपादे उदङ् मेरोस्तु दक्षिणे ।
मध्योदयार्द्धरात्रास्तकालान् कुर्याद्रविः क्रमात् ॥ ५४ ॥

अन्यत्र देवभागे तु हानिवृद्धि दिवानिशोः ।
अनेन प्रत्यहं याम्ये व्यस्तं देवेऽन्यथान्यथा ॥ ५५ ॥

भूमण्डलात् पञ्चदशे भागे सौम्यायने द्वयोः ।
नाड़ीषष्टया सकृद्रात्रिर्देवे न्यत्र दिवा भवेत् ॥ ५६ ॥

अन्यथा अयनात्पातोपरतोयं भसञ्चयः ।
वर्तते विपरीतो हि स्पष्टक्रान्त्युद्भवो ह्युदक् ॥ ५७ ॥

याम्यं चेति पुनस्तस्मात्तन्मेरोः सन्ति योजनैः ।
परतो वासरस्यापि सदा वृद्धिक्षयो भवेत् ॥ ५८ ॥

अस्तोन्मण्डलमुर्ध्वस्थाः पितरो दर्शनिर्गमे ।
स्वोपर्यकं प्रपश्यन्ति तन्मासं पैतृकं दिनम् ॥ ५९ ॥

कल्पेन्दुभगणाः क्षुस्माः खत्रयाब्धिद्विपावकैः ।
आकाशकक्षा सा कक्षा भक्ताकल्पभसञ्चयैः ॥ ६० ॥

कल्पभूवासरैः सर्वभूक्तियोजनमेव सा ।
युक्ता गतिकलाः षष्ठिः क्ष्मार्ककक्षा च पश्चिमः ॥ ६१ ॥

व्यासार्द्धयुक्तसंधात्री कर्णार्द्धोना तदुन्नतिः ।
सत्त्येव ज्योतिषां योगाहतकल्पा फलाय सा ॥ ६२ ॥

कृत्वा समन्तु भूगोलमभीष्टं दारवन्ततः ।
आधारकक्षाद्वितयं कक्षा विषुवती तथा ॥ ६३ ॥

भगणांशाङ्गुलैस्तत्र क्रान्त्यन्तादङ्गुलैरपि ।
अयनादयनंक्रान्तिः कक्षान्ते षट्ध्रुवादिकम् ॥ ६४ ॥

आच्छाद्य शुक्लवस्त्रेन यन्त्रयुक्तान् ग्रहादिकान् ।
न्यस्तक्षितिजवृत्तं च कृत्वा यन्त्रं च कालवित् ॥ ६५ ॥

भूमिं यद्बहुभिर्यन्त्र प्रत्यक्षेणाखिलं गतम् ।
यस्य कृत्वोपरि स्थानमात्मनस्तत्र संस्थितिः ॥ ६६ ॥

कालान्ते भग्नमखिलं कृत्वा दृष्ट्वा ग्रहादिकम् ।
नष्टे दिवे दिवा रात्रौ लोकत्रितयगे क्षये ॥ ६७ ॥

शेते ब्रह्मा स्वयं पत्रे न्यग्रोधस्य क्षपाश्रये ।
महानिव दिवापूर्णे मही संमुद्रिताखिला ॥ ६८ ॥

सृष्ट्वा पुनर्जगत् सर्वं करिष्यति यथातथम् ।
शक्तिमात्रं च शेषं तत् जगच्च प्रतिसञ्चरेत् ॥ ६९ ॥

स्वस्वकर्मानुरूपं तु यथापूर्वं तथोद्भवम् ।
ब्रह्मणः शरदां पूर्णे शतशो याति तज्जगत् ॥ ७० ॥

सर्वं कार्यं कारणे स्वे लीयते सर्वकारणम् ।
मायाशवलितं ब्रह्मा पुनः सृष्टिं करिष्यति ॥ ७१ ॥

तत्त्वमस्यादिवाक्यैर्यत् सम्यक्ज्ञानं प्रजायते ।
तेन नश्यति सा माया नान्यथा कोटिकर्मभिः ॥ ७२ ॥

विनष्टोव्याकुतं स्वस्थानिरूपपरमामृतम् ।
कूटस्थमोक्ष इत्युक्तं चित्रं तत्र विचारय ॥ ७३ ॥

समाधिमार्ग एवायं संसारजयकारणम् ।
एतद्ध्यायन् बुद्धिमान् स्यात् कृतकृत्यः स एव हि ॥ ७४ ॥

इति गुह्यतमं शास्त्रं भूक्तिमुक्तिफलप्रदम् ।
अधिगम्य ततः सोमाच्छौनकः पूर्णमानसः ॥ ७५ ॥

लक्षदेहाश्च देहैश्च पूर्णचक्षुः पुनः पुनः ।
नमस्कृत्वा निशादेव्या विवशो गददस्वरः ॥ ७६ ॥

तुष्टाव शान्त: स्वगुरुं शान्तं सविग्रहं मुनिम् ।
जय चन्द्रामृतांशो भो जय शंकरभूषण: ॥ ७७ ॥

जय सर्वज्ञ सर्वात्मन् जय सर्वेश्वर प्रभो ।
कृतार्थोहं कृतार्थोहं पुण्योहं पूतविग्रह: ॥ ७८ ॥

धन्योहं वीतशोकोहमित्योंब्रह्माहमेव च ।
अच्छेद्योहमदाह्योहमौमेकाहं शिवम् ॥ ७९ ॥

अहं विष्णुरहं ब्रह्मा शक्रोहमहमंशुमान् ।
अहमग्निरहं व्योम सर्वमेतदहं जगत् ॥ ८० ॥

त्वत्प्रसादाद्द्विहश्रेष्ठ एवमेतदवैम्यहम् ।
त्राहि मामिति संप्रार्थ्य प्राणिपत्य पुनः पुनः ॥ ८१ ॥

गुरूं समार्चयामास गन्धपुष्पाक्षतादिभि: ।
दक्षिणां च हिरण्यं च वस्त्रभूषणपूर्वकम् ॥ ८२ ॥

अभिवाद्य नमस्कृत्य परं ब्रह्म पुरातनम् ।
ज्ञात्वेदं मुनय: सर्वे सोमालयमनोरथम् ॥ ८३ ॥

प्रतिप्रणेमुरित्यन्ये ज्ञानं पप्रच्छुरादरात् ।
स तेभ्य: प्रददात् प्रीत: सम्यक्ज्ञानमनिन्दितम् ॥ ८४ ॥

तदेव देवस्तद्ब्रह्म वेदचक्षु: परं शुभम् ।
अव्येतव्यं सदा विप्रैरूत्तमैर्वेदवादिभि: ॥ ८५ ॥

इति श्रीसोमसिद्धान्ते चतुर्थे गोलाध्यायो दशम: ॥

॥ समाप्तोऽयं ग्रन्थ: ॥

Transliteration

Śrī Gaṇeśāya namaḥ

Chapter I: Madhyamādhikāraḥ

bṛhaspatisutaṃ śāntaṃ sukhasīnaṃ pṛiyakṣaṇam |
abhivandyaṃ munirdhīmān śaunakaḥ paripṛcchati || 1 ||

bhagavan sarvaśāstrajña sarvabhūtahite rata |
kathaṃ grahasthitiryāvallagnakālavidhāḥ kramāt || 2 ||

uparāgaśca kheṭānāṃ yogaścāragrahāḥ kramāt |
graharkṣasvodayaḥ pātastatrāpi graharūpiṇaḥ || 3 ||

śṛṅgonnatirjagatsṛṣṭisthitisaṃhṛtayopi ca |
etanme saṃśayaṃ chindhi bhavavannauṣadhīpate || 4 ||

śrutvā caitat trilokeśaścandramāḥ śaunakoditam|
pratyuvāca mahābhāga idaṃ vacanamādarāt || 5 ||

maharṣe tvaṃ samarthosi jñātumetadaśeṣataḥ |
śrṇu śaunaka vakṣyāmi śāstraṃ paramadurlabham || 6 ||

vedāṅgamakhilaṃ śreṣṭhaṃ yatpṛṣṭohaṃ tvayā mune |
daśagurvakṣaraḥ prāṇaḥ ṣaḍbhiḥ prāṇairvinaḍikā || 7 ||

tatṣaṣṭyā nāḍikā proktā nāḍīṣaṣṭyā divāniśam |
tattriṃśatārkṣamāsaḥ syāt sāvanorkodayaistathā || 8 ||

tayaindavastattithibhiḥ saṅkhāntyā saura ucyate |
tathā dvādaśabhirmāsairdinanāḍī vināḍikāḥ || 9 ||

ṣaṣṭirmadhuvasantādyairbatsarāstu ṛturbhavet |
surāsurāṇāṃ taddivamahorātraṃ viparyayāt || 10 ||

tatṣaṣṭiḥ ṣaḍgaṇā divyaṃ varṣamāsurameva ca |
catustrihyekaguṇitaṃ pūrvoktaṃ divyasaṃkhyayā || 11 ||

dvādaśābdasahasraṃ tu yugavarṣamiti kramāt |
śataṃ tādṛksamaṃ teṣāmādau sandhyābhidhīyate || 12 ||

sandhyāṃśaste ca tatpūrvāparadharme pravṛttayaḥ |
sandhyāsandhyāṃśasahitaṃ vijñeyaṃ taccaturyugam || 13 ||

kṛtādīnāṃ vyvastheyaṃ dharmapādavyavasthayā |
caturyugānāṃ saikā syāt saptatirmanusambhavaḥ || 14 ||

sandhīkṛtamitasyānte dhātrīpiṇḍajalaplavaḥ |
sasandhyaste manavaḥ kalpe jñeyāścaturdaśa || 15 ||

kṛtapramāṇaḥ kalpādau sandhiḥ pañcadaśa smṛtaḥ |
itthaṃ yugasahasreṇa bhūtasaṃhārakārakaḥ || 16 ||

kalpo brāhmamahaḥ proktaṃ śarvarī tasya tāvatī |
paramāyuḥ śataṃ tasya tayāhorātrasaṃkhyayā || 17 ||

sarveṣāmeva jīvānāṃ śatamevāyurūcyate |
tattacchvāsaprāṇakālastamaśeṣavinirṇayaḥ || 18 ||

vikalānāṃ kalā ṣaṣṭyā tatṣastyā bhāga ucyate |
tatriṃśatā bhavedraśirbhagaṇo dvādaśaiva te || 19 ||

prākcarāste grahāstuṅgāḥ pātāḥ pratyakcarāḥ smṛtāḥ |
pratyakṣabhagaṇasteṣāṃ pauṣṇānte bhagaṇastathā || 20 ||

kujārkiguruśīghrāṇāṃ sūryajñośanasāṃ yuge |
pūrnāmbaranabhovyomaradvedā bhasañcayāḥ || 21 ||

rasāgnisurabāṇādriśailārthaḥ śītagostathā |
dantāṣṭarasanandākṣinayanāni kujasya ca || 22 ||

jñaśīghrasya nabhastarkakhāgatryaṅkanagendavaḥ |
bṛhaspateḥ khadasrāśvivedaṣaḍvahnayastathā || 23 ||

śukraśīghrasya tarkādrivahnyākṛtinabhodayaḥ |
śanerbhujaṅgaṣaṭpañcatarkābdhisitaraśmayaḥ || 24 ||

indūccasya trikṛtyaṣṭabhujaṅgamapayodhayaḥ |
nāgāgniyamadṛgvahnihastāḥ pātasya śītagoḥ || 25 ||

bhūsāvanadinārkasya udayādudayāstathā |
aṣṭanetrāṣṭaśailendugośailādriśarendavaḥ || 26 ||

bhānāmaṣṭākṣisarpādritridvihyaṣṭaśarendavaḥ |
prāgyāyibhagaṇonāste yuge tasyodayaḥ smṛtaḥ || 27 ||

śaśimāsā bhavantyeva sūryendubhagaṇāntaram |
cāndrāḥ khāṣṭakhakhavyomakhakhāgnivyomaṣaṭdharāḥ || 28 ||

ṣaḍvahnitrihutāśāṅkatithayaścādhimāsakāḥ |
tithikṣayā yamārthākṣihyaṣṭavyomaśarāśvinaḥ || 29 ||

sahasraguṇitaṃ kalpe yadyuge tatprakīrtyate |
sūryamandasya bhagaṇāḥ kalpe saptāṣṭavahnayaḥ || 30 ||

kaujasyābdhinabhonetrā baudhāsyāṣṭartuvahnayaḥ |
jīvasya khakharandhrāṇi śaukrasyārthaguṇeṣavaḥ || 31 ||

gognayaḥ śanimandasya pātānāmatha kīrtyate |
kaujasya manunetrāṇi baudhasyāṣṭāṣṭasāgarāḥ || 32 ||

jīvasya kṛtaśailendu śaukrasya trinabhonava |
śanipātasya bhagaṇāḥ kalpe yamarasartavaḥ || 33 ||

kalpādau khakhavedādrikṛtai ryaddivyahāyanaiḥ |
sṛjyate vidhinā viśvaṃ taṅgeyādabdasañcayāt || 34 ||

atha māheśvarāsukhyo brahmāṇodhunā |
saptamasya manoryātā dvāparānte gajāśvinaḥ || 35 ||

khacatuṣkabhujaṅgāṣṭaśararandhraniśākarāḥ |
sṛṣṭeratītāḥ sūryābdā vartamānāt kaleratha || 36 ||

māsīkṛtābdāścaitrādyairgatamāsairyutāḥ pṛthak |
adhimāsahatāḥ sūryamāsairlabdhādhimāsakaiḥ || 37 ||

yuktā dinīkṛtā yuktāstithibhirnihatāḥ pṛthak |
kṣayāhaiścandramāsāptā viśodhyāvamavāsarāḥ || 38 ||

sāvano dyugaṇaḥ sūryādittham̱ yosau nagairhṛtaḥ |
sūryādyo vāsarādhīśo lañkāyāmardharātrikaḥ || 39 ||

siddhapuryāṃ tu madhyāhne yamakoṭyāminodaye |
vārapravṛttiḥ sandhyāyāṃ romakāyāmiti sthitiḥ || 40 ||

rātryarṅgaparato vācyā prabṛttiḥ pūrvadeśajā |
laṅkāyāmanyathā paścāttaddeśāntarakālataḥ || 41 ||

vārapravṛtterghaṭikā dvighnyo vāṇa hṛtāḥ kramāt |
pañcabhiḥ khakhadinapāt kṣepā vārādibhiḥ smṛtāḥ || 42 ||

prākpañcodhataśeṣārdhe kālahoreti nāḍikāḥ |
dyugaṇastriṃśatā ṣaḍghnaṣaṣṭyā dvitritaye phale || 43 ||

saike saptāviśeṣe te māsavarṣapatī kramāt |
yathā khabhagaṇaghnāhā bhagaṇādigrahāt kuhaiḥ || 44 ||

dyugaṇo bhagaṇābhyasto bhagaṇādi kuvāsaraiḥ |
bhagaṇebhyastathā bhuktiḥ pātaścakrādviśodhitāḥ || 45 ||

guroratītabhagaṇā dvādaśaghnā gṛhairyutāḥ |
vartamānairgatebhyobdā vijayādyāḥ khaṣaṭ hṛtāḥ || 46 ||

laṅkāmervantarābhyastāḥ kāñcī lohitakaṃ saraḥ |
avantīvatsagulmau ca tatparītendutegrahāḥ || 47 ||

unmīlanādatītādvā dṛksiddhaṃ gaṇitāgatāt |
yadā tadā madhyagasya svasthānaṃ pratyaganyathā || 48 ||

deśāntaraghnāḥ ṣaṣṭighnāḥ svabhūparidhinā hṛtāḥ |
tannāḍikā syāttaddadyāttābhya eva tadanyathā || 49 ||

tālavargo mahīkarṇa stadvargāddaśatāḍitāt |
mūlaṃ bhūparidhisthoyaṃ lambajyāghnastribhajyayā || 50 ||

bhaktaḥ svakastena bhuktirdeśāntarahatā hṛtā |
liptādi prāgṛṇaṃ paścāt svaṅgate sa svakaḥ smṛtaḥ || 51 ||

svadeśajā grahāstepi madhyarātribhavāḥ svake |
iṣṭanāḍohatā bhuktiḥ ṣaṣṭyā svarṇaṃ gataiṣyayoḥ || 52 ||

vakriṇaḥ phaṇipāḥ paścātprāgyāyī vyomagaḥ svakaḥ || 53 ||

iti śrīsomasiddhānte caturthe śaunakapraśne
madhyamādhikāraḥ prathamaḥ ||

Chapter II: Spaṣṭādhikāraḥ

bhacakrāt ṣasābatyaṃśāḥ samabhūyā ca saiva hi |
ādyāgrakhaṇḍadvīpārdhe piṇḍajyā taddalābhidhā || 1 ||

prathamajyāptakhaṇḍena khaṇḍaḥ khaṇḍaḥ parasya ca |
anyāparajyotyakhaṇḍā jyāścaturviṃśatiśca hi || 2 ||

utkramāt piṇḍakāḥ khaṇḍā utkramajyāptapiṇḍakāḥ |
yadotkrameṇa jyonāntyā jyārdhapiṇḍāḥ kramādamī || 3 ||

taśyanetrāṇi gobdhyabdhistathārūpanagartavaḥ |
khāṅkāṣṭau bāṇaśūnyeśāḥ śaracandraguṇendavaḥ || 4 ||

kṛtibāṇendavo gobhūmahīdharahimāṃśavaḥ |
digaṅkacandrāstrinavanakhāḥ saptartuḍrkkarāḥ || 5 ||

candrānalābdhiyamalā bāṇanāgaśarāśvinaḥ |
aṣṭāśvinaganetrāṇi nandapañcabhagāśvinaḥ || 6 ||

nāgādrinavanetrāṇi kṛtāṣṭagaganānalāḥ |
saptātyaṣṭiguṇāstarkapañcanetrahutāśanāḥ || 7 ||

prakṛtitridaśa netramunidevā yathākramāḥ |
navāmbarābdhibahulā rūpāgnikṛtapāvakāḥ || 8 ||

ibhatrigatyavasthāścotkramajyāṃ prabravīsyatha |
śailā navāśvinastarkarasā munipinākinaḥ || 9 ||

dvidhṛtiḥ kṣmotkṛtirvedārthatri purṇarasābdhayaḥ |
godyṛrthā diknagāstryarthadvīpāḥ śailaviyaddiśaḥ || 10 ||

kṣmātyaṣṭicandrā bāṇābdhiviśveṣṭāśviśarendavaḥ |
atidhṛtyadriśa śano dhṛtinandaniśākarāḥ || 11 ||

trihastaśaśinetrāṇi devapāvakavāhavaḥ |
aṣṭābdhitattvaṃ śailartubhānyaṅkāṣṭanavāśvinaḥ || 12 ||

guṇacandradvidahanā vasutrikṛtavahnayaḥ |
grahaṃ svatuṅgāt saṃśodhyocchiṣṭaṃ kendraṃ pade same || 13 ||

gamyā dorjyā gatātkoṭiroje pāde'nyathā bhavet |
liptā hṛtā tattvayamaiḥ śiṣṭa jāntarayorvadhāt || 14 ||

tattvāśvibhiḥ phalaṃ yojyaṃ gatajyāyāṃ kalādikam |
ravermandaparidhyaṃśā manavo yamalāgnayaḥ || 15 ||

arthādrayo vedaguṇāḥ surāḥ sūryā navārṇavāḥ |
kujādīnāmatho śaighryā viṣayānaladasrakāḥ || 16 ||

guṇaviśve khaśailāśca hyutkṛtirnavapāvakāḥ |
ṣaḍtanvinduhṛtā dorjyā jñeyā vṛttā kujasya tu || 17 ||

arkendvormanuvahnābhraśaśāṅkaiśca tribhajyayā |
anyeṣāṃ jñoccamānde'tha śaighrye śukre jñabhūbhuvām || 18 ||

ekajyayā ṛṇaṃ śaighrye jīvārkyostaddhanaṃ bhavet |
sphuṭavṛttahate bāhukotijye bhagaṇāṃśakaiḥ || 19 ||

phalajyo mandajo cāpaṃ bhūjāt phalakalāḥ smṛtāḥ |
mṛgakarkyādijasvarṇavyāsārddhe śīghrakoṭitaḥ || 20 ||

phalajyāto doḥphalajyā vargaikyādyat padaṃ śrutiḥ |
doḥphalajyā trijīvāghnī śrutyāptaṃ syāttu taddhanuḥ || 21 ||

śaighryaṃ taddoḥphalaṃ proktaṃ cāpānayanamucyate |
āsannajyāthavā śiṣṭaṃ śiṣṭaṃ tattvāśvibhirhatam || 22 ||

śuṅgāśuṅgajyāntarāptaṃ śuṅgajyāsaṃkhyayā hataiḥ |
tattvāśvibhiḥ samāyojyaṃ dhonurliptāḥ prakīrttitāḥ || 23 ||

svarṇaṃ bāhuphalaṃ kendre meṣajūkādike grahe |
śīghrārddhamandārddhakhage phalārddhakṛtasaṅgakaḥ || 24 ||

madhye śaighrāphalasyarddhaṃ māndamarddhaphalaṃ tathā |
śaighrārddhaṃ madhyage mande māndaṃ śīghraphalaiḥ kramāt || 25 ||

bhaumādīnāmayaṃ mārgo mandakarmaikamanyayoḥ |
bhānubāhuphalābhyastā grahabhūktiḥ samuddhṛtā || 26 ||

liptābhacakraliptābhiraravat khacarepi tat |
nātyantarādṛggrahayoḥ ṣaṣṭighnaṃ śeṣaliptikāḥ || 27 ||

tadyutaṃ kendrabhuktervā grahavanmandakarmaṇi |
yat phalaṃ karkinakrādau svarṇaṃ tajjyotiṣāṃ gatau || 28 ||

śīghrakendragatistrijyākṣusmā karṇoddhṛtārṇam |
śīghroccabhukteḥ syādbhuktirvakrabhuktirviparyaye || 29 ||

tadṛṇaṃ madhyabhuktiśca hitvā śīghroccabhuktitaḥ |
śeṣārddhamadhyabhktyaikyaṃ śighrārddhagatirucyate || 30 ||

yuge ca ṣaṭśataikatve bhacakraṃ prāk ca lambate |
tadguṇo bhūdinairbhakto dyugaṇo'yanakhecaraḥ || 31 ||

tacchuddhacakradorliptā dviśatyāptāyanāṃśakāḥ |
saṃskāryā jūkameṣādau kendre svarṇaṃ grahe kila || 32 ||

tatsaṃskṛtagrahāt krāntilagnamapyunnatiḥsphuṭā |
harinakālabhāgāśca lagnaṃ yastaṃ tu sādhayet || 33 ||

grahadorjyādrigoviśvairhatā trijyoddhṛtā dhanuḥ |
tasyāḥ krāntirūdagyāmyā tatpūrvāparabhāgajā || 34 ||

krāntyantakṣepamānena grahāṇāṃ sañcaraṃ kiyat |
tulābhinnakakupkrāntikṣepayogāntaraṃ kramāt || 35 ||

śukrajñapātayormāndaṃ phalaṃ māndaṃ tṛtīyakam |
caturthaṃ grahavacchaighryaṃ pāteṣvarkāṅgirosṛjām || 36 ||

pātān grahebhyaḥ śighroccāt prohya dorjyā jñaśītayoḥ |
candrāt khatārakaiḥ khāṅkaiḥ khārkaiḥ ṣaṣṭyā svabhāskaraiḥ || 37 ||

nabhorkaistāḍayedantyacalakarṇaiḥ svakairbhajet |
vijyayendoḥ phaladhanurvikṣepaḥ krāntivatkakup || 38 ||

krāntijyā viṣuvadbhāghnī trisaptaśarasaṃguṇā |
krānteḥ kotijyayā bhaktā dvighnaṃ yātarahāsavaḥ || 39 ||

taccāpaṃ svadinābdhāṃśe svarṇaṃ yāmyenyathottare |
kṣepā dinārddhe kramaśo bhānāmapi vijistrayam || 40 ||

grahodayaprānahatā rāśiliptāhṛtā gatiḥ |
svāhorātrāsubhiḥsvarṇaṃ cakrāsurṛjuvakritaḥ || 41 ||

arkonacandraliptābhyastithayo nakhaparvataiḥ |
gatagamyā ca ṣaṣṭighnā nāḍyo gatyantaroddhṛtāḥ || 42 ||

dhruvāṇi śakunaṃ caiva catuṣpānnāgamarddhataḥ |
kiṃstughnaṃ kṛsṇabhūtāyāścatvāri karaṇāni ca || 43 ||

babādīnāṃ tataḥ sapta carākhyakaraṇāni tu |
māseṣṭakṛttva ekaikaṃ karaṇānāṃ prakalpayet || 44 ||

tithyārṅgabhogaṃ sarveṣāṃ karaṇānāṃ prakalpayet |
gatagamyakalārāśergatyā hānistu saṃkrame || 45 ||

saṃskṛtāyanabhāgārkasaṃkramastvayanaṃ kila |
snānadānādiṣu śreṣṭhaṃ madhyamaṃ sthānasaṃkramaḥ || 46 ||

grahaliptāṣṭaśatyā bhaṃ gamyāhānigataiṣyakam |
tathārkenduyuteryogo gatyaikena dināni tu || 47 ||

iti śrīsomasiddhānte spaṣṭādhikāro dvitīyaḥ ||

Chapter III: Tripraśnādhikāraḥ

chāyā vaiṣuvatī yā sā nāma mādhyāhnikī ca sā |
tathārkeṇa hite trijye viṣuvatkarṇabhājite || 1 ||

akṣajyālambajīve taccāpe yāmyekṣalambane |
śaṅkucchāyakṛtiyutermūlaṃ karṇonyathāpi vā || 2 ||

tulyabhinnadigakṣāṃśakrāntyorviśleṣaṇaṃ natam |
taddostrijye hate sūrye koṭyāca harabhāśrutī || 3 ||

soumyākṣonā yadākrāntirakṣajyā dvādaśāhatā |
krāntijyāptā śrutirbhānau pracīrekhāṃ samāgate || 4 ||

samamaṇḍalakarṇāptā etaddvādaśasaṃguṇā |
samamaṇḍalaśaṅkuḥ syādakṣajyāgunitā naraḥ || 5 ||

paramāpakramajyāptā bhujajyā taddhanū raviḥ |
krāntijyeṣṭaśrutighnā ca lambāptāgrāṅgulādikā || 6 ||

viṣuvatyā taddhanarṇaṃ yāmye syāduttare bhuje |
anyathā vā bhujo'nena diśāṃ saṃsādhonaṃ bruve || 7 ||

krāntijyāviṣuvatkarṇabadhorkairagramaurvikā |
trijyāvargārddhatograjyāvargonād dvādaśāhatān || 8 ||

punardvādaṣanighnācca labhyate yatphalaṃ budhaiḥ |
śaṅkuvargārddhasaṃyuktaviṣuvatkarṇabhājitā || 9 ||

labdhaṃ tu karaṇī nāma tāṃ pṛthak sthāpayettu saḥ |
viṣuvacchāyārkabadhādagrajyāsaṃguṇāttathā || 10 ||

bhaktā phalākhyaṃ tadvargasaṃyuktakaraṇīpade |
phalena hīnasaṃyuktaṃ dakṣiṇottaragolayoḥ || 11 ||

yāmyayorvidiśoḥ śaṅkureva yāmyottare ravau |
udak carati tasyārke śaṅkustūttarayostu saḥ || 12 ||

tattrijyāvargaviśleṣānmūlaṃ dṛgjyābhidhīyate |
svaśaṅkunā vibhajyāpte dṛktrijyādvādaśāhate || 13 ||

chāyākarṇau tu koṇeṣu yathā svaṃ deśakālayoḥ |
koṇaprabhāgakṛtidalaṃ yaṃ hatvā tribhajyayā || 14 ||

krāntijyākoṇakarṇāptaṃ tacchāyāmānakaṃ bhavet |
dṛgjyā syātkṛtitastyaktā trijyāvargātpadaṃ ca yat || 15 ||

udakcarajyayā yuktā trijyayā yāmyayonitā |
natotkramajyayā hīnā krānteḥ koṭijyayā hatā || 16 ||

trijyāptā dvādaśaguṇā viṣuvatkarṇabhājitā |
śaṅkuḥ pūrvavadevādichāyākarṇau svakādhike || 17 ||

abhīṣṭacchāyayābhyastā trijyā tatkarṇabhājitā |
dṛgjyā tatpratilomedho tatajyādyodayonatāḥ || 18 ||

tadutkramadhanuḥ pūrvāparajyāsyurnatāsavaḥ |
madhyacchāyā madhyabhujā trijyāptā tacchravoddhṛtāḥ || 19 ||

natajyā syānnatabadhastattathāhopratisthitā |
tatsūryanabhaliptāśca tadīyakrāntiliptikāḥ || 20 ||

dikbhede miśritāḥ sāmye viśiṣṭāścākṣaliptikāḥ |
tajjyākoṭibhuve jive akṣalambanamaurvike || 21 ||

akṣajyārkahatā bhaktā labdhaṃ yā viṣuvatprabhā |
bhinnatulyavadhākṣaikyaviśleṣajyākramābhidhā || 22 ||

trijyāptā munigoviśvedhanubhākajibhatrayoḥ |
karkyādau prohya cakrārddhāttulādau bhārddhasaṃyute || 23 ||

tulādau prohya bhagaṇānmayameṣādināyakaiḥ |
prākcakraṃ calitaṃ hīnā chāyārkāt karaṇāgatāt || 24 ||

paścāditagavāsvarṇaṃ calāṃśāstaddināntarā |
chāyārkagatasaṃśuddhaṃ chāyārkobhayaliptikāḥ || 25 ||

deśāntarakalābhānāmanupātāttathottarā |
chāyādoḥ kṛtiviśleṣān mūlaṃ śaṅkustathā vidhauḥ || 26 ||

śaṅkucchāyā samasthāne kalpyamādvādaśāṅgulam |
tacchāyāgraṃ bhujavyastā diśaṃ śaṅkubhujāśrayoḥ || 27 ||

sthulaśaṅkuśca prasārye madhye tattalaśaṅkunā |
prācīrekhāṃ vilikhyedaṃ vṛttaṃ tasmācca madhyataḥ || 28 ||

timinā yāmyasaumyā ca vidigrekhe ca yuktitah |
caturasraṃ bahiḥ kuryāt sūtrairmadhyādviniḥsṛtaiḥ || 29 ||

tathā diśaṃ bhujāḥ prāchī rekhārddhaiśca sāmāhatāḥ |
bāhudvayāntare yatsyādayātayutivaddhanuḥ || 30 ||

vindutrayaspṛksūtreṇa sphuṭacchāyābhramaṃ sadā |
khāgāṣṭayorthagogaikāḥ śaratyaṅkahimāṃśavaḥ || 31 ||

kramotkramādadhaḥ sthāpya meṣāllaṅkodayāsavaḥ |
svadeśacarakhaṇḍonā mṛgādyāḥ karkaṭādayaḥ || 32 ||

svadeśacarakhaṇḍānyāḥ svodayādanupātataḥ |
lagnametairmadhyalagnaṃ natairlaṅkodayāsabaḥ || 33 ||

lagnagrahāntaraprāṇā vijñeyāḥ kālasādhane |
sūryadune niśāśeṣāllagnārkādadhike divā || 34 ||

bhacakrārddhayutā bhānoradhikāstamānāt param || 35 ||

iti śrīsomasiddhānte tripraśnādhikārastṛtīyaḥ ||

Chapter IV: Candragrahaṇādhyāyaḥ

yojakānāṃ paṇcaṣaṣṭiḥ śataghnā bhāskarasya tu |
viṣkambho maṇḍalasyendoḥ sāśīti catuḥśatī || 1 ||

madhyagatyā hṛtā spaṣṭagatighnā vyāsakau sphuṭau |
sphuṭārkamaṇḍalakalā somasvabhagaṇāhatā || 2 ||

syādājabhāgaṇairbhaktā indoḥ ṣaṣṭistadānanam |
bhāsvadāsakalāścandrakakṣāyāṃ tithiyojanaiḥ || 3 ||

sphuṭārkabhuktirbhūvyāsaguṇitā madhyayoddhṛtā |
labdhaṃ sūcī mahīvyāsasphuṭārkaśravaṇāntaram || 4 ||

madhyenduvyāsaguṇitaṃ madhyārkavyāsabhājitam |
viśodhya labdhaṃ sūcyāstu tamo liptāstu pūrvavat || 5 ||

bhacakrorddho bhavedbhūtā tathārkeṇa pracalitā |
urage grahaṇaṃ yadvā kriyabhārddhādhikonake || 6 ||

chādakorkasya śītāṃśuradhaḥstho ghanavadbhavet |
bhūcchāyācchādakaścandraścādyenyatra paristhitaḥ || 7 ||

parvāntakenduvikṣepaṃ prohya bhūbhāśaśāṅkayoḥ |
mānaikyārddhādgrahaṇaṃ syādanyathā madhyakālakam || 8 ||

pakṣāntaṃ dormadhyakālaṃ yathārkasya tathā nahi |
māsāntara tadbimbaṃ madhyasthākāśadarśanāt || 9 ||

prākpaścāllambanenonayuktaṃ māsānta eva tat |
madhyakālastu tadvacca sparśamokṣeti cāraṇāt || 10 ||

kimbhāharārddhe sūryendvordakṣiṇottarasaṃsthayoḥ |
bimbamadhyagataṃ vyoma nahi lambanakāraṇam || 11 ||

pūrvāparasthayorbimbamadhyayorantarāparam |
kālaheturato lagnaṃ jyā ntyāpakramasaṃguṇā || 12 ||

lambajyāptodayajyeṣṭamadhyalagnanatajyayā |
ḥatā tribhajyayā bhaktā vargayośca na tajyayoḥ || 13 ||

biśleṣānmūlamucyeta dṛkkṣepa iti saṃskṛtim |
prohya trijyākṛrtermūlaṁ dṛggatijyānayā haraḥ || 14 ||

ekajyāmadhyatovargalagnārkāntaratośubhaḥ |
chedena bhakto nāḍyādi lambanaṃ candrasūryayoḥ || 15 ||

asakṛt karmaṇānena madhykāle sthirīkṛte |
dṛkkṣepāt saptavargaghnāt trijyayāvanatirbhavet || 16 ||

madhyalagnanatāṃśākhyā diktulyentaradṛkayā |
natyā tatkrāntirityetaccandre kṣepaḥ sphuṭaḥ smṛtaḥ || 17 ||

tatprohyarkendumānaikyadalācchannaṃ vivasvataḥ |
grāhyagrāhakamānaikyaviśleṣārddhakṛteḥ padam || 18 ||

vikṣepavargahīnādyatṣaṣṭighnaṃ candrasūryayoḥ |
bhuktyantareṇa sthityarddhaṃ vimardārddhaṃ krameṇa ca || 19 ||

tadūnapakṣamāsāntāt sparśanaṃ ca nimīlanam |
arkadā rasakṛccaivaṃ mokṣonmīlanamanyathā || 20 ||

bhānostallambanenaiva kalāḥ spaṣṭāḥ syureva hi |
madhyena yā tayā spaṣṭasthityrddhaṃ sparśamokṣayoḥ || 21 ||

iṣṭamadhyāntarā nāḍyā tāḍitā ravicandrayoḥ |
gatyantareṇa ṣaṣṭyāptāḥ koṭiliptā ravestu tāḥ || 22 ||

madhyasthityarddhaguṇitā spaṣṭasthityarddhabhājitāḥ |
sphutasthire kṣepa vargaikyānmūlaṃ karṇottare padam || 23 ||

mānayogārddhataḥ prohya grāsastātkāliko bhavet |
iṣṭagrahaṇakālastu vyatyayo noktamārgataḥ || 24 ||

akṣabhāghnā natajyākṣakarṇāptātasya kārmukam |
velāṃśāstasya yāmyo ste pūrvāpara kapālayoḥ || 25 ||

satrirāśigrahakrāntyā yutonāstulyabimbayoḥ |
diśojavimalā prāgvattvaṅgulānyabhakhādribhiḥ || 26 ||

dinārddhaprāṇa ekonadhṛtyā tacchannaliptikāḥ |
bimbakṣepādiliptāśca bhavantyevāṅgulāni tu || 27 ||

svacchatvād dvādaśāṃśopi grastaścandrasya dṛśyate |
liptātrayamapi grastaṃ tīkṣṇatvānnavivasvataḥ || 28 ||

sūryodayāstasamaye yuktacchannopi bhāskaraḥ |
pitṛbhaktivihīnānāṃ tīkṣṇasantati lāpayet || 29 ||

itiśrī somasiddhānte caturthapraśne candragrahaṇādhyāyaḥ ||

Chapter V: Parilekhādhyāyaḥ

chedyakena vinā yasmānna jñeyo yadupaplave |
viśeṣotra pravakṣyāmi chedakajñānamuttamam || 1 ||

samasthale nyastavinduḥ samaḥ svarṇāṅgulena tu |
bimbayogārddhamanena grāhyārddhena yathākramam || 2 ||

likhedvṛttatrayaṃ koṣṭhe yathoktaṃ sādhayedapi |
prāgindorgrahaṇaṃ paścānmokṣorkasya viparyayāt || 3 ||

prāgarddhādhikasya vṛttasya balanaṃ tadyathādiśam |
pratyagagrenyathā rekhe madhye tadbalanāgrataḥ || 4 ||

nītvā rekhāmadhyavṛttayogāt kṣepaṃ yathādiśam |
ravīndvorvivarāntastaṃ madhyasūtre tadagrataḥ || 5 ||

tatsūtre grahasaṃyogāṅgāsamokṣau vinirdiśet |
valanakṣepadṛktulyabalane prāṅmukhaṃ nayet || 6 ||

bhede paścānmukhaṃ rājña stadarkasya viparyayāt |
tadagrānmadhyage sūtre madhyakṣepaṃ tadagrataḥ || 7 ||

grāhakārddhena tadbimbenoparāgasya madhyamaḥ |
vyapakṣepatrayāgre tu yattadā grāhakaḥ śaśī || 8 ||

mānaikyārddheṣṭagrahaṇaṃ śeṣatulyaśalākayā |
grāhakamadhyādasya mārge nirdiṣṭasthānatonuyaḥ || 9 ||

chāyā grāhakabimbena grahaṇaṃ sphuṭamādarāt |
sarvadā bhāskaracchannaṃ kṛtaṃ tvaryāntu śītagoḥ || 10 ||

dhūmraṃ kṛṣṇaṁ kṛṣṇatāmraṃ kapilaṃ padaśo bhavet |
rahasyametaddevānāṃ suśiṣyāya pradīyate || 11 ||

paṭopari likhitaṃjñāṅstaddhara yathādiśam |
diśoryānti tathā kāṣṭhāṃ kalpayediti me matam || 12 ||

iti śrīsomasiddhānte caturthapraśne parilekhādhyāyaḥ ||

Chapter VI: Nakṣtragrahayuddhasamāgamādhyāyaḥ

bhavantyatītadhiṣṇyānāṃ bhogaliptāyutā dhruvāḥ |
aṣṭābdhayo viyadvedāḥ śaratarkā munīṣa vaḥ || 1 ||

ibhārthā gobdhayoṣṭāṅgāḥ ṣaḍaśvāḥ śrutibhūmayaḥ |
vedārthāḥ sāgararasāḥ śūnyabāṇāḥ bhorasāḥ || 2 ||

catvāriṃśad yuganagāḥ gajāgāḥ sārārttavaḥ |
manavaśca ṣaṭśrutayo vaiśvamāpyarddhabhogagam || 3 ||

āpyasyaivābhijitprānte vaiśvānte śravaṇaḥ sthitaḥ |
śravaṇasyāntyapādo vā śraviṣṭāyāḥ svabhogataḥ || 4 ||

nabhonāgāśca ṣaḍvargo dvidvikā nagaparvatāḥ |
krānteḥ kṣepalavāsteṣāṃ daśa dvādaśa pañca ca || 5 ||

udamāsye pañcadaśa nava soumye rasānabhaḥ |
sāmyendava udagbhāge viyatsūryāstrayodaśa || 6 ||

yāmye rūdrāśca yamalāḥ saugyabhāge nagāgnayaḥ |
yāmyedhyarddhatrayo vedā nava sārddheṣavaḥ śarāḥ || 7 ||

udakṣaṣṭiḥ khāgnayaśca ṣaṭtriṃśadatha dakṣiṇāḥ |
adhyarddhabhāgaḥ saumyāyāṃ caturviṃśatirūtkṛtiḥ || 8 ||

khaṃ cāgastyāśītibhāgairyāmye kṣīṇe yamāṅgataḥ |
sākhevairyamaviṃśāṃśe mṛgavyādhastu dakṣiṇe || 9 ||

hutabhuk brahmahṛdayaṃ vṛṣe dvāviṃśabhāgagau |
aṣṭabhistriṃśatā caiva vikṣiptāvuttareṇa tau || 10 ||

pūrvasyāṃ brahmahṛdayādaṃśakiḥ pañcabhiḥ sthitaḥ |
prajāpatirvṛṣānte tu saumyeṣṭatriṃśadaṃśakaiḥ || 11 ||

apāṃvatsastu citrāyā uttareśaistu pañcabhiḥ |
bṛhatkiñcit tato bhāgairāpaḥ ṣaḍbhistathottare || 12 ||

iti tāragrāhāṇāṃ syurdhruvasaṃkhyānameva hi |
prayojanaviśeṣosti na jāne tatra gaṇyate || 13 ||

vṛṣe saptadaśe bhāge yasya yāmyoṃśakadvayāt |
vikṣepobhyadhiko bhindyādrohiṇyāḥ śakaṭaṃ tu saḥ || 14 ||

tārāgrahāṇāmanyonyaṃ yuddhaṃ vātha samāgamaḥ |
samāgamaṃ candradhiṣṇyaiḥ sūryeṇāstamayaḥ saha || 15 ||

mandaśīghrādhikānetā saṃyoge gatagamyayoḥ |
kālayorvakriṇorvyastaṃ prāgyāyinyodhiko gataḥ || 16 ||

bhuktyantareṇa bhuktighnā grahāntarakalāhṛtā |
ekasmin bhuktiyogena vakriṇyastu samedhikāḥ || 17 ||

grahāntarakalāstadvadbhuktayogadināni hi |
vikṣepo viṣuvadbhāghnaḥ sūryāpto natasaṃguṇaḥ || 18 ||

dinārddhāpta udakkṣepe svarṇaṃ paścimapūrvayoḥ |
dakṣiṇāḥ prākpratīcyāste taddṛkkarma grahastu saḥ || 19 ||

sabimba grahajakrāntikṣepaghnāstrijyayā hṛtā |
ṣaṭkṛtyāptā dhruvaḥ svarṇaṃ bhadiśorbhinnatulyayoḥ || 20 ||

dvitīyametad dṛkkarma kecinnecchanti sūrayaḥ |
samaliptyoḥ punaḥ kāryāvetau dṛkkarmayuggraho || 21 ||

etayorbhinnatulyāṃśākṣepaikyāntaratodhike |
mānaikyārddhe bhavetāṃ tu tulyasparśenyathānyathā || 22 ||

bhāgānyaṃ parito labdhaghnāśvivṛtyāṃśāviraśmayaḥ |
grahāntaraikavikṣepe bhāge tasmin samāgamaḥ || 23 ||

yuddhamaṃśuvimardākhyaṃ paravyāsamatonake |
ekotra cedaṇurdvaucedatra sthūlau samāgamau || 24 ||

aṃśādhike tau prabalau yadi syātāṃ samāgamau |
aṃśādhike tu tau svalpau vidhvastau kūṭavigrahau || 25 ||

sthūlo jayī raśmimāṁśca jito yo gurūdīptimān |
udakstho dakṣiṇastho vā bhargavaḥ prāyaśo jayī || 26 ||

vedognayo hyaṣṭayoṣṭā ṣaṣṭirgajābdhayaḥ |
viṣkambhaścandrakakṣāyāṃ bhaumādīnāṃ yathākramam || 27 ||

ekajyāghnāścaturghnāste dvicatuṣkarṇabhājitāḥ |
sphuṭavyāsaḥ pañcadaśavibhaktā mānaliptikāḥ || 28 ||

ekajyādviguṇāsteṃśā bhuktā vā bimbayojanam |
bhaumādīnāṃ tu margoyamevānukteḥ punaḥ sphuṭaḥ || 29 ||

svadṛṣṭanatānatasthāne yathā dikbhramaṇaṃ same |
śaṅkudvaye sthāpite tacchāyāmārgāntaraṃ gataḥ || 30 ||

chāyādiśi svaśaktyagre darpaṇasthaṃ mukhaṃ yathā |
tathā paśyed grahaṃ tārāvikṣepāntasamanvite || 31 ||

phālgunyorbhādrapadayostaṭhaivāṣādḥayordvayoḥ |
viśākhāśvinisaumyānāṃ yogatārottarā smṛtā || 32 ||

paścimottaratārāyāṃ dvitīyā paścime sthitā |
hastasya yogatārāsau śravisṭhāyāśca paścimā || 33 ||

jyeṣṭhāśravaṇamaitrākhāṃ varhaspatyasya madhyamā |
bharaṇyāgneyapitryāṇāṃ revatyāścaiva dakṣiṇā || 34 ||

rohiṇyādityamūlānāṃ prācī sarpasya caiva hi |
yathā pratyavaśeṣāṇāṃ sthūlā syādyogatārakā || 35 ||

itiśrīsomasiddhānte caturthe
nakṣatragrahayuddhasamāgamādhyāyaḥ
ṣaṣṭhaḥ II

Chapter VII: Grahodayāstamānādhikāraḥ

athārkāṃśusamākrāntamūrtīnāmalpatejasām |
udayāstagate yau tatparijñānaṃ prakirtyate || 1 ||

avakriṇādeḥ sūryādibhādikāḥ śīghragastataḥ |
paścādyāntyudayaṃ prācyāmūnamastaṃ parenyathā || 2 ||

sūryāstakālikau paścātprācyāmudayakālikau |
divākaragrahau kuryād dṛkkarmātha grahasya tu || 3 ||

ubhayorantaraprāṇāḥ ṣaṣṭyā kālāṃśakāhṛtāḥ |
saṣaḍbhayoḥ praticyāṃ tu mārgoyaṃ jyotiṣāmapi || 4 ||

astāṃśāścandrabhaumādyāḥ atyaṣṭimunirīśvarāḥ |
āśāsthitiṃ kramātproktāḥ sūryādye kālajāstvime || 5 ||

jñaśukrayormahattvātte sūryo aṣṭau ca va kriṇau |
svātyagastyamunirvyādhāccitrā jyeṣṭhā punarvasū || 6 ||

abhijid brahmahṛdayaṃ trayodaśabhiraṃśakaiḥ |
hastaśravaṇaphālgunyaḥ śraviṣṭā rohiṇī maghā || 7 ||

caturdaśāṃśakairdṛśyā viśākhāśvinadaivataiḥ |
kṛttikāmūlamaitrāṇi sārparaudrarkṣameva ca || 8 ||

dṛśyante pañcadaśabhirāṣāḍhādvitayaṃ tathā |
bharaṇitiṣyasaumyāni saukṣmyāt ciḥsaptakāṃśakaiḥ || 9 ||

śevāṇi saptadaśabhirdṛśyādṛśyāni bhāni tu |
kālāmśairadhikairebhyo dṛśyānyalpairadarśanam || 10 ||

kāleṣṭāṃśāntaraḥ kālaḥ kalā gatyantaroddhṛtāḥ |
gatiyogena vakriṇyāptāstu vārādikaṃ phalam || 11 ||

yallagnādyatra kālāṃśāstallagnāsuhatā gatiḥ |
rāśiliptāhṛtā syātāṃ kālabhuktī tayorūbhe || 12 ||

yadvā rāśikalābhyastā hṛtā sā svodayāsubhiḥ |
kṣetrāṃśā bhāskare svarṇaṃ paścātprāksvāstabhāskaraḥ || 13 ||

astārkakrāntisaṃkhyā ye grahasatvaradarśanāt |
udayāstameva kurvantyastārkarkṣādibhiḥ kalāḥ || 14 ||

kāryaṃ dvitīyaṃ dṛkkarma nṛṇāṃ pratyakṣakārakam |
śāstrīyavyavahāre tu lokaṃ niṣphalayojanam || 15 ||

abhijid brahmahṛdayaṃ svātīvaiṣṇavavāsavāḥ |
ahirbuhnāmudaksthatvānna lupyante arkaraśmibhiḥ || 16 ||

sūryosuryādhikenyasminnapi ṣaḍbhāni nikṣipet |
sūryāstakālikau kuryāttau ca sūryastatāḍitau || 17 ||

itarāntasthayānyābhirdhanarṇaṃ tatphalaṃ tathā |
bhūyo nāḍyo muhūrtā cedasakṛttābhirastataḥ || 18 ||

astārkamānataḥ paścādanyastaddivaso bhavet |
saṣaḍbhārkadinenyasminna ṣaḍbhāni vinikṣipet || 19 ||

anyatsarvaṃ prakurvīta rāśirūrdhvamadhastataḥ |
udetyanya iti prokta udayāstavinirṇayaḥ || 20 ||

iti śrīsomasiddhānte grahodayāstamānādhikāraḥ saptamaḥ ||

Chapter VIII: Sṛṇgonnatyadhikāraḥ

arkendvoḥ krāntiviśleṣo yutistulyānyathādiśoḥ |
tanmaurvikārkādyaśrendustadicchā guṇitonayā || 1 ||

madhyāhnaścandramākarṇastatsthādiktvādavāgudak |
dvādaśaghnākṣajīvāyāṃ svarṇaṃ lambajyayā bhujaḥ || 2 ||

padaṃ tacchaṅkuvargaikyāt karṇaḥ koṭistu bhāskaraḥ |
bhāskaronendukalikāścandrabimbāṅgulāhatā || 3 ||

bhacakrārddhakalābhaktā śuklakṛṣṇavimaṇḍalī |
vāhū yathādiśaṃ kāṣṭhāṃ madyavindoḥ prasārayet || 4 ||

vāmaṃ kṛṣṇaṃ tataḥ paścānmukhīkotikṛtaṃ tayoḥ |
madhye likheccandrabimbaṃ koṭikarṇayuteḥ sphuṭam || 5 ||

karṇasūceṇa dik śuddhā bimbāparadiśāśritam |
śuklaṃ vā kṛṣṇasūceṇa nītvā tanmukhamatra ca || 6 ||

yāmyottaradiśoścāpaṃ likhecchṛṅgonnatiṃ vadet |
ādau candrasya dṛkkarma kartavyaṃ digviparyayaḥ || 7 ||

uttare ca yathāyogyamityāhuḥ śastrayoginaḥ || 8 ||

iti śrīsomasiddhānte śṛṅgonnatyadhikāroṣṭamaḥ ||

Chapter IX: Pātādhyāyaḥ

yathā tigmāṃśucandrau sta ekāyanagatau tayoḥ |
yoge cakre krāntisāmyaṃ pātaḥ syāt saca vaidhṛtaḥ || 1 ||

bhinnāvanagatau bhākhacchītagu tadyutau yadā |
bhacakrārddhekrāntisāmyaṃ mukhyapātastadā bhavet || 2 ||

sūryacandramasau yāvadanyonyābhimukhaṃ yadā |
saṃghaṭṭanodbhavo bahnirvyatipāta iti smṛtaḥ || 3 ||

yacchubhānāṃ vināśāya nandatīva patatyayam |
vyatipātaḥ prasiddhotra sañgābhedena vaidhṛtaḥ || 4 ||

sa kṛṣṇo dārūṇavapurlohitākṣo mahodaraḥ |
sarvāriṣṭakaro raudro bhūyo bhūyaḥ prajāyate || 5 ||

saṃskṛtāyanabhāgārkacandrābhyāṃ yattadīdṛśam |
lakṣaṇaṃ bhavati prāhurmukhyapātastatopi ca || 6 ||

saṃskṛtāyanabhāgārkacandrayorāśisaṃyutau |
bhārddhatve bhagaṇatve vā krāntisāmyoditāyane || 7 ||

yato dvitīyasaṃkrāntirgrahakrāntigate gatiḥ |
krāntisāmye madhyakālastadbhuktau jyāntareṇa ca || 8 ||

sthityarddhamānayogārddhaṁ tenādyantaṃ yathocitam |
viṣkambhādau saptadaśa tṛtīyoṃśaśca yadbhavet || 9 ||

yogeṃśau ca vyatipātaḥ prajvalajjvalanākṛtiḥ |
vyatipātotra yo ghoraḥ sarvaśobhananāśanaḥ || 10 ||

snānadānajapaśrāddhavratahomādikarmabhiḥ |
prāpyate sumahatpuṇyaṃ tatkālajñānatastathā || 11 ||

iti śrīsomasiddhānte caturthe pātādhyāyo navamaḥ ||

Chapter X: Golādhyāyaḥ

amṛtāṃśuśca bhagavānmanasālocya yajjagat |
dṛśyate sarvamevaitadidaṃ vacanamavravīt || 1 ||

ahameva paraṃ brahma paramātmājarāmaraḥ |
avyakto nirguṇaḥ sākṣī kūṭastho yo nirañjanaḥ || 2 ||

anādipurūṣo ananto hyavāṅmanasagocaraḥ |
satya eva paraṃ jyotiradvitīyaśca kevalaḥ || 3 ||

ānandakāyakaraṇavihīno nirbhayaḥ śivaḥ |
aṇoraṇīyān mahato mahīyān jñānavigrahaḥ || 4 ||

manasaḥ salilaṃ jātaṃ tanme sarvaṃ pratiṣṭhitam |
mayyetra līyate sarvaṃ nātra kāryā vicāraṇā || 5 ||

anādirmama pīyūṣā prakṛtirviśvakāraṇam |
proktamapyākṛtirnāmnā snānasanyāsamadbhutam || 6 ||

no bhinnaṃ nāpyabhinnaṃ ca kutaścidbhinnameva na |
bhinnābhinnaṃ ca no yeṣāṃ vayaṃ vā na bhavānapi || 7 ||

nobhayaṃ kevalaṃ svacchaṃ brahmātmaikatvavadgrahī |
tamo nīhārakalpānte nahi vetti sphuṭāsphuṭam || 8 ||

vyoma śabdavatī mātrā bhinnaṃ tacchabdamātrataḥ |
sparśatanmātrānilobhūdrūpatanmātrapāvakaḥ || 9 ||

rasatanmātrakādāpo gandhatanmātrabhūrataḥ |
tattatsambalitā mātrā etya sarvaṃ prajāyate || 10 ||

avañcīkṛtabhūtebhya etebhyaḥ sotra pañcakam |
vākpañcakaṃ ca caikaṃ syādekaikaṃ jāyate punaḥ || 11 ||

tacca pañcamahābhūtasaṃyukto jñānaśaktitaḥ |
kriyāśaktirmanaḥ prāṇaścāsīccaitaccaturvidham || 12 ||

prāṇo daśavidhaḥ saptadaśabhiḥ śabdapūrvakaiḥ |
liṅgaṃ sukṣmamabhūt tena bhaktārto varttate yadā || 13 ||

apañcīkṛtabhūtāni samāśritya paraḥ pumān |
ākāśavāyutejombubhūmirevaṃ sasarjja saḥ || 14 ||

pareṣāṃ daśame caikaṃ tattaddaṇḍamaṣaḍmukham |
mayi pañcīkṛtaṃ bhūtaṃ svalpakāryaguṇānvitam || 15 |

anye guṇaikavṛddhiḥ syānmahattvāt karaṇasya ca |
karaṇātsāṃśakāryasyādhyalpatvāditi nirṇayaḥ || 16 ||

anantaraṃ tu mukhānāṃ proktānīyā tathā mahī |
bhīmarūpātsaṣṛkṣitvā brahmātmāśiśasūpadam || 17 ||

haimānāmaṇḍakādīnāṃ sarvamantastamo mataḥ |
hiraṇyagarbhohaṃ nāmnā tatrāgresacaranmahān || 18 ||

pañcānanamahaṅkāraṃ brahmāṇaṃ sṛṣṭavān vibhuḥ |
vedān varāsane tasmin sarvalokapitāmahe || 19 ||

sa ca svayaṃbhūḥ sarvātmā tatra gatvā vanaṃ samāḥ |
svayamevātmano dhyānaṃ tadaṇḍamakarod dvidhā || 20 ||

tābhyāṃ sa śakalābhyāṃ ca yāvadbhūmiṃ ca nirmame |
madhye diśontarikṣaṃ ca śāśvataṃ sthānamavyayam || 21 ||

cakṣuṣognirdivānāthaṃ manasā candramā api |
tejobhūkhāmbuvātebhyaḥ kramādaṅgādarakādikam || 22 ||

sa sarvaṃ vibhide vyoma punardvādaśadhā kriyāt |
cakāra nāmānamātmānamahaṃkāro bharūpiṇam || 23 ||

vibhajya kṛtavān sūkṣmaṃ tato viśvaṃ carācaram |
nirmame devapūrvaṃ tu guṇakarma tadādikam || 24 ||

samantādaṇḍamadhye asmin bhūgolo vyomni tiṣṭhati |
tadantare puṭāḥ sapta jñeyāḥ pātālabhūmayaḥ || 25 ||

nirayāstadadhodho vā aṣṭāviṃśatikoṭayaḥ |
tadūrdhvaṃ ṣaṭbhuvarlokāḥ śobhante tasya pārśvataḥ || 26 ||

grahatārādilokāste tatra tatra svarādayaḥ |
tiṣṭhantyādhāraśaktyā ca tattadarhajanānvitāḥ || 27 ||

bhūgolamadhyago merūrūbhayatra vinirgataḥ |
manvindravedamunaya ūrdhvāḥ srotasa uttamāḥ || 28 ||

ūrdhvāṣṭāṅge vasantyete madhyāṣṭāṅge mahāsurāḥ |
adhaḥ śrotasa evānye madhyaśrotasthitogiriḥ || 29 ||

lavaṇābdhirgāṃ paritya sthitosyā mekhaleva hi |
tanmadhye yamakoṭiśca purī laṅka ca romakā || 30 ||

pūrvādyā ca siddhapurī bhūpādāntaritāśca tāḥ |
purīmevāntaraṃ viddhi bhūpādaṃ viddhi śaunakam || 31 ||

sarvepyūrdhvasthitākāśādalpakāyāśca bhūtalam |
paśyanti cakrākāraṃ tu na kapitthopamaṃ mune || 32 ||

uparyātmānamapare tiryaganye mahītale |
adhogātraṃ kalpayanti teṣāṃ kvordhvaṃ kka cāpyadhaḥ || 33 ||

uktānāṃ viṣuvatyūrdhvaṃ purāḥ kheṭā vrajantyamī |
na tāsu viṣuvacchāyā vyakṣadeśaḥ sa tu smṛtaḥ || 34 ||

tataḥ sthānād dhruvo merorūrdhvasthopi ca lakṣyate |
sthitāviva pratīyete merostadvadbhamaṇḍalam || 35 ||

dhruvonnatiṃ bhacakrasya natirakṣamitiḥ parā |
lamvatulyātvabhimukhaṃ yāvadviddhi tadunnatim || 36 ||

bhacakradhruvayormadhye prakṣiptāḥ pravahānilaiḥ |
vrajantyajasraṃsannaddhā grahakakṣā yathākramam || 37 ||

paścādvrajantotijavānnakṣatraiḥ satataṃ grahāḥ |
jīyamānāstu lamvante tulyameva svamārgagāḥ || 38 ||

prāggatitvamatasteṣāṃ bhagaṇaiḥ pratyahaṅgatiḥ |
pariṇāhavaśādbhinnāstadvaśādbhāni bhuñjate || 39 ||

savyaṃ bhramati devānāmapasavyaṃ suradviṣām |
upariṣṭādbhagoloyaṃ vyakṣe paścānmukhaḥ sadā || 40 ||

cumvakobhraminyāyena uccapātā adarśanāḥ |
grahā nānāgatiṃ kuryurdevatā bhagṇāśritāh || 41 ||

pravahaḥ śvasanaścetān svoccābhimukhamīrayet |
evaṃ yat prāṅmukhaṃ yānti taddhanaṃ ṛṇamanyathā || 42 ||

dūrasthitaḥ svaśīghroccādgrahaḥ śithilaraśmibhiḥ |
savyetarākṛṣṭatanurbhavedvakragatistadā || 43 ||

nṛpaṣaḍvargapañcāśadatyaṣṭīṣurasaiḥ kujāt |
antyakendrāṃśanīcāṃśairvakriṇo yānti pātavat || 44 ||

vakrānuvakrā kutilā mandā mandatarā samā |
tathā śīghrātiśīghrākhyā grahānāmaṣṭadhā gatiḥ || 45 ||

mandādipañcasaṃjñāśca vakre cānyaiḥ prakīrtitāḥ |
pātopabhogoḥ kheṭānāmuttarābhimukhaṃ nayet || 46 ||

grahāḥ prāgbhagaṇārddhasthā dakṣiṇābhimukhaṃ tathā |
pātābhyāmapakṛṣyante śīghroccaṃ vudhośukrayoḥ || 47 ||

tacchīghrākarṣaṇāttau tu vikṣipyete yathoktavat |
aste grahasya kṣepānte svakrāntyantātprasāryate || 48 ||

bhūvṛttaṃ krāntibhāgaghnaṃ bhagaṇāṃśavibhājitam |
avāptayojanairvyakṣāduparistho graho vrajet || 49 ||

meṣādāvuditaḥ sūryastrīn rāśīnudaguttaraḥ |
sañcaram prāgaharmadhyaṃ pūrayenmerūvāsinām || 50 ||

karkyādīn sañcaraṃstadvadhaḥ paścārddhameva saḥ |
tulādīṃstrīn mṛgādīṃstrīṃstadvadeva muradviṣām || 51 ||

ato dinakṣaye sāyamayanānto viparyayāt |
vyakṣodgamaṃ ca tiryaktvāttriṃśatā ca kṣapāpyahaḥ || 52 ||

purato bhūcaturthāṃśaṃsvasthānādvāsayadraviḥ |
tattaddigbhyāṃ tattaddiśāmukhaṃ sañcarayannapi || 53 ||

tattatpaścimabhūpāde udaṅ merostu dakṣiṇe |
madhyodayārddharātrāstakālān kuryādraviḥ kramāt || 54 ||

anyatra devabhāge tu hānivṛddhī divāniśoḥ |
anena pratyahaṃ yāmye vyastaṃ devenyathānyathā || 55 ||

bhūmaṇḍalāt pañcadaśe bhāgesaumyāyane dvayoḥ |
nāḍīṣaṣṭyā sakṛdrātrirdeve anyatra diva bhavet || 56 ||

anyathā ayanātpātoparatoyaṃ bhasañcayaḥ |
vartate viparīto hi spaṣṭakrāntyudbhavo hyudak || 57 ||

yāmyaṃ ceti punastasmāttanmeroḥ santi yojanaiḥ |
parato vāsarasyāpi sadā vṛddhikṣayo bhavet || 58 ||

astonmaṇḍalamūrdhvasthāḥ pitaro darśanirgame |
svoparyakaṃ prapaśyanti tanmāsaṃ paitṛkaṃ dinaṃ || 59 ||

kalpendubhagaṇāḥ kṣusmā khatrayābdhidvipāvakaiḥ |
akāśakakṣā sā kakṣā bhaktākalpabhasañcayaiḥ || 60 ||

kalpabhūvāsaraiḥ sarvabhuktiyojanameva sā |
yuktā gatikalāḥ ṣaṣṭhiḥ kṣmārkakakakṣā ca paścimaḥ || 61 ||

vyāsārddhayuktasaṃdhātrī karṇārddhonā tadunnatiḥ |
sattyeva jyotiṣāṃ yogāhatakalpā phalāya sā || 62 ||

kṛtvā samantu bhūgolamabhīṣṭaṃ dāravantataḥ |
ādhārakakṣādvitayaṃ kakṣā viṣuvatī tathā || 63 ||

bhagaṇāṃśāṅgulaistatra krāntyantādaṅgulairapi |
ayanādayanaṃ krāntiḥ kakṣānte ṣaṭdhruvādikam || 64 ||

acchādya śuklavastreṇa yantrayuktān grahādikān |
nyastakṣitijavṛttaṃ ca kṛtvā yantraṃ ca kālavit || 65 ||

bhūmiṃ yadvahubhiryantraṃ pratykṣeṇākhilaṃ gatam |
yasya kṛtvopari sthānamātmanastatra saṃsthitiḥ || 66 ||

kālānte bhagnamakhilaṃ kṛtvā dṛṣṭvā grahādikam |
naṣṭe dive divā rātrau lokatritayage kṣaye || 67 ||

śete brahmā svayaṃ patre nyagrodhasya kṣapāśraye |
mahāniva divāpūrṇe mahī saṃmudritākhilā || 68 ||

sṛṣṭvā punarjagat sarvaṃ kariṣyati yathātatham |
śaktimātraṃca śeṣaṃ tat jagacca pratisañcaret || 69 ||

svasvakarmānurūpaṃ tu yathāpūrvaṃ tathodbhavam |
brahmaṇaḥ śaradāṃ pūrṇe śataśo yāti tajjagat || 70 ||

sarvaṃ kāryaṃ kāraṇe sve līyate sarvakāraṇam |
māyāśavalitaṃ brahmā punaḥ sṛṣṭiṃ kariṣyati || 71 ||

tattvamasyādivākyairyat samyakjñānaṃ prajāyate |
tena naśyati sā māyā nānyathā koṭikarmabhiḥ || 72 ||

vinaṣṭovyākṛtaṃ svasthānirūpaparamāmṛtam |
kūṭasthamokṣa ityuktaṃ citraṃ tatra vicāraya || 73 ||

samādhimārga evāyaṃ saṃsārajayakāraṇam |
etaddhyāyan buddhimān syāt kṛtakṛtyaḥ sa eva hi || 74 ||

iti guhyatamaṃ śāstraṃ bhuktimuktiphalapradam |
adhigamya tataḥ somācchaunakaḥ pūrṇamānasaḥ || 75 ||

lakṣadehāśca dehaiśca pūrṇacakṣuḥ punaḥ punaḥ |
namaskṛtvā niśādevyā vivaśo gadgadasvaraḥ || 76 ||

tuṣṭāva śāntaḥ svagurūṃ śāntaṃ savigrahaṃ munim |
jaya candrāmṛtāṃśo bho jaya śaṅkarabhūṣaṇa || 77 ||

jaya sarvajña sarvātman jaya sarveśvara prabho |
kṛtārthohaṃ kṛtārthohaṃ puṇyohaṃ pūtavigrahaḥ || 78 ||

dhanyohaṃ vītaśokohamityoṃbrahmāhameva ca |
acchedyohamadāhyohamaumekamahaṃ śivam || 79 ||

ahaṃ viṣṇurahaṃ brahmā śakrohamahamaṃśumān |
ahamagnirahaṃ vyoma sarvametadahaṃ jagat || 80 ||

tvatprasādādgrahaśreṣṭha evametadavaimyaham |
trāhi māmiti saṃprārthya praṇipatya punaḥ punaḥ || 81 ||

gurūṃ samarcayāmāsa gandhapuṣpākṣatādibhiḥ |
dakṣiṇāṃ ca hiraṇyaṃ ca bastrabhūṣaṇapūrvakam || 82 ||

abhivādya namaskṛtya paraṁ brahma purātanam |
jñātvedaṃ munayaḥ sarve somālayamanoratham || 83 ||

pratipraṇemurityanye jñānaṃ papracchurādarāt |
sa tebhyaḥ pradadāt prītaḥ samyakjñānamaninditam || 84 ||

tadeva devastadbrahma vedacakṣuḥ paraṃ śubham |
adhyetavyaṃ sadā viprairūttamairvedavādibhiḥ || 85 ||

iti śrīsomasiddhānte caturthe golādhyāyo daśamaḥ ||
|| samāptoyaṃ granthaḥ ||

Critical Aparatus

Manuscripts consulted:
B1 Bhanderkar Oriental Research Institute
B2 Sanskrit college library, Benaras now in Sampurnanada University
P1 Printed Text ed. by Vidyesvariprasad Dvivedi, Jyotiṣsiddhānta-saṁgraha

1. ṣaṣṭimadhuvasantādyairbatsarastu ṛturbhavet B2
   ṣaḍvirmadhuvasantādyairbastaro ṛtubhirbhavet B1
2. {(dvā) daśābdasahasraṁ tu yuga}is absent in B1
3. {Paradharme pra} is absent in B1
4. caturyugānāṁ in place of dṛśānāṁ; ref. B1 & P1
5. mūrkhāmbaranabhovyomaradvedā 4320000 B1, B2, P1
6. rasāgnisurabāṇādriśailārthāḥ 57753376 B1, B2, P1
7. dantāṣṭarasanandākṣinayanāni 229832 B2, P1
8. nabhastarkakhāgatryaṅkanagendavaḥ 17937060 B1, B2, P1
9. khadasrāśvivedaṣaḍvahnayastathā 364220 B1, B2,P1
10. tarkādrivahnyākṛtinabhodrayaḥ 7022376 B2, P1
11. śanerbhujaṅgaṣaṭpañcatarkābdhisitaraśmayaḥ 146568 B1, B2, P1
12. indūccasya trikṛtyaṣṭabhujaṅgamapayodhayaḥ 488203 B1, B2, P1
13. nāgāgniyamaṭṭagavahnihastāḥ 232238 B1, B2, P1
14. māheśvarāmukhyo divase brahmaṇodhunā (sukhyo in place of mukhyo in P1), 'divase' is omitted in B1
15. phalajyā mandajyā (phalajyo mandajyo B1) P1
16. nātyantarāṭṭaggrohayoḥ ṣaṣṭighnaṃ śeṣaliptikāḥ B2, P1
17. tadati kendra bhuktā B2, (tadyutaṁ kendrabhuktervā in B1)
18. tathārkeṇa hate trijye B1, B2, P1
19. harabhāśrutī B2

20. etaddvādaśasaṁgunā B1, B2
21. labdhaṃ yā viṣuvatprabhā B2, P1
22. mṛgādyāḥ B2, P1
23. yojokānāṁ B2, P1 (yojanānāṁ in B1)
24. sāśīti catuḥśati B1, B2
25. bhacakrārṅgo B2, P1 (bhacakrānrṅgo in B1)
26. kriyabhārṅgārdvakonake B1, P1
27. māsāntara tadbimbaṃ B2, P1 (masāntare tadbimbeṁ in B1)
28. lagnaṃ jyā B2, P1 (lagnaṁ jyāṁ in B1)
29. vargayośca na B1, P1
30. arkadvā B1, P1
31. sphuṭasthire kṣepa B2, P1, (sphuṭasthite in B1)
32. pūrvāparakapālayoḥ B1, P1
33. prāgarṅgādhikasya vṛttasya B2, P1, (prāgmādhikasya in B1)
34. ravīndvorvivarāntastaṃ B2, P1, (ravīndraviparitasya in B1)
35. rājña B1, P1
36. bhāskarocchannam kṛtaṃ B1, P1
37. tvaryāntu B2, P1 (kharnātu in B1)
38. mandaśīghrādhikānetā (B1, P1)
39. sabimba (B1, P1)
40. snānasanyātadadbhetam (this word is not clear in B1)
41. sphuṭāsphuṭam B1, P1
42. pañcānanamahaṅkāraṁ B1, P1

Translation with Notes

ch. I. v 1–4

Pay homage to son of Vṛhaspati, sage Śaunaka asked him to talk about the positions, motions, time etc. of the planets and planet like heavenly bodies (asterisms or like that).

v 5–6

After listening the queries Candra said to Śaunaka that this knowledge is rare and those who are expert in Veda, Vedanga and Vedanta can only learn this subject.

v 7–8

Candra starts with Time which is very important in astronomy. (He first told the units of time) Ten gurvaksharas are equal to one prāṇa, six prāṇa is equal to one vināḍi, six vināḍī is equal to one nāḍī sixty nāḍī is equal to one day and thirty days equal to one month.

v 9–10

(These verses describe) the units of time in concise form i.e. month, day, nāḍī, vināḍī, season etc. The ahorātra (day-night) of asuras are opposite from god's ahorātra.

v 11–14

The combination of day and night six months duration each, constitutes a divine day. Three hundred and sixty such divine days constitute a divine year. A divine or demonical year is equal to 360 solar years. The origin of divine day and night has been identified from the duration of darkness. Caturyuga is an amount of period consisting of 12 thousamd divine years or 4320000 solar years. A manvantara is constituted by 71 yugas.

v 15–20

A kalpa, the higher unit of measurement of time, consists of 14 manvantaras along with their twilights. One twilight means to the period of kṛeta yuga proceeds the kalpa. So, there are fifteen twilights in all in a kalpa. One kalpa is known as the day of Brahmā. The total span of life of Brahmā is stated to be 100 Brahma years. The small units of measurement of time are (again): sixty seconds (vikalā) make a minute (kalā); sixty kalā make a degree (bhāga) thirty of degrees composed a sign (rāśi) and twelve rāśis make a revolution (bhagaṇa).

v 21–24

In a yuga, the revolutions of the Sun, Mercury, and Venus and of the conjunctions (śīghra) of Mars, Saturn, and Jupiter moving eastward, are four million, three hundred and twenty thousand (4,32,0000); of Mars, two million, two hundred and ninety six thousand, eight hundred and thirty two (2,296,832); of Mercury, seventeen million, nine hundred and thirty seven thousand and sixty (17,937,060); Of Jupiter, three hundred and sixty four thousand, two hundred and twenty (364, 220); of Venus's conjunction, seven million, twenty two thousand, three hundred and seventy six (7,22376); of Saturn, one hundred and forty six thousand, five hundred and sixty eight (146,568).

v 25–27

The Moon's apsis (ucca) in an age, four hundred and eighty eight thousand, two hundred and three; of its node (pāta), in the opposite direction, two hundred and thirty two thousand, two hundred and thirty eight.

Of the planet like heavenly objects (asterism), considering risings and settings, one billion, five hundred and eighty eight million, nine hundred and seventeen thousand, eight hundred and twenty eight; the number of risings of the asterisms and diminished by the number one billion, five hundred and eighty two million, two hundred and thirty seven thousand, eight and twenty eight; gives the number of risings of the planets of an age.

v 28–31

The lunar days are of one billion six hundred and three million eighty; of intercalary months, one million five hundred ninety three thousand three hundred and thirty six. Taking the civil days from the lunar, the remainder is the number of omitted lunar days (tithikṣaya). The revolutions of the Sun’s manda (apsis) are three hundred eighty seven; of that of Mars, two hundred and four; of Mercury, three hundred sixty eight; of Jupiter, nine hundred and that of Venus, five hundred thirty five.

v 32–34

Of the apsis of Saturn, thirty nine; the revolutions of the nodes, retrograde etc. are that of Mars, two hundred fourteen; of that of Mercury, four hundred eighty-eight; of that of Jupiter, one hundred seventy four; of that of Venus, nine hundred three; of the node of the Saturn, the revolution of a kalpa are six hundred and sixty-two from the kalpa, forty three thousand and four hundred years before the creation of earth.

v 35–39

The twenty eight ages that are past, and likewise the present golden age, from their sum if subtract the sum of creation, divine years started. The result is the time elapsed, one billion nine hundred fifty eight million, and eighty thousand solar years. (To this adding the number of years of the time, reducing the sum to months and add the months of the current year) setting the result separately, multiplying it by the number of intercalary months, and divide by that of solar months, and adding to the last result the number of intercalary months are found.

v 40–46

In the Romakasiddhānta the positions and motion of planets is indicated. Multiplying the daily motion of a planet by the distance in longitude (desāntara) of any place and dividing by its corrected value. Thus succession of the week-day takes place.

Multiplying the sum of days by the number of revolutions of any planet, and divide by the number of civil days, the position of the planet is determined. The places of conjunction and apsis of each planet, and in like manner of the nodes, which have a retrograde motion, subtracting the result from the whole circle. Multiplying by twelve to the past revolution of Jupiter, adding the signs of the current revolution (bartamānairgatestathā) and divide by sixty, the remainder marks the year of Jupiter's circle, counting from vijaya.

V 47–53
When in a total eclipse of the Moon, the emergence (unmīlana) takes place after the calculated time for its occurrence, then the place of the observer is to the east of the central meridian. Multiplying by the difference of the times of unmīlana and nimīlana in nāḍīs the corrected circumference of the earth at the time of observation and dividing by sixty, the result indicates the distance of the observer from the meridian. The succession of the week-day takes place, to the east of the meridian, at a time after midnight equal to the difference of longitude in nāḍīs.

Spaṣṭādhikāra

2. V. 1–18
Pindajyā is defined as the mathematical tool which is achieved by dividing by tabular sines in succession by the first and adding them, what is left after subtracting the quotients from the first and the result is twenty-four tabular sines; three thousand four hundred and thirty-one; three thousand four hundred and thirty eight; subtracting these in reversed order, from the half-diameter, gives the versed-sines. The size of greatest declination is thirteen hundred and ninety seven; by this multiplying any sine, and divide by radius; the arc corresponding to the result is said to be the declination.

07, 29, 66, 117, 182, 261, 354, 460, 579, 710, 1007, 1345, 1528, 1719, 1918, 2123, 2333, 2548, 2767, 2989, 213, 3438 are the utkramajyā of $3\frac{3}{4}$ part of a circle. For mass and others, the degrees of epicycle of the conjunction are, at the end of the even quardrants, two hundred and thirty five, one hundred and thirty three, seventy, two hundred and thirty two, thirty nine. The process of correction for the apsis is the only one required for the Sun and Moon; for Mars and other planets are processes that for the conjunction that for the apsis, again that for the apsis and that for the conjunction, in succession.

V. 19–

Multiply the base sine by the difference of the epicycles at the odd and even quadrants, and divide by radius, the result is corrected epicycle. By this corrected epicycle, multiply the base-sine and perpendicular sine respectively, and divide by the number of degrees in a circle; the arc corresponding to the result from the base-sine is the equation of apsis. To the mean place of the planet applying half the equation of the conjunction, likewise half the equation of the apsis to the mean place of the planet and thus apply the whole equation of the apsis and that of the conjuction.

Multiplying the daily motion of a planet by the Sun's result from the base-sine and dividing by the number of minutes in a circle, the result of planet's true place is determined in the same direction applied in the Sun.

From the mean daily motion of the Moon, subtract the daily motion of its apsis in order to treat the difference, applying the result as an additive or subtractive equation, to the daily motion. The equation of planet's daily motion, is to be calculated in the same way as the place of the planet in the processes for the apsis. Multiply the daily motion by the difference of tabular sines corresponding to the base sine of anomaly, and then divide by two hundred and twenty-five. Subtracting the daily motion of a planet, corrected for the apsis, from the daily motion of its conjunction, then multiplying the remainder by the difference between the hypotenuse and radius; then dividing by the variable hypotenuse; the result is additive to the daily motion when the hypotenuse is much greater than the radius, and subtractive when it is less, then the remainder is the daily motion in a retrograde order. When latitude and declination are of same direction, the declination (krānti) is increased by the latitude; when of different direction, it is diminished by it, to find the true declination. Multiplying daily motion of a planet by the time of rising of the sign in which it is, and dividing by eighteen hundred, the quotient add to or subtract from, the number of respirations in a revolution; the result is the number of respirations in the day and night of that planet. Calculate the sine and versed sine of declination; then radius, diminished by versed-sine, is the day radius.

From the number of kalās in the sum of the longitudes of the Sun and the Moon are found the conjunction (yogas), by dividing that sum by the portion of an asterism.

When declination (in the south) is multiplied by two, the day and the night of the asterism may be determined.

Tripraśnādhikara

3. V. 1–10

Draw a line between east and west through an extremity of the equinotical shadow, the distance between any given shadow and the line of equinotical shadow denominate the measure of amplitude. The square root of the sum of the squares of the gnomon and the shadow is the hypotenuse. If from the square of the later the square of the gnomon be subtracted, the square root of the remainder is the shadow. The gnomon is found by the converse.

The sine of latitude, multiplied by twelve and divided by the sine of co-latitude, gives the equinotical shadow.

Multiply the sines of colatitude and of latitude respectively by the equinotical shadow by twelve, and divide by the sine of declination; the results are the hypotenuse when the Sun is on the prime vertical. If the sine of declination of a given time be multiplied by radius and divided by the sine of co-latitude, the result is the sine of amplitude, and if further multiplied by the hypotenuse of a given shadow at that time, and divided by radius, it gives the measure of amplitude in digits (aṅgula). If from half the square of radius, the square of the sine of amplitude be subtracted, and the remainder multiplied by twelve, and again multiplied by twelve and then further divided by the square of the equinotical shadow increased by half the square of the gnomon – the result obtained is called the surd (karañi).

If the sine of altitude of the southern directions (intermediate) and the Sun's revolution takes place to the south or to the north of the gnomon, the sine of altitude is that of the northern intermediate directions. The square root of the difference of the squares of that and of radius is recognized the sine of zenith-distance. If then the sine of zenith-distance and radius be multiplied respectively by twelve, and divided by the sine of altitude, gives results of the shadow and hypotenuse at the angles under the particular circumstances. The day-measure radius is to be increased by the sine of ascensional difference when declination is in the north or diminished by the same, when declination is in the south. The result is day-measure and this diminished by the versed sine of the hour-angle, then multiplied by the day radius and divided by the radius, is the divisor (cheda). Again being multiplied by the sine of colatitude (lamba) and divided by the radius gives the sine of altitude.

In succession, the sines of one, of two and of three signs, the quotients, converted into arc, being subtracted, each from the following; beginning with Aries, the time of rising at Lankā.

Lunar Eclipse

4v 1–

Multiplying the earth's diameter by the true daily motion of the Moon and dividing by its mean motion; the result is the earth's corrected diameter. The difference between the earth's diameter and the corrected diameter of the Sun is to be multiplied by the Moon's mean diameter, and further divided by the Sun's mean diameter, then subtract the result from the earth's corrected diameter and the remainder is the diameter of the shadow. The earth's shadow is distant half the sign from the Sun, when the longitude of the Moon's nodes the same with that of the shadow, or with that of the Sun, or when it is a few degrees greater or less, there will be an eclipse.

The Moon is the eclipser of the Sun, coming to stand underneath it; the Moon moving eastward enters the earth's shadow and the later becomes the eclipser. Subtracting the Moon's latitude at the time of opposition or conjunction from half the sum of the measures of the eclipsed and eclipsing bodies, whatever the remainder is, that is the amount obscured. Dividing by two the sum and difference respectively of the eclipsed and eclipsing bodies; from the square of each of the resulting quantities subtract the square of the latitude, and taking the square root of the two remainders, these multiplied by sixty and difference of the daily motions of Sun and Moon, half of the duration and half of the time of total obscuration are found.

Multiply the daily motions by the half duration and divide by sixty, subtract the result for the time of contact and add for that of separation respectively. By the latitudes, the half duration and half time of total obscuration are to be calculated, and the process repeated. The middle of the eclipse is to be regarded as occurring very close to lunar day; if from that time the time of half-duration be subtracted, the moment of contact is found, if it is added, the moment of separation. If from and to it is subtracted and added respectively, in the case of total eclipse, the half-time of total obscuration, the results are called immersion and emergence. If from the half duration of the eclipse any given interval be subtracted and the remainder be multiplied by the difference of the daily motions of the Sun and Moon and divided by sixty, the result will be perpendicular. The latitude is the base, the square root of the sum of their squares is the hypotenuse; subtract this from half the sum of the measures, the remainder is the amount of obscuration at a given time. If the time be after the middle of the eclipse, subtract the interval from the half duration on the side of separation, the result is the amount remaining obscured on the side of separation.

As much remains after diminishing the Moon's latitude by the difference of the semi-diameters of the shadow and the Moon, so much of the Moon's diameter is visible in the sky.

Taking the sum of the akṣavalana and ayanavalana, when they are in like directions and subtract when they are in unlike directions, then find the Rsine of that, this corresponds to the circle of signs. Divide the nāḍis of the unnatakāla by the true semi-duration of the day and increase the result, they are obtained in an aṅgula which is defined as the measure of the central width.

Parilekhādhyāya

5
Since, without a projection, the precise differences of the two eclipses are not understood, I shall explain the exalted doctrine of the projection. Having fixed, upon a well-prepared surface, a projected point in the first place, with a radius of forty-nine digits, a circle for the deflection is found.

Setting the result down in the two places, multiply it by the number of omitted lunar days, and divide by that of lunar days, then subtract from the last result and the number of omitted lunar days at midnight, on the meridian of lanka is obtained.

Nakṣatragrahayuddhasamāgama

6
Dhruva is defined as if the positions of asterisms in kalā, if the share of each one be multiplied by ten, increased by minutes in the portions of the past asterisms the results of the polar longitude will be forty eight, forty, sixty five, fifty seven, fifty eight, four, seventy eight, seventy six, fourteen, fifty four, sixty four, seventy four, seventy four, sixty four, eighty six. Uttara-āshādha is at the middle of the portion of Pūrva-āshādha, the position of śravaṇā is at the end of Uttara-āshādha; śravisthā is at the point of connectionof the thirdand fourth quadrants of śravanā, then in their portions, eighty, thirty six, twenty two. Now their respective latitude, reckoned from the point of declination of each, ten, twelve, five north, five, ten, nine south. North six, nothing south, seven north, nothing, twelve, thirteen south, eleven, two then thirty seven north; south, one and half, three fourth, nine, five and a half, five north, sixty, thirty and thirty six south, half a degree, twenty four north, twenty six degree, nothing for Asvini etc. in succession. Agasthya at the end of Gemini, at eighty degree south and Mṛgavyādha is situated in the twenth degree of Gemini; its latitude reckoned from point of declination, is forty degree south; Agni and brahmahridaya are in Taurus, the twenty two degree. If sphere constructed one may examine corrected latitude and polar longitude. Of the two phālgunis, two bhādrapadas, one of each is

stated to be in northern; that which is the western and the northern stars, of each second-situated in westward, śravisthā is in west. Of Jesthā, Śravana, Pushyā likewise Revati is in the southern. Of Rohini, Punarbasu and Mulā, it is eastern, in each case the junction stars are sthula than others.

Udayāstādhikāra

7

It is required to get knowledge of risings and settings of the heavenly bodies of inferior brilliancy compared to Sun. The planets whose longitudes are greater than the Sun, go to their setting in the west; when it is less, setting in the east; Mercury and Venus are retrograding. Svāti, Agasthya, Avijit, Brahmahṛdaya etc. rise and set at thirteen degrees. Hasta, Śravanā, Phālguni, Śravisthā, Rohini and Maghā become visible at fourteen degrees as well as Viśakhā and Aśvini. Krittika, Anurādhā, Mulā, and likewise Aśleśā and Ādrā are seen at fifteen degrees; the pair of Āśādhās, Bharaṇi, Puśyā and Mārgyaśīrśa are seen at twenty one degrees; the rest of the asterisms become visible and invisible at seventeen degrees.

Śṛṅgottarādhikāra

8

The Moon is visible at twelve degree distance from the Sun in the west or invisible in the east. Adding six signs to the longitudes of the Sun and Moon respectively, the ascensional equivalent in prāṇa is obtained; whereas if the Sun and Moon are in same sign their interval is ascertained in kalās. Thus multiplying the daily motions of the Sun and Moon by the result in nāḍis, then dividing by sixty, and adding to the longitude of each corrected value for its motion, thus their result in prāna is obtained. Of the declinations of Sun and Moon, if the directions are the same, take the difference, whereas in the contrary case take the sum. The corresponding sine is to be regarded as south or north, according to the direction of the Moon from the Sun. Multiplying the result by the hypotenuse of the Moon's mid-day shadow, and when it is in the north, multiply by twelve, when it is in the south add it to the same. The result, divided by the sine of colatitude gives the base, in its own direction; the gnomon is the perpendicular; the square root of the sum of their square is the hypotenuse.

Pātādhyāya

9

When the Sun and Moon are in the same side of any solstice, and when the sum of their longitudes being a circle they are of equal declination. When the Sun and Moon are in opposite side of any solstice, their declination are the same. Vyātipāta is defined by the difference of vaidhṛti. Being black, of frightful shape, bloody eyed, big bellied, the source of misfortune to all, it is produced again and again. Thus the knowledge of the time of occurrence is obtained. When the equality of declinations of the Sun and Moon takes place in the near of the equator, the aspect may then occur a second time; in the contrary case, it may fail to occur.

Golādhyāya

10

This chapter is the part of cosmogony, geography and creation. Astronomy related terms are used here and approach is like a student asked the teacher about his questions. Like Sūryasiddhānta it is not as the questioning method all over the chapter but there are statements. In this astronomical text, mathematical as well as geometrical concepts are there but there are so many myths included in this chapter. 'He, in the scripture, is denominated the goldren–wombed, the blessed being the first existence, he is called as, Āditya, the generator.' Golādhyāya has been flourished day after day in classic India. It has been matured enough in Bhaskarāchārya's Siddhāntaśiromoni. He compiled all the existing knowledge in the part of his book. Here he used the spherical astronomy in a suitable manner.

This chapter contains the description of creation. It describes the phenomena of night and day in different latitude and zones, relation of the motion of the circle of asterisms and of the planets. It gives the relation between the orbit of the asterisms, the circle of the sky and orbits of the planets. It gives the rule to determine the distance of the planets from the earth. It also gives the length of the orbits of the planets.

Oh God! tell me the creation of visible elements. Oh Parambrahma! (you) are the supreme, unmanifested, free from qualities. From mind, the eather, water, earth, wind, fire were produced. The creation of this universe is absolutely dependent on these five elements.

Amonst them, first three elements are more important. In order to the production of the creation, the supreme god creates ahaṁkāraṁ, Brahmā (Pitāmaha). Pitāmaha bestowed the Veda as gift and established Brahma in the middle of the Brahmāṇḍa, he revolves and radiates light. From eyes, Agni; from mind, Moon; are born. Again, dividing himself twelve-fold (rāśi) further to asterisms, (twenty-seven-fold) are manifested. Then he divided whole universe in several parts mixing three properties (satta, raja, tama) in various proportions and produced different forms of matter.

The earth-globe (bhugol) stands in the middle of the egg, bearing the supreme might of Brahmā. Seven cavities are within it (residence of serpents and demons). The number of cavities is twenty-eight and about these cavities, six spheres (imaginary) are there. On these spheres, planets, asterisms, exist in their own pace. Meru is passing through the earth globe and producing on either side. At the upper end, Indra and other gods, the great sages (maharshi) while the demons (mahāsura) stay in the lower end and in between two, mountains and occeans separate these two spheres (loka). Surrounding it one side is great salted ocean, and mountains are referred as Yomakoti, Puri and Lanka. In the eastward, the siddhyapuri (is situated), where the sages (lived) there without trouble. The cities are situated at a distance from one another of a quadrant of earth's circumference (grahakakṣa). Above them when the Sun is in the equinoxes, then no equinotical shadow (viṣuvachāyā) is shown. In both directions from meru, are two pole stars, fixed in the midst of the sky. These two pole stars are fixed on the line of latitudes. Because of this position, cities of colatitude are in 90 degree and at meru also equal degree is maintained.

In the half revolution beginning with Aries, the Sun being in the hemisphere of the gods, is visible to the gods, but while in the beginning with Libra he is visible to the demons. These two hemispheres are (imagined) as the opposite to each other.

(The cause of planetary motion) Anywhere in the globe, everybody while standing in a place thinks his place to be the uppermost. The circle of asterisms, bound at the two poles, impelled by the provector (pravāha) wind, revolves eternally, if any cause disturbs it (anyathā). The motion of the planets is of eight kinds; retrograde (vakra), somewhat retrograde (anuvakra), transverse (kuṭila), slow (manda), very slow (mandatara), even (sama), very swift (śīghratara), and swift (śīghra).

Multiplying the earth-circumference by the Sun's declination, and dividing by the number in a circle, (the result) in yojana, is the distance from the place of no latitude when the Sun is passing overhead.

The Sun, rising at the first of Aries, while moving on northward for three signs, completes the former half day of the dwellers upon meru.

While moving through the three signs beginning with Cancer, (completes) later half of the day; he (accomplishes) the same for the enemies of the gods while moving through the three signs beginning with Libra and next with Caprion, respectively.

Hence, their night and day are mutually opposed to one another; and the measure of the day and night is by the completion of Sun's revolution.

The Sun, during his northern and southern progress revolves directly over a fifteenth part of the earth's circumference, on the both sides of gods and demons. There occurs once, at the end of the Sun's half-revolutions from solstice to solstice, a day of sixty nadis, and (a night of the same length).

If the stated number of revolutions of the (Moon's orbit), the result is to be known as the orbit of the ether (ākāśakakṣa), so far does the rays of the Sun penetrate.

General Notes

The astronomical works of India are divided into two categories, viz. the Siddhānta treatises and the Karana treatises.

The Somasiddhānta belongs to the first category. The Śabda-kalpadruma, a Sanskrit encyclopaedia, mentions nine Siddhantas viz. 1) Brahmasiddhānta, 2) Sūryasiddhānta, 3) Somasiddhānta 4) Bṛhaspatisiddhānta 5) Gargasiddhānta 6) Nāradasiddhānta 7) Parāśarasiddhānta, 8) Pauliśasiddhānta and 9) Vaśiṣṭhasidhānta. The other important Siddhānta alluded is Romaka.

Most of the siddhāntas are lost. At the time of Varahamihira, whose date is about 550 A.D. five prominent Siddhāntas which he considered worthy of notice were extant and he has given a summary of those Siddhāntas in his Pañcasiddhāntikā. These are: 1) Paitāmaha, 2) Vaśiṣṭha 3) Romaka 4) Pauliśa and 5) Saura.

The main aim of the Somasiddhānta is to give the astronomical rules and not the explanatory process by which those rules were derived. The style of the work shows that it is an abridged form of some voluminous work where the entire process would have been given with all definitions and explanations. The Somasiddhānta omits all such details and states only the formulae with the chief object of committing them to memory for summary calculation and as the early Indian astronomical works this siddhāntic text is full of nice linguistic richness.

The astronomical features of the Somasiddhānta are as follows:

1. **Yugas:** One of the most important astronomical theories of India is the theory of epochs, mentioned in the Somasiddhānta. According to the epoch theory, a Caturyuga consists of 43,20,000 solar years. Its sub-divisions being Kṛta, Tretā. Dvāpara and Kali yugas consisting of 17,28,000; 12,96,000; 8,64,000 and

4,32,000 solar years respectively. Seventy-one caturyugas also known as Mahayugas constitute a Manvantara and fourteen Manvantaras along with fifteen twilights equal to the period of a Kṛtayuga constitute a Kalpa which is the day of Brahmā, the night being also of the same duration.

The basis and purpose of the division of time into the epochs of long duration are purely astronomical. The main purpose of the epoch theory is to calculate the mean annual and daily motions of the planets to the most approximate value. The complete revolutions of a planet in a Mahayuga are divided by the civil days of that period which gives the mean daily motion of the planet.

2. **Computation of Civil Days:** It is for calculation of the mean positions of the planets on a particular day of any period. The Somasiddhānta has given a detailed method of computing the civil days on the basis of which the other data such as the mean positions of the planets their apices, nodes and conjunctions are determined.

3. **Orbits of the Planets and their Distances**
The Somasiddhanta gives the methods to know the orbits of the planets and their distance from the Earth. The linear motion of all the grahas is the same. Their angular motion varies according to the distance of the planet from the Earth. Thus the planet at a larger distance from the Earth will have a larger orbit. The orbit of the other is obtained by multiplying the orbit of the Moon by its revolutions in a Kalpa. The orbits of other planets are obtained by dividing the orbit of the ether by the revolutions of the respective planets in a Kalpa.

4. **Cause of the Revolution of the Heavens and the Planetary Motions**
The cause of the motions of the planets and asterisms is the wind called Pravāha. The asterisms as well as the planets move westward. But the asterisms move at a faster speed with the

result that planets lag behind and appear as moving eastward. According to the Somasiddhānta, the circle of asterism is tied with both the poles and moves around them by the force of the Pravāha. The orbits of the planets tied with the circle of asterisms also move along with the asterisms.

5. According to the Somasiddhānta, the annual rate of precession is 54 seconds (vikalās) whereas according to the modern concept it is slightly more than 50 seconds.

6. **Eclipses:**
   The rules for calculating the various stages of the eclipses are also correct to the most approximate extent. While determining the solar eclipse the parallax of the Sun has also been taken into consideration. The rules for determining the directions of the contact and separation and the amount of obscuration are undoubtedly correct to every extent and the methods of projecting the eclipse on a map are perfectly in order.

7. **Junction and other States:** the Somasiddhanta has marked the positions of the prominent stars of the asterisms called Junction-stars (yoga tārās) because the conjunction of the planets with the asterisms is determined with respect to them.

Other stars, the positions of which have been mentioned by the Somasiddhanta are: Agastya, Mṛgavyādha, Agni, Brahmahṛdaya, Prajāpati and Apamvatsa.

These are only the salient features of astronomical aspect of the Somasiddhanta.

Somasiddhanta	Bhaskara	Manusmrti
10 gurbakshara = 1 prāna	18 Nimesas = 1 Kastha	18 Nimesa = 1 Kastha
6 prāna = 1 vinādi	30 Kasthas – 1 kata	30 Kasthas = 1 Kata
60 vinādi = 1 nādi	30 Kalas – 1 Ghati	30 Kalas = 1 Muhurta
60 nādi = 1 day	2 Ghatis = 1 Ksana(muhurta) 30 Muhurtas = 1 day and night	30 Muhurtas – 1 day and night

After defining the divisions of time up to nāḍi, the Somasiddhānta defines the measures of day, month and year of various types of time reckonings in use in India, as follows.

Sidereal: Sixty nāḍis constitute a sidereal (nakṣatra) day and night. Thirty such days constitute a month and twelve such months constitute a sidereal year.

Civil: A civil (savana) day including night is the amount of period taken from one Sun-rise to another

Thirty civil days constitute a month and 12 civil months constitute a civil year.

Lunar: thirty lunar days constitute a lunar month. Twelve lunar months constitute a lunar year.

Solar: the transit of the Sun from one sign of the zodiac to another is known as saṇkrānti which is equal to one solar month. Twelve such months constitute a solar year.

Divine and Demoniacal Day and Year

Twelve solar months constitute a divine day. The divine day is also considered as one demoniacal night and the divine night is the demoniacal day. The combination of day and night (ahorātra) is designated as the day. Three hundred and sixty such divine days constitute a divine or demoniacal year is equal to 360 soar years or 360 × 360 = 129600 Solar days.

The concept of divine and demoniacal day and night has originated from the duration of sunshine and darkness at the North and South poles. The sunshine and darkness at the South Pole are known as the demoniacal day and night respectively.

Caturyuga

Caturyuga is an amount of period consisting of 12 thousand divine years or 43,20,00 solar years. This period is divided into four sub-periods known as Kṛtayuga. Tretā yuga, Dvāpara yuga and Kali yuga. The measurement of each sub-period is obtained by dividing the entire period of a yuga (i.e. 43, 20,000 solar years) by ten and multiplying the quotient by four, three, two and one respectively. Thus, the measurements of these sub-periods are as follows.

Kṛeta	$\frac{4320000 \times 4}{10}$	= 17,28,000 years
Tretā	$\frac{4320000 \times 3}{10}$	= 12,96,000 Years
Dvāpara	$\frac{4320000 \times 2}{10}$	= 8,64,000 Years
Kali	$\frac{4320000 \times 1}{10}$	= 4,32,000
	Total (Caturyuga or Yuga)	= 43,20,000 Years

Yuga	Morning twilight	Central period	Evening twilight	Total
Kṛta	1,44,000	14,40,000	1,44,000	17,28,000
Tretā	1,08,000	10,80,000	1,08,000	12,96,000
Dvāpara	72,000	7,20,000	72,000	8,64,000
Kali	36,000	3,60,000	36,000	4,32,000
Total				43,20,000

Manvantara

A Manavantara is constituted by 71 yugas. At the end of each Manvantara there is a twilight equal to the period of Kṛta Yuga which is marked by inundation.

Thus, the period of Manavantara = 71 × 43,20,000
= 30.67,20,000 solar years
Period of twilight = 17,28,000 solar years

Kalpa

The next higher unit of measurement of time is the kalpa which consists of 14 Manvantaras alongwith their twilights. One twilight equal to the period of Kṛta yuga precedes the Kalpa. 14 Thus there are fifteen twilights in all in a Kalpa.

So, one Kalpa = 14 Manvantaras + 15 twilights of the duration of Kṛta yuga each

= 14 × 71 Mahāyugas + 15 Kṛtayugas

= 994 Mahāyugas + $\frac{15 \times 4}{10}$ Mahāyugas

$$\left(1 \text{ Kṛta} = \frac{1.\text{M.Y.} \times 4}{10}\right)$$

= 994 Mahāyugas + 6 Mahāyugas

= 1000 Mahāyugas

= 1000 × 12000

= 12,000,000 divine years

= 1000 × 43,20,000

= 4,32,00,00,000 Solar years

Life of Brahmā

One Kalpa is known as the day of Brahmā. The equal amount of period is his night in which the creation is deluded and remains latent for a period of a Kalpa before it re-emerges.

The total span of the life of Brahma is stated to be 100 Brahma years. One Brahma year contains 360 Brahma days (including nights). One day and night of Brahma is constituted by two Kalpas or 2000 Mahāyugas

Time Reckoning: Now first define reckonings as well as the purposes for which they are used:

1. **Saura (Solar) Years**: Due to the annual revolution of the earth around the Sun the Sun appears moving from west to east on its path known as the ecliptic. The ecliptic is divided into twelve signs, corresponding to the signs of the zodiac. On the day of vernal equinox (known as Meṣa), when the days and nights are equal the Sun is stated to be at zero degree, being at the equator. After making a complete revolution the Sun comes again on the equator. The time taken by the Sun in making a complete revolution is known as a solar year

2. **Solar Month**: the transit of the Sun from one sign to another, during its course of revolution, is known as Saṅkrānti. Thus, there are twelve Saṅkrāntis in a solar year. The interval of time between two Saṅkrāntis is known as a solar month.
3. **Solar day**: The time taken by the Sun in travelling one degree is known as a solar day.

   The solar year measured on the basis of true equinox regardless of its original position is known as tropical solar year (sāyana saura varsa)
4. **Solstices**: From the time when the Sun transits in the Makara sign, the Sun is said to be of northern progress (Uttarāyana) up to a period of six months. From the time of the Sun's transit into the Karka sign the Sun is said to be of southern progress upto a period of six months.
5. **Six Seasons**: According to the Somasiddhanta, the seasons are determined from the solstices. The six seasons of two solar months each are reckoned from the Makara sign, the southern solstice.
6. **Lunar-reckoning**: The lunar-reckoning is not an independent calendar but depends on the relative distance of the Moon from the Sun. When the Moon comes into conjunction with the Sun, it is said to be amāvasyā, the moonless night. As soon as the distance between the Moon and the Sun becomes 12 degrees, it is said to have past the one lunar day. When the distance becomes 24 degrees two lunar dates are past. Thus, the lunar dates increase in the multiples of twelve degrees. At the end of 15 such dates the Sun and the Moon become 180 degrees apart and it is known as the end of the Pūrnimā. After thirty such dates, the Moon again comes into conjunction with the Sun and the ley is known as the end of the Amāvasyā. The lunar dates are known as tithis. Thus, thirty tithis constitute a month, known as lunar month and twelve lunar months constitute a lunar year.
7. **Intercalary months**

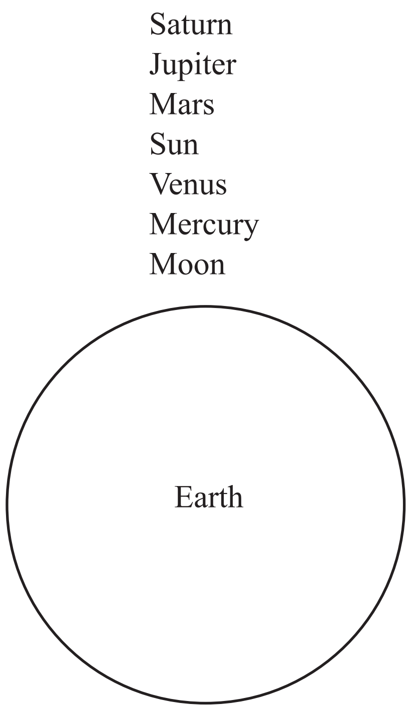
   In connection with the lunar-reckoning it is necessary to make a mention of the intercalary months, in order to calculate the mean and true positions of the Moon. In practice, we use 12 lunar months in a solar year. But the number of civil days in a lunar year is less than the number of days in a solar year by about 10.89170 days. Thus, in about thirty-three months, the difference of about one lunar month takes place. For an adjustment with the solar calendar, the difference is reduced by dropping the increase. This dropped month is known as the intercalary month

8. **Sidereal reckoning:**
   Due to the rotation of the earth on its axis, the stars in the sky appear as moving from east to west. So, the circle of asterisms makes a complete revolution in about 23 hours, 56 minutes and 4 seconds. This period is known as the sidereal day. Thirty such days make a month and 12 such months make a sidereal year.
9. **Civil (savana) Reckoning:**
   The civil day is determined by the interval from rising to rising of the Sun. Thirty such days constitute a month and 12 savana months constitute a year.

In ancient India the grahas were considered to be seven, the Sun, Moon, Mars, Mercury, Jupiter, Venus and Saturn. They were considered to be geocentric presuming that the planets move around the earth.

Order of the Planets: In the Somasiddhanta, the planets are stated to be revolving in the Brahmāṇḍa below the orbit of the asterisms. Their orbits, according to the Somasiddhānta has evolved the system of complete revolutions, called as bhaganas of the planets in a Mahāyuga or a Kalpa. The planets, however, lag behind on their respective paths equal in amount. Therefore, the planets appear as moving eastward and their daily mean motions are calculated on the basis of their complete revolutions. The daily mean motions of the planets differ because of the difference in the measures of their respective orbits.

The underlying idea of this principle is that all the planets move eastward at an equal linear speed and the linear distance travelled by them in a day is the same. But their angular distance varies dependent on the measures of their orbits.



Somasidhānta's View

The number of revolutions of the planets in a mahāyuga, as mentioned by the Somasiddhanta is as follows:

Graha	Number of bhaganas made in a Mahāyuga
Sun	43,20,000
Mercury	43,20,000
Venus	43,20,000
Moon	5,77,53,336
Mars	2,96,832
Jupiter	3,64,220
Saturn	1,46,568

Revolutions of Apices, Conjunctions and Nodes:

There are variations in the motions of the planets which are sometimes fast and sometimes slow. Therefore, the motion of a planet calculated on the basis of the revolutions mentioned above is only the average motion which does not tally with the actual motion of that planet. Therefore, to know the exact motion of a planet it is necessary to mention their variable points viz. Mandocca, śīghrocca and pāta which are supposed to be responsible for the variation in the motion of the planets. The mandocca and śighrocca also move eastward and ultimately complete the respective circles and reach their original places of beginning. These circles are known as the bhaganas of the mandocca and śighrocca respectively.

The revolutions of the śighrocca, mandocca and pāta of each planet, as mentioned by the Somasiddhānta are as follows:

	Revolutions in a Mahayuga		
Planet	Śīghrocca	Mandocca	Pāta
Sun			
Moon		4,88,203	2,32,238
Mars	43,20,000	-	-
Mercury	1,79,37,060	-	-
Jupiter	43,20,000	-	-
Venus	70,22,376	-	-
Saturn	43,20,000	-	-

Planet	Revolutions in a Kalpa	
	Mandocca	Pata
Sun	387	-
Mars	204	214
Mercury	363	488
Jupiter	900	174
Venus	535	903
Saturn	39	662

This rule is based on the method of proportion. The sine of the maximum amount of deflection according to the Somasiddhanta is 1397 kalās which is the sine of an arc equal to 23°-58’-31”. This deflection is, when the longitude of the Sun is 90° and its sine is equal to radius, i.e. 3438 kalas.

Manda Kendra and Śīghra Kendra

Definitions of mandocca (apsis) and śīghrocca (conjunction) are known to us have been given. The circular difference between the mandocca and the mean planet is called as manda kendra. Similarly, the difference between the s'ighrocca and the mean planet is known as the śīghrakendra. In the modern astronomy the terms anomaly and commutation are used corresponding to the mandakendra and śīghrakendra.

Bhūjajyā and Koṭijyā

Sines and Cosines of the kendra (computed in the above manner) are known as bhūjajyā and koṭijyā respectively. For knowing the bhūjajyā and koṭijyā, it has first to be determined in which quadrant (pāda), the kendra lies. The first and the third quadrants are known as viṣamapāda and the second and fourth quadrants are known as sama (even) quadrants.

If the kendra is in the odd quadrant, the sine of the travelled arc is known as the bhūjajyā and the sine of the arc to be travelled is known as the koṭijyā. If the kendra is in the even quadrant, the sine of the arc to be travelled is known as the bhūjajyā and the sine of the travelled arc is known as the koṭijyā.

The angular difference of two places can be known either clockwise or anticlockwise. In the Somasiddhanta. the difference between the mandocca and the mean planet as well as the difference between the śīghrocca and the mean planet is measured in the clockwise direction.

Apsis

The planet if tied by the strings of wind is pulled by the apsis towards it and according to nearness it will be greater. The wind known as pravāha also pushes it towards the apsis. In this way the planet pulled eastward or southward gets variation in its motion.

The speed of the planet is retarded near the apsis, the farthest point and is accelerated near the other side of it which is nearest the earth. The positions of the mean and true planets coincide on both the apsis. When the planet goes in the western semi-circle from the point of apsis, it moves at a slower pace and therefore, its longitude near the apsis is less than the longitude of the mean planet. The speed gradually increases as the planet moves forward and becomes equal at the quadrature with the mean motion. Thereafter the speed of the true planet becomes more than the mean motion and becomes the highest at the perihelion.

As the planet moves further on, the true motion remains more than the mean motion till it becomes equal at the end at the third quadrant. Thereafter the true motion becomes less than the mean motion and becomes slowest as it reaches the apsis where the true planet coincides again with the mean planet.

Conjunction:

The principle of the conjunction is the same as that of the apsis. The only difference to be noted is that the conjunction is heliocentric.

From the statement of the Somasiddhanta, that in the conjunction, the Sun attracts the planets and the motion of the planets accelerates as they reach their perihelions.

Node (Pāta):

Another governing factor in planetary motions as is the node. The node is the point where the orbit of a planet appears as crossing the ecliptic. There are two nodes opposite to each other.

The position of the node goes on successively moving westward and makes a circle. It is known as the revolution of the node of a particular planet. Its motion is very slow and a complete circle except in the case of the node of the Moon, cannot be made in a Mahāyuga. So their revolutions are given for a Kalpa.

Comparative Table of the Revolutions in a Kalpa as given by the Somasiddhānta and Bhāskarāchārya

Planets	Revolutions S S	Bhāskara II	Rev. of the conjunctions S S	Bhāskara II	Rev. of the apsis S S	Bhāskara II	Rev. of the nodes S S	Rev. of the nodes Bhāskara II
Sun	4320000000	4320000000		387	480			
Moon	57753336000	57753336000		488203000	488105858		232238000	232311168
Mars	2296832000	2296832000	4320000000	204	292		214	267
Mercury	4320000000	4320000000	17937060000	368	332		488	521
Jupiter	364220000	364220000	4320000000	900	855		174	63
Venus	4320000000	4320000000	7022376000	535	653		903	893
Saturn	146568000	146568000	4320000000	39	41		662	574

Rise of the Planets in Eastern Horizon

The number of Sun rises in the east in a Mahāyuga, then we proceed in the following way:

Bhaganas of the asterisms

In a Mahāyuga = 1,58,22,37,828

Bhaganas of the Sun to a MY = 43,20,000

Risings of the Sun in the east = 1,57,79,17,828

This is actually the number of civil (savana) days in a Mahāyuga.

Lunar Months in a Mahāyuga

The lunar months in a Mahāyuga are known by subtracting the revolutions of the Sun from the revolutions of the Moon.

The synodic revolution of the Moon is known as the lunar month. It is the period between the two conjunctions or the oppositions of the Sun and Moon, which is slightly less than 30 days.

Intercalary Months in a Mahāyuga

The number of intercalary months (adhimāsa) in a Mahāyuga is known by the difference of the solar and lunar months.

In practice, we use 12 lunar months in a solar year. But the number of civil days in a lunar year is less than the number of days in a solar year by about 10.89170 days. Thus in about thirty three months, the difference of about one lunar month takes place. To adjust with the solar calendar, the difference is reduced by dropping the increase. This dropped month is known as adhimāsa.

The number of lunar months in a mahāyuga
= Revolutions of the Sun—(synodic revolutions) revolutions of the Moon
= 5,77,53,336 – 43,20,000 (subtract)
= 5,34,33,336

The number of solar months in a Mahāyuga = 4320000 × 12 = 5,18,40,000

The number of intercalary months in a Mahāyuga = 53433336 – 5,18,40,000 (subtract) = 15,93,336

The number of Intercalary months can be known by the simple arithmetical process of proportion:

Solar months in a Mahāyuga: Adhimasas in a Mahāyuga: Computed solar months: Required adhimāsas

or the required adhimāsas = Adhimāsas in a Mahāyuga × computed solar months

Solar months in a Mahāyuga:

By adding the number of intercalary months to the computed solar months, we get the lunar months. These months are converted into days by multiplying by 30.

The popular name used for the civil days computed in the above manner in the astronomical treatises of India are ahargaṇa.

Mean Daily Motions of the Planets:

The mean daily motions of the planets can be known by dividing the number of revolutions in a Mahāyuga by the civil days in a Mahāyuga.

The period in which a planet completes a revolution can be known by dividing the civil days by the number of revolutions in a Mahāyuga. The length of a revolution of the planets and their mean daily motions are given in the table.

Length of revolutions and Mean Daily Motions of the Planets

Planets	Number of revolutions in 4320000 years	Civil days in which a revolution is completed				Mean daily motions				
		d.	n.	v.	p.	0	I	II	III	IV
Sun	4320000	365	15	31	3.14		59	8	10	10.4
Mercury	1,79,37,060	87	58	10	5.0	4	5	32	20	41.9
Venus	70,22,326	224	41	54	5.06	1	36	7	43	37.3
Mars	22,96,832	686	59	50	5.87		31	26	28	11.1
Jupiter	3,64,220	4332	19	14	2.09		4	59	6	48.6
Saturn	1.46,568	10,765	46	23	0.41		2	0	22	53.4
Moon: Sid. rev	5,77,53,336	27	19	18	0.15	13	10	34	32	3.8
Moon: Syn.rev	5,34,33,336	29	31	50	0.70	12	11	26	41	53.4
Rev. of apsis	4,88,203	3232	5	37	1.86		6	40	58	42.5
Rev. of node	2,32,238	6794	23	59	2.35		3	10	44	43.2

To Find the Mean Position of a Planet at a Given Place:
The mean positions of the planets found on the basis of the revolutions of the planets and civil days belong to Lanka at midnight. To find the mean position of a planet at a place other than Lanka corrections are required to be made proportionately depending on the situation of that place. For that purpose, the use of the following devices is mentioned in the Somasiddhanta - lambajyā, trijyā, sphuṭa paridhi, latitude of a given place and the daily motion of the planet.

Jyā: If an object moves on the circumference of a circle, the angle traced by it from its original place is measured on the centre of that circle. This angle lies between the radii joining the centre with the original point and the point where the object lies after travelling a certain angular distance.

Suppose A is the initial point on the above circle from which an object starts to move on the circumference of the circle and reaches the point B. Then the angle ACB between the radii CA and CB is the angle traced by the object. The portion of the circumferance AB is known as the capa (arc) travelled.

AX is the X axis, YY" a perpendicular drawn on AX on the point C Is the Y-axb.

Let us draw a perpendicular BD on CA.

BD is the jyā (sine) of the angle ACB or of the arc AB.

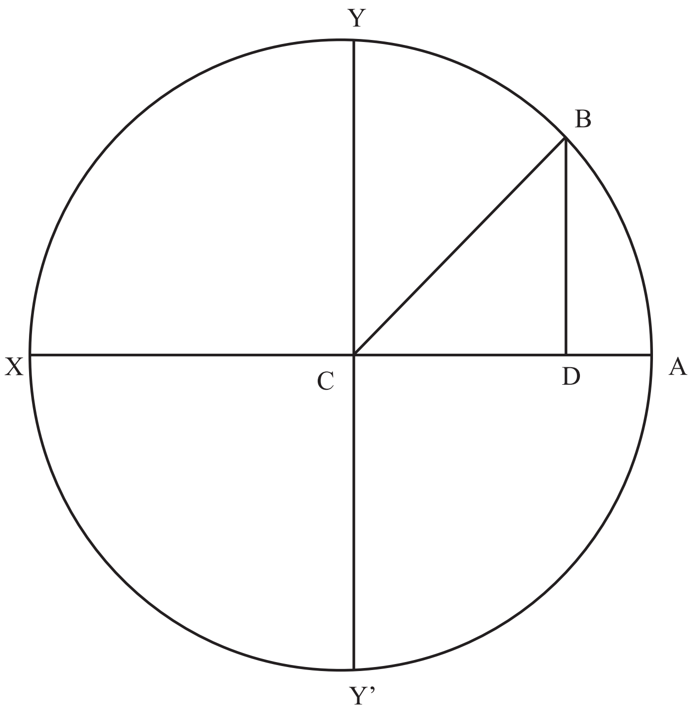


Fig. 13:

Trijyā: Trijyā is the sine of an angle of 90°. The angles in Indian system are measured in rasis. A rasis consist of 30 degrees. Thus, three rasis consist of 90°. The word trijyā is therefore, the short form of trirasijyā.

Trijyā in Indian system is measured in terms of kālas. It consists of 3438 kālas.

Kojyā (cosine): kojyā an abbreviated form of Kotijyā, is the jyā of the complementary angle in a quadrant. In the above diagram BE, the sine of the angle BCY is the Koṭijyā, of the angle ACB.

Akṣajyā: If the angle ACB is treated as the latitude of a place, its sine BD will be known as akṣajyā.

Lambajyā: Lambajyā is the term used to denote the Koṭijyā of the latitude, or the sine of the co-latitude. If angle ACB is the latitude of a place, angle BCY is its co-latitude BE is the sine of the co-latitude i.e. it is known as lambajyā.

Deśāntara: Desāntara is the longitude of a place measured east or west from the standard meridian which in ancient India was that which passed through Lanka. Longitudes are denoted by three kinds of measurements. Viz (1) Linear measurement, (2) time measurement and (3) angular measurement.

The prime meridian is supposed to divide the earth in two halves, east and west since the full circle of the earth contains 360 degrees, one half contains 180 degrees. The Sun apparently makes a complete revolution of the earth in 60 ghatis (24 hours). Therefore, in one ghati it travels 6 degrees or one degree is travelled by the Sun in 10 palas or 4 minutes. Therefore, a different of one degree in the longitude makes a difference of about 4 minutes in time. Since the Sun rises in the east, the Sunrise at any place lying east in another place is earlier and later at any place lying west corresponding to the longitudinal difference.

Method to know the Longitude:

According to Somasiddhānta, complete lunar eclipse was the proper time to know the longitude of a place. There are four stages in the process of an eclipse - (1) Beginning point of the obscuration of the lunar disc (sparśa), (2) Total immersion (nimilana), (3) Beginning of the emergence from darkness (unmilana) and (4) Freedom from darkness (mokṣa).

The longitude in time can easily be converted into yojanas by the following method.

$$\text{Deśāntara yojanas} = \frac{\text{Time longitude} \times \text{sphuṭa paridhi}}{60}$$

The Sun makes a complete revolution of the sphuṭa paridhi on which the given place lies in 60 ghaṭis.

The lunar eclipse is specially chosen for determining the longitudes because it is easily observable and is also not affected by the parallax.

Inclination (Vikṣepa) of the Planets' orbits:

The orbit of a planet intersects the ecliptic at two points known as pātas (nodes). From these points, the planet's path is deflected northward and southward respectively. This deflection of the path, supposed to be caused by the nodes is known as the Vikṣepa. This inclination increases upto a certain point after which it starts decreasing and ultimately coincides with the ecliptic on the opposite node.

Spaṣṭādhikāra states the various types of Planetary Motions

Eight kinds of the motions of the planets have been mentioned in the Somaasiddhanta. They are Vakra, Anuvakra, Kuṭila, Manda, Sama, Śīghratara, Śīghra.

One of the most important devices for knowing the true positions of the planets and other astronomical quantities is the sine of an arc.

The Somasiddhanta has described a unique system of determining the sines of a quadrant. A quadrant is divided into 24 equal parts, each part containing 33/4 degrees or 225 kalās.

The first sine of an angle of 225 kalās is known by dividing the kalas of a rāśi (30 degrees = 1800 kalās) by eight which comes to 225.

The second sine, that is the sine of an angle containing 450 kalās.

Utkramajyā (Versed Sines)

The siddhanta has further given the method of finding the versed sines which is very simple and original.

No. of Division	Sines of the Somasiddhānta	Versed Sines
1.	225	7
2.	449	29
3.	671	66
4.	890	117
5.	1105	182
6.	1315	261
7.	1520	354
8.	1719	460

9.	1910	579
10.	2093	710
11.	2267	853
12.	2431	1007
13.	2585	1171
14.	2728	1345
15.	2859	1528
16.	2978	1719
17.	3084	1918
18.	3177	2123
19.	3256	2333
20.	3321	2548
21.	3372	2767
22.	3409	2989
23.	3431	3213
24.	3438	3438

The word used for sine in the Somasiddhānta is jyārdha which is often said as jyā in the short form.

To find the Sines of given angles and vice-versa

The angle, whose sine has to be known, should, first be converted into Kalās and divided by 225. The quotient is the preceding number of divisions of sine (jyāpiṇḍaka). The remainder is multiplied by the difference between the preceding and the following sines and the product is divided by 225. The quotient is added to the preceding sine. The result is the sine of the desired angle.

To Find Mean Declination (Krānti)

The declination is the amount of deflection of the ecliptic from the celestial equator, measured from the vernal equinox, measured from the vernal equinox. If the Sun's mean longitude is known the mean declination can be found.

$$\text{Declination} = \text{Arc of } \frac{\text{Sine of the longitude of the planet} \times 1397}{\text{Radius}}$$

The sine of the maximum amount of deflection, according to Somasiddhanta is 1397 kalās. The deflection is when the longitude of the Sun is 90 degree and its sine is equal to radius, i.e. 3438 kalās.

True Daily Motion of the Moon:

For finding the true daily motion of the Moon, first of all the mean daily motion of the apsis of the Moon is subtracted from its mean daily motion. The result may be called as the correct daily motion.

The method is this that the difference of the sines corresponding to the mean anomaly is multiplied by the daily motion of the planet and divided by 225. The quotient thus obtained is the sine of the daily motion. It is multiplied by the correct epicycle and divided by the circumference (21600 kalās), as is done in the case of finding the bhujaphala. The quotient thus obtained is the desired equation of the motion. If the mean anomaly lies in the second or the third quadrant, the equation is added to the mean motion and subtracted if the anomaly lies in the first or the fourth quadrant. The result thus obtained is the correct daily motion of the Moon. This deflection is when the longitude of the Sun is 90° and its sine is equal to radius, i.e. 3438 kalās.

If it is known that the mandaphala and śaighraphala of a planet with respect to its apsis and conjunction respectively we can know the true place of a planet.

True Daily Motion of the Sun:

True daily motion of the Sun can be found in the same way as the daily motion of the Moon except this that the daily motion of its apsis is not required to be subtracted from the mean daily motion of the Sun and also of other planets obviously because of the fact that the daily motion of the apsis of the Sun is practically imperceptible and hence negligible.

True Daily Motion of Other Planets:

For finding the true dally motion of the other five planets, corrections both with regard to the apsis and conjunction have to be applied.

The correct daily motion found with respect to the apsis has to be subtracted from the daily motion of the conjunction. The remainder is multiplied by the difference of the radius and the last variable hypotenuse. The result is divided by the variable hypotenuse. The quotient is added to the daily motion, if the hypotenuse is greater than the radius and subtracted if it is less. If the daily motion is less than the subtractive result, the former should be subtracted from the later, but in that case the motion will be retrograde.

Retrograde Motions:

When the planet appears moving in the contrary direction it is stated as retrograde. According to the Somasiddhanta, the planet becomes retrograde when, due to its distance from the conjunction on either side, the cords connecting the planet with the conjunction become slack, the force of attraction of the conjunction dwindles and the planet becomes retrograde.

True Nodes and Latitudes of Planets:

When the true longitude of the planet is determined the true node and latitude can also be determined on the basis of the data used for finding the true place of the planet.

The method to find the true nodes of different planets:

To the mean nodes of Mars, Jupiter and Saturn, the equation of the conjunction as acquired by the forth process is applied in the same direction as in the case of me planet itself. To the nodes of Venus and Mercury, the equation of the apsis as found by the process is applied in the opposite direction. The result is the true node.

Diurnal Period of a Planet:

Due to the rotation of the earth, the planet appears rising above the horizon everyday. The interval between two risings of the planet is known as its diurnal period.

The planets are measured along the ecliptic which is divided into 12 signs of the zodiac which also rise everyday successively in the east above the horizon. The time taken in one complete revolution of the zodiac is known as the sidereal day (nakṣatra ahorātra) which is of the duration of 60 ghaṭis.

Day Radius (Dyujyā):

The apparent path of the planet on which it appears moving daily (due to the earth's rotation) is known as diurnal circle (see V.24 (vi)). Its radius is called as dyujyā.

Dyujyā = Radius − Versed sine of true declination.

Kṣitijyā (Earth Sine)

The rule for knowing the kṣitijyā is given in the Somasiddanta as follows:

Kṣitijyā = palabha × krāntijyā / 12

Carajyā

Carajyā is the correspondent value of kṣitijyā on the equator. The time taken by the planet on its diurnal circle is the same as on the celestial equator.

$$\text{Carajyā (Sine of ascensional difference)} = \frac{\text{Palabha} \times \text{krāntijyā}}{12}$$

To find the Measure of Day and Night:

In Indian system, the time is measured in prāṇas which correspond to the kalās of a circle. In a circle, there are 21600 kalās (360° × 60), and the time taken by a planet in completing its rotational circle is also 21600 prāṇas (60 ghaṭis × 60 palas × 6 prāṇas = 21600 prāṇas) known also as asus.

The diurnal period of a planet is the measure of day and night combined at the equator and all other places irrespective of the latitude of the place and declination of the planet. But the measures of day and night separately at the places lying north or south of the equator vary from those of the equator. The celestial equator is divided into four equal segments by the prime vertical meridian circle and the circle of the horizon - one from the eastern point to the zenith, second from the zenith to the western point, third from the western point to the nadir (the lowest point of the prime vertical) and the forth from the nadir to the eastern point. Each segment is traversed by the planet into equal duration of time.

Viṣuvadbhā (Equinoctial Shadow)

The term is used for the mid-day shadow of the gnomon east on the north-west line of the dial at any given place on the day of equinox.

In the later astronomical works, the most popular name for this is Palabhā or akṣabhā (the shadow of latitude)

Agra

The difference between any given, shadow and the visuvadbhagrga is known as agra.

Values of Gnomon, Shadow &, Hypotenuse:

The values of these quantities can be found by the geometrical process of a right-angled triangle. Thus,

Hypotenuse (Karṇa) = $\sqrt{}$ (Śañku^2 + Chāyā^2)

Śañku = $\sqrt{}$ (Hypotenuse^2 – Chāyā^2)

Chāyā = $\sqrt{}$ (Hypotenuse^2 – Śañku^2)

Ayana calana

The Indians knew very correctly that the equinox is a variable point. In a Mahāyuga, the circle of asterisms oscillates eastward 600 times. This number is multiplied by the days computed for the required period and divided by the number of days in a Mahāyuga, the sine of the result thus obtained is multiplied by three and divided by ten. These are found the degrees of the equinox at a particular day.

The Somasiddhānta suggests to tally the precession of equinox acquired by mathematics with the actual one by examining on the days of solstices or equinoxes. As there are 600 oscillations in a Mahāyuga. i.e. 43,20,000 solar years, one revolution takes place in 7200 years and a quarter revolution takes place in 1800 years. By this, we can find the yearly movement of the equinox:

If in 1800 years, the movement is 27 degrees, in 1 year the movement is = 27 / 1800 degrees = (27× 60 × 60) /1800 = 54″

This rate of yearly precession tallies very nearly with the modern rate of precession which is considered to be nearly 50.262 vikalās.

Latitude and Co-latitude

The latitude and co-latitude of a place can be found in the following manner by the gnomon and its shadow:

(A) When the Sun is on the equator

(1) Sine of latitude (akajyā) $= \dfrac{\text{Equinotical shadow} \times \text{radius}}{\text{Equinotical hypotenuse}}$

(2) Sine of co-latitude (lambajyā) $= \dfrac{\text{Gnomon} \times \text{radius}}{\text{Equinotical hypotenuse}}$

The arcs of these sines give the respective latitude and co-latitude of a place.

(B) When the Sun has Declination:

When the Sun has certain declination, the latitude of a place can be known by means of the zenith distance and the declination of the Sun. The distance of the Sun from the zenith on the midday, when the Sun is on the meridian, is known as the zenith distance. The distance of the Sun from the horizon on the meridian is the altitude. The zenith distance can be found by means of gnomon and its shadow in the manner analogous to its latitude. On the days of the equinoxes, the zenith distance itself is the latitude because Sun on that day is on the equator. Therefore,

$$\text{the sine of zenith distance (natajyā)} = \frac{\text{Mid-day Shadow} \times \text{Radius}}{\text{Hypotenuse (svakarṇa)}}$$

The True and Mean Longitudes of the Midday Sun by Zenith distance:
If the latitude of a place and the Sun's zenith distance are of the same direction, their sum gives the declination. With the sine of declination, the longitude of the Sun can be known as follows:

Sine of the longitude = (Sine of the declination × radius) / (sine of extreme declination)

This rule is based on the proportion:
If the sine of declination is extreme,
the sine of longitude = Radius
If the sine of declination is as found,

the sine of longitude = (radius × sine of declination) / sine of extreme declination

The arc of this longitude gives the position of the Sun in the respective quadrant at the time of mid-day. If the Sun lies in the Meṣa, Vṛṣa and Mithuna signs, the arc itself is the true longitude. If it lies in the Karka, Siṁha and Kanyā signs, the true longitude of the Sun is found by diminishing this arc from the sum of six signs (i.e. 180 degrees). If it lies in any sign from Tulā to Makara, the true longitude is obtained by adding this amount to six signs. If it lies in any sign from Makara to Meṣa, the true longitude is obtained by diminishing it from the sum of 12 signs. (i.e. 360 degrees).

The mean longitude of the Sun can be found by applying the equation of apsis repeatedly in the reverse order.

Mid-day Shadow and Hypotenuse by Declination and Latitude:
First of all, is to find the zenith distance by of the declination and the latitude. If they are of the same direction, their sum and if they are of the opposite direction their difference is the zenith distance.

Then the Sine and Co-sine of the zenith distance is calculated. With the relation of these two values compared with the relation of the gnomon and its shadow. The shadow and the corresponding hypotenuse is in the following way.

Mid-day shadow = (gnomon × sine of the zenith distance) / (co-sine of the zenith distance)

Mid-day shadow-hypotenuse = (gnomon × radius) / (co-sine of the zenith distance)

Amplitude of the Sun:
The distance of the extremity of the shadow at any given time from the Visuvadbhagra is known as agra.

The amplitude of the Sun-rise or Sun-set (i.e. the arkagra) can be found by the following method:

Arkagra = (sine of the declination × hypotenuse of eq. shadow) / gnomon

This relation can be put as follows:

Arkagra / sine of declination = hypotenuse of eq. shadow / gnomon

It means the relation between the arkagra and the sine of declination corresponds to the relation between the hypotenuse of the shadow and the gnomon.

Base of the Amplitude:
If the Sun lies in the southern hemisphere i.e. if the declination of the Sun is in the south, the base (bhuja) of the amplitude is obtained by adding the karṇāgra to the palabha. If the Sun lies in the northern hemisphere, it is obtained by diminishing the karnagra from the palabha.

In both these cases the base is north. If the Karṇāgra is greater than palabha, while the Sun is in the northern hemisphere, the base is south and is obtained by diminishing palabha from the Karṇāgra. At the time of mid-day, the shadow itself is the base.

Hopotenuse on prime-vertical:
When the Sun is on the prime vertical (samamaṇḍala), the shadow-hypotenuse can be found by either of the following two rules, given by the Somasiddhanta

(i)Shadow hypotenuse = (sine of co-latitude ×palabha) / krāntijyā
(ii) ,, = (sine of latitude × 12) / krāntijyā

Prime vertical is the circle which goes through the east and west points and the zenith of the observer. When the Sun is exactly on this circle, the shadow of the gnomon remains on the East-West line. Therefore, the distance of the extremity of the shadow always remains at equal distance from the visuvadbhagra.

Sine of Zenith Distance (Dṛgjyā) and the Sine of Altitude (Konaśaṅku), when the Sun is in the Intermediate direction.

When a great circle is described through the zenith and the object in the sky, it is known as dṛkmaṇḍala. The sine of the arc intercepted between the zenith and the object is known as dṛgjya, or the sine of zenith distance. When the Sun is on the meridian the meridian circle itself is the arṇamaṇḍala and the zenith distance is the arc between the zenith and the Sun on the meridian.

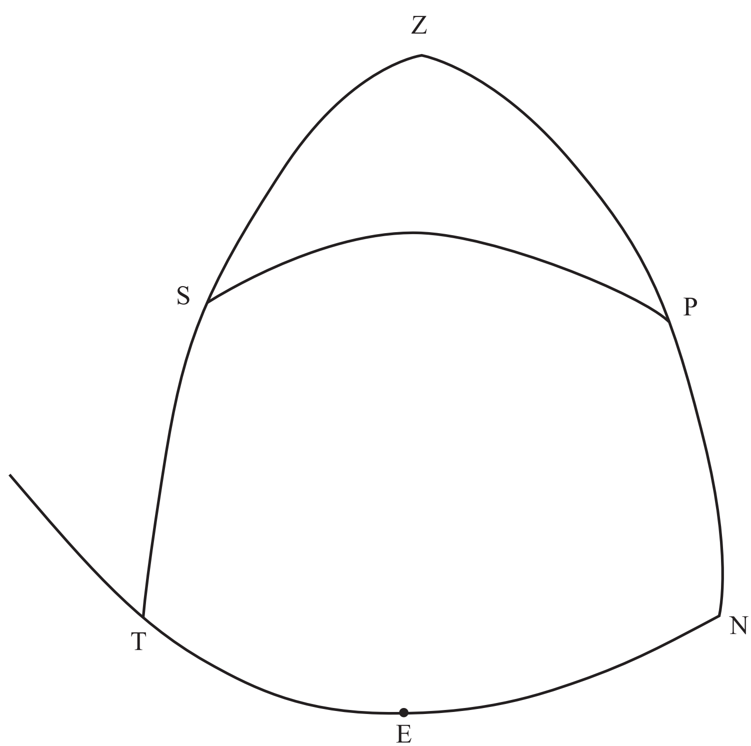
When the Sun is on the meridian, the sine of altitude has been called as unnatajyā. Here it is called in the text as śaṅku.

When the Sun has south declination, it lies in the āgneya (east-south) direction in the forenoon and in the naiṛṛt (south-west) direction in the afternoon. When it has north declination, it lies in the forenoon in the īśāna (north-east) direction and in the vsāyavī (north-west) direction in the afternoon.

After having found the konaśaṅku (the sine of altitude), the dṛgjyā (the sine of zenith distance) can be found as follows:

Sine of zenith distance = $\sqrt{(\text{Radius}^2 - \text{Koṇaśaṅku}^2)}$

Let us also explain it by the modern method applicable to a spherical triangle. In the figure, the triangle ZPS is a spherical triangle. Its three sides PZ, ZS and SP are the arcs of three great circles. A spherical triangle is a figure described by the arcs of three great circles around the same centre and having the same radius. Since the radius is constant it is denoted as unity. PZ is the arc of the prime vertical meridian drawn through the poles and the observer's zenith. ZS is the arc of the circle drawn through the zenith and the place of the Sun (S) and PS is the arc of the circle drawn through the poles and the place of the Sun. ZS is the zenith distance and PZ is the co-azimuth. Azimuth is a term used for denoting the arc of the horizon from the northern point of the horizon to the place where the dṛkmaṇḍala meets the horizon. If the arc PZ is extended it will meet the horizon at N If the arc ZS is extended, it will meet the horizon at T. Thus, the arc NT is the azimuth, denoted by the corresponding angle NZT or PZS.



Antya: Antya is the sine of the arc of that portion of the equator which lies between the point of intersection of the meridian of the observer's horizon and the equator and the prime vertical meridian.

It corresponds to the sine of that portion of the arc of the diurnal circle which is traversed from the sun-rise to the mid-day.

Nata: Nata is the angular distance measured on the equator from the prime vertical meridian to the point where the meridian of the Sun intersects with the equator.

Hour angle by shadow:

The sine of Zenith distance, sine of altitude, cheda. Hour angle etc. can be found by shadow and hypotenuse.

(1) Sine of zenith distance $= \dfrac{\text{Shadow} \times \text{Radius}}{\text{Shadow Hypotenuse}}$

(2) Sine of Altitude $= \sqrt{\text{Radius}^2 - \text{Dṛgjyā}^2}$

(3) Cheda = (śaṅku× Trijyā)/Lambajyā

(4) Sine of Sun's distance from the horizon (Unnatajyā) = (Cheda × Trijyā)/Dyujyā

(5) Natotkramajyā = Antya – Unnatajyā

(6) Natakalā (Hour angle) = Arc of natotkramajyā

The Path of Shadow:

The Somasiddhanta has given the method of drawing the path on which the point of shadow moves on any particular day. According to this method, three points of shadow have to be marked – first at forenoon, second at noon and the third at afternoon.

Rising Times of Signs:

The ecliptic is measured along the zodiac which is divided into twelve equal parts known as Meṣa etc. Each sign consists of 30 degrees.

According to the Somasiddhanta the maximum declination of the Sun from the equator is nearly 24 degrees (23.5 degrees according to the modern calculations) Therefore, the ecliptic is inclined to the equator up to a maximum angle of 24 degrees measured from the points of equinoxes when the ecliptic coincides with the equator.

On the day of vernal equinox (21st March) the Sun has zero declination and rises exactly on the eastern point of the horizon. But on the subsequent days, when the declination of the Sun gradually increases northward, the Sun rises slightly in the north of the eastern point of the horizon. This distance continues to increase till the Sun traverses an arc of 90 degree (due to earth's annual revolution around the Sun). From 900 to 1800 the declination decreases gradually and becomes zero when the longitude of the Sun is 1800. At this point again the ecliptic coincides with the equator. From 1800 to 2700 the declination increases again but its direction is southward. From 2700 onwards, the declination starts decreasing and when the Sun's longitude is 3600, the declination becomes zero and the Sun rises again on the eastern point of the horizon.

When the Sun is at the point of vernal equinox, it is stated to be on the beginning point of the Meṣa sign. Its ending point is at a distance of 30 degrees on the ecliptic from the point of equinox. The ending point of the Meṣa sign is the beginning point of the Vṛṣa sign and its ending point is at a distance of 600 on the ecliptic measured from the point of vernal equinox. Similarly, the beginning point of the Mithuna sign is at 600 and the ending point at 900 and so on.

Due to the daily motion of the earth on its axis, the signs appear as rising consecutively above the horizon and making a complete circle in about 24 hours.

Rising Time at the Equator:

The rising times of the signs at Lanka supposed to be at the equator are the basis of knowing the rising times of the signs at other places. The method to know the rising times of the signs at Lanka is as follows.

The sines of the first, second and third signs are multiplied each by the day radius of three signs and divided each by the respective day radius. The arcs of three quotients are respectively the arcs of the first sign; first and second signs; first, second and third signs.

Thus, if the first arc is subtracted from the second arc, the result is the arc of second sign. If the second arc is subtracted from the third arc, the result is the arc of the third sign. Since one kalā for an arc is equal to one prāṇa, the number of kalās in an arc is the number of prāṇas taken in rising of that arc.

Rising asus of Meṣa =

$$\text{Arc of}\left(\frac{\sin 30^\circ(\text{meṣa})\times\text{Day Radius of three signs }(90^\circ)}{\text{Day Radius of }30^\circ}\right) \quad \text{......(i)}$$

Rising asus of Meṣa & Vṛṣa combined =

$$\text{Arc of}\left(\frac{\sin\ 60^\circ(\text{Meṣa \& Vṛṣa})\times\text{Day Radius of }(90^\circ)}{\text{Day Radius of }60^\circ}\right) \quad \text{......(ii)}$$

Rising asus of Meṣa, Vṛṣa and Mithuna combined =

$$\text{Arc of}\left(\frac{\sin 90^\circ\times\text{Day Radius of }(90^\circ)}{\text{Day Radius of }90^\circ}\right) = \text{Arc of radius} \quad \text{......(iii)}$$

Thus, the rising asus of Vṛṣa = (ii) – (i)

The rising asus of Mithuna = (iii) – (ii)

Rising Times of Signs at Any Given Place:

From the rising times of Meṣa. Vṛṣa and Mithuna at Lanka the portions of ascenstional difference (Carakhaṇḍas) of a given place are subtracted, the remainders are the rising times of three signs at that place. To find the rising times of Karkaṭa, Siṁha and Kanyā, the portions of ascensional difference are added in reverse order to the times of these signs at the equator. The times of the next six signs are obtained by reversing the order of the first six signs.

Meridian Lagna (Madhyalagna):

Meridian lagna is the point of the ecliptic intersecting with the North-South prime vertical at a given time.

The Method to find the meridian lagna:

If the hour angle is east, this arc should be subtracted from the longitude of the Sun, if it is west, the arc should be added to be longitude of the Sun. The result is the meridian lagna.

When the Sun crosses the prime vertical meridian, it is known as the mid-day. Therefore, the point of the ecliptic lying on the prime vertical at any given time is known as the Madhya lagna. It is the middle of the Diurnal circle above the east and west horizon. It is also known as the tenth lagna because considering the lagna at the horizon as the first lagna and counting eastward after making twelve divisions of the ecliptic. The tenth part starts from the mid meridian.

Time from the Longitude and Lagna:
As given in the Somasiddhanta, the time at a particular moment can easily be known by knowing the difference between the longitude of the Sun and the lagna at the horizon . In this process the rising times of the remaining arc of whichever is less and the rising times of the travelled arc of whichever is greater are added to the intermediary signs, the result is the time elapsed since Sun-rise.

Lunar Eclipse:
Lunar Eclipse occurs at the time of full Moon. This phenomenon would occur at every full Moon if the orbit of the Moon coincided with the ecliptic. But the orbital plane of the Moon is inclined at an angle of 50 to that of the ecliptic. Therefore, this phenomenon does not take place at every full Moon. It the entire disc of the Moon is obscured by the shadow, the eclipse is known as total eclipse, when only a part of it is obscured, it is known as partial eclipse.

Diameters of the Sun and Moon:
According to the Somasiddhanta the mean diameter of the Sun is 65000 yojanas and of the Moon it is 480 yojanas. These diameters vary corresponding to the motions of the Sun and Moon. In reality, the diameters of the Sun and the Moon never vary but appear to be so depending on their relative distance with reference to the earth .

The correct diameters at any given time can be known by the following method.

$$\text{Correct Diameter} = \left(\frac{\text{Mean Diameter} \times \text{Correct Motion}}{\text{Mean Motion}}\right)$$

The formula is based on the method of proportion:

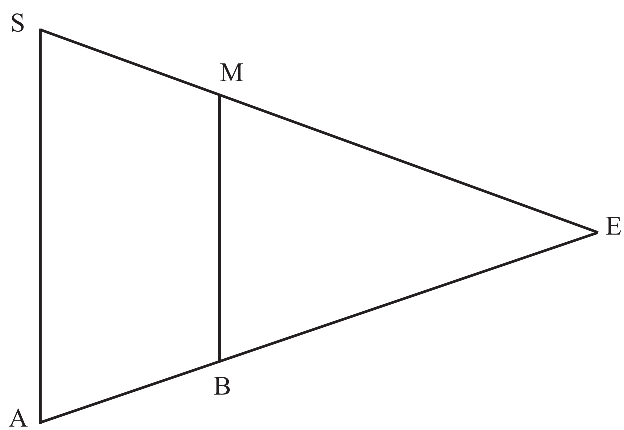
Mean Motion: Mean Diameter :: True Motion: True Diameter)

Sun's Correct Diameter on the Moon's Orbit:

The Sun's true diameter as projected on the Moon's orbit can be known by the following two methods.

(1) $\dfrac{\text{Correct Diameter of the Sun} \times \text{Sun's rev. in a M.Y.}}{\text{Moon's rev. in a M.Y.}}$

(2) $\dfrac{\text{Correct Diameter of the Sun} \times \text{Moon's orbit}}{\text{Sun's orbit}}$



Suppose E is the centre of the earth. SA the ture diameter of the Sun. MB its projection on the Moon's orbit. The triangles AES and BEM are similar.

Therefore

$$\frac{MB}{SA} = \frac{EB}{EA}$$

$$MB = \frac{SA \times EB}{EA}$$

EB is the radius of the Moon's orbit and EA is the radius of the Sun's orbit. We know that the relation between the radii of the two circles is the same as between their circumferences. Therefore,

$$\frac{EB}{EA} = \frac{\text{Moon's orbit}}{\text{Sun's orbit}}$$

Therefore

$$MB = \frac{SA \times \text{Moon's orbit}}{\text{Sun's orbit}}$$

Or Sun's diameter on the Moon's orbit

$$= \frac{\text{Sun's correct diameter} \times \text{Moon's orbit}}{\text{Sun's orbit}}$$

Suci and the Diameter of the Earth's shadow:

The word Suci has been used in the Somasiddhanta for the Earth's diameter on the Moon's true orbit.

$$\text{Suci} = \frac{\text{Earth's diameter} \times \text{True daily motion of Moon}}{\text{Mean daily motion of Moon}}$$

The formula shows that if the true daily motion of the Moon is equivalent to its mean daily motion. Then the Suci is equivalent to the earth's diameter. It varies with the variation in the Moon's motion. It means the Suci is the diameter of the earth corrected with reference to the Moon's daily motion.

Occasion for Eclipses:

The shadow of the Earth remains at a distance of sic signs, i.e. 180 degrees. When the longitude of the Moon's node is the same (or even slightly more of less) as that of the shadow or that of the Sun, there is an occasion for an eclipse. Such an occasion arises either at the end of Pūrṇimā or Amāvasyā when the Moon lies respectively six signs apart from the Sun or on the same longitude.

In a period of one lunar month the Moon completes a full revolution of the Earth. When the Moon comes at a distance, six signs apart from the Sun, it is known as Pūrṇimā. When it coincides with the longitude of the Sun, it is known as Amāvasyā. Thus, in a month, there is one Pūrṇimā which marks the end of the month and one amāvasyā which marks the middle of the month. At the end of Pūrṇimā the Sun, the Earth and the Moon come in a straight line. At this occasion the shadow of the Earth and the Moon lie on the same longitude. The Moon is covered under the darkness of the shadow. And the lunar eclipse takes place.

Determination of the Eclipsed Portion:

To determine the portion of the solar or lunar disc obscured, the latitude (vikṣepa) of the Moon should be subtracted from half of the sum of the Moon should be subtracted from half of the Sum of the diameters of the eclipsed and eclipsing bodies. The remainder gives the portion eclipsed.

In the case of the solar eclipse, the Sun is the eclipsed and the Moon is the eclipsing body. From the sum of the angular measures of their radii, the latitude of the Moon is subtracted. In the case of the lunar eclipse, the Moon is the eclipsed and the shadow of the Earth is the eclipser. From the sum of the angular measures of their radii, the Moon's latitude is similarly subtracted. If the remainder is more than the measure of the eclipsed body the eclipse is total, if less, the eclipse is partial.

Half-Duration of the Eclipse:

The half-duration of the eclipse from the beginning to the middle has been termed by the Somasiddhanta as sthityardha which literally means the half of the stay of the eclipse.

The Sum of the measures of the eclipsed and eclipser is divided by two. From the square of the resulting quantity the square of the latitude (vikṣepa) is subtracted. The square root of the remainder is multiplied by sixty and divided by the difference of the true motions of the Sun and the Moon. The result will be the time of the half of the duration of the eclipse.

Half-Duration of Immersion:

The period during which the disc remains totally immersed is the period of its immersion. Its half has been termed as vimārdha. The method to find its value in terms of time is the same as above, except this that the difference of the half of the measures of the eclipsed and the eclipser is to be taken instead of the sum.

From half duration of the eclipse, longitudes of the Sun and Moon at the time of contact are known by diminishing the respective motion travelled by them during the half duration of eclipse from the longitudes at the end of the parva. The method of calculating motion from the half-duration of eclipse is based on the proportion.

60 ghaṭis: Daily motion: : Half-duration : Required motion

$$\text{Thus, the required motion} = \frac{\text{Half duration} \times \text{Daily motion}}{60}$$

Directions of the Eclipse:

For projecting the position of the eclipse on a map, the directions of the eclipsed portion are required to be known. The north and south postions of the eclipsed body are determined by drawing a great circle (samaprotavṛtta) through the north and South points of the horizon passing through the eclipsed body. The east and west directions are determined by drawing the east-west prime vertical circle (samamaṇḍala) through the eclipsed body.

Since the eclipsed the eclipsing bodies lie on the ecliptic or closely near it, the directions are determined by the deflection of the ecliptic from the samamaṇḍala (east west prime vertical). This deflection in angular amount has been called in the Somasiddhanta as the valana.

The ayana valana is the deflection to the ecliptic from the equator measured on the horizon of the eclipsed body. It is known as ayana because the solstice (ayana) lays 900 away from the initial point. i.e. the vernal equinox.

The rules to determine the akṣa:

Ayana and sphuṭa valana, as prescribed in the Somasiddhanta, are as follows

$$\text{Akṣa valana} = \text{Arc of } \frac{\text{Natajyā} \times \text{Akṣajyā}}{\text{Trijyā}}$$

Ayana valana = Declination of (longitude of the body + 900)

Sphuṭa valana = Akṣa valana + Ayana valana

The sine of the sphuṭa valana is divided by 70 digits. The result is the required sine of the sphuṭa valana

Parilekhādhyāya

The projection is necessary to know precisely the eclipsed portions of the discs.

Marking of Valana:

Valana is the deflection of the ecliptic from the eastern point on the horizon of the eclipsed body. This valana reduced to digits, should be marked on the larger circle (valanavṛtta) in the following manner.

In the lunar eclipse the valana at the time of contact should be marked from the eastern point in the proper direction whether north or south. But for the time of separation the direction of the valana should be reversed.

Marking of the Deflection:

The points thus marked on the circle of deflection are known as Valanagra or the extremities of the deflection.

Marking of Extremities of Latitude for the Contact and Separation:

After the extremities of the deflection have been determined on the defection as well as the aggregate circle, the extremities of the latitude at the time of contact and separation should be marked on the aggregate circle.

In the lunar eclipse the extremities of the latitude should be marked opposite to their proper directions. In this case the eclipsing body is the shadow of the Earth the centre of which lies on the ecliptic. The Moon enters the shadow from its eastern side and markes the contact on tis northern or southern part opposite to its deflection from the ecliptic. It means if the latitude is in the north, it will make the contact on its southern part, if it is in the south, it will make the contact on its northern side.

Marking of Deflection and Latitude for the mid-eclipse:
In the lunar eclipse, if the direction of the deflection and the latitude is the same. The deflection should be marked on the eastern side of the north-south line. If they are of the opposite direction the deflection should be marked on the western side of the north-south line. It should be noted that the deflection should be marked east or west from the north or south point opposite to the true direction of the latitude.

The point of deflection marked is to be joined with the central point. On this line the latitude, measured from the central point towards the point of deflection should be marked.

From the point of latitude, a circle with the radius of the eclipsing body should be described. The portion of the eclipsed body cut by the arc of this circle is the obscured portion.

Visibility of the lunar and solar Eclipses:
According to the Somasiddhanta the obscuration even of as small a quantity as the twelfth part of the lunar disc is visible due to its clearness. But due to the brilliancy of the Sun. The obscuration upto the amount of three kalās is not visible.

To Draw the Obscuration at any Intermediate Position:
At any given time between the contact and separation, the obscuration of the disc can be marked.

Knowing by calculation the amount of obscuration for the given time and subtracting it from the sum of the radii of the eclipsed as well as eclipsing bodies and converting the remainder into digits we get the intermediate position of the obscuration.

To Mark the points of Immersion and Emergence:
In the case of the total eclipse, the points of immersion and emergence can also be known by the similar method as mentioned above. In this case the diference of the radii of the eclipsed and the eclipsing bodies has to be taken.

Colours of the eclipsed Moon:
The colour of the eclipsed Moon varies from stage to stage. When the eclipsed portion is less than half, its colour is smoky. If it is more than half its colour is black. At the time of emergence its colour is dark copper (kṛṣṇatāmra). When the obscuration is total, its colour is reddish-grey (kapila).

The Somasiddhanta has used three terms for conjunction (1) Yuddha (war) (2) samāgama (meeting) and (3) astamāna (heliacal setting). The five planets (i.e. the Mars. Mercury, Jupiter. Venus and Saturn) have either yuddha or samāgama with one another. When they are in conjunction with the Moon, they are said to have samāgama and when they are in conjunction with the Sun, they are said to be in the state of astamāna (setting).

The five planets as different from the Sun and the Moon are named as tārāgrahas (star-planets) because they appear as stars in the sky.

To know whether the conjunction has just taken place:
The planets move eastward when their direction is proper. The longitudes of the ecliptic are also marked eastward. Thus, the longitudes increase when the planets move in their proper direction. If they move in the retrograde direction, their longitudes decrease. So, the following rules are deduced.

- If the longitude of the swift moving planet is greater than that of the slow one and the direction of both is eastward, then the conjunction would have taken place in the past.
- If the longitude of the swift moving planet is less than that of the slow planet, it would mean that the conjunction would take place in near future.
- If the planets are retrograde, the position will be contrary. That is, if the longitude of the swift moving planet is greater than that of the slow planet, the conjunction is to take place; if it is less, the conjunction has taken place.

Spot of conjunction:

If the planets are moving in the same direction, then the distance between the two planets should be multiplied by the daily motion in kalas of the respective planet and divided by the difference of the daily motions. The result will give the distance from the respective planet at which the conjunction has taken place or will take place. If the conjunction has taken place it should be subtracted from the longitude of the planet.

It the distance equal to the difference in daily motions can be covered by a planet by moving equal to its daily motion then, Distance equal to the difference in daily motions: Distance travelled in a day : : Given distance : Required motion.

$$\text{i.e. required motion} = \frac{\text{Given distance} \times \text{Daily motion}}{\text{Difference in daily motion}}$$

If the two planets are in opposite direction then the distance of conjunction is obtained by dividing by the sum of the daily motions the difference multiplied by the daily motion of the respective planet. If the conjunction is yet to take place the result is additive to the eastward planet and subtractive from the retrograde planet. If the conjunction has already taken place, the process is to be reversed.

Time of conjunction:

The time before and after which the conjunction has taken place or will take place can be found by dividing the difference of the planets by the difference of the daily motions, if the planets are direct and by the sum if they are retrograde.

True Conjunction:

The real conjuction takes place when the two planets lying on the same kadambaprotavṛtta also lie on the same circle drawn from the northern point of the observer (samaprotavṛtta)

On the equator, the pole and the north point are the same. Therefore, there is no difference in the circle from the north point and the pole through the planet. In other words, the akṣadṛkkarma on the equator is zero. As the latitude increases the akṣadṛkkarma also increases and on the horizon this distance is equal to the latitude of the observer. When the planets are on the prime vertical meridian, then also the circle through the north point and the pole is the same and hence the akṣadṛkkarma is zero.

Apparent Conjunction:

The apparent conjunction takes place when the two planets are on the same samaprotavṛtta. The two points, determined above, are on the repective samaprotavṛttas. For finding , when these samaprotavṛttas wil coincide, the point of conjuction and the time to that should be calculated again by the relative motions of each planet. The new point of conjunction will be the point of apparent conjunction.

Diameters of the Planets:

The diameters of the five Iesser planets viz. Mars, Saturn, Mercury, Jupiter and Venus as visible on the Moon's orbit are given by the Suryasiddhanta as 30, $37\frac{1}{2}$, 45, $52\frac{1}{2}$ and 60 yojanas respectively. These measures divided by fifteen give their angular measures in kalās.

True Dimensions of the Planets:

The rule given for knowing the true dimensions is as follows:

Divide the mean diameters of the planets by the Sun of radius and the fourth variable hypotenuse and multiply by 2. Multiply the product by radius. The result is the correct diameter of the planet. The rule can be put in the following form:

$$\text{True Diameter} = \frac{\text{Mean Diameter} \times 2 \times \text{Radius}}{\text{Radius} + \text{Hypotenuse}}$$

True Diameter:

The basic proportion for finding the true diameter is:

True distance: Mean Distance: : Mean Diameter : True Diameter

Types of Conjunction:
The Somasiddhanta has described five types of conjunction depending on the way the planets come into contact. They are as follows:

Ullekha: When there is only the contact (sparśa) of the planets, it is known as ullekha.

Bheda: When a planet covers some part of another planet but both appear as distinctly apart, the phenomenon is known as bheda.

Aṁśuvimarda: When the discs of the planets remain apart but their rays mingle, the phenomenon is known as aṁśuvimarda encounter (yuddha)

Apasavya: If the interval between the planets is less than a degree and if one planet is faint, it is known as apasavya encounter.

Samāgama: If the interval is more than one degree, the phenomenon is known as samagma. If both the planets are powerful.

Conjunction of Asterisms:
To determine at which particular moment a planet is in conjunction with an asterism, one particular point has to be marked. Thus, in each asterism a particular star is chosen. When a planet cones into contact with that star of a particular asterism it is said to be in conjunction with that asterism. That star is known as junction-star (yogatārā).

The twenty-seven divisions of the ecliptic are of equal length each measuring $13^{o}\ 20'$ or 800 kalas. Thus the length of the arc of one asterism as measured on the ecliptic is $13^{o}\ 20'$. The longitudes of the asterisms are concordant with those of the ecliptic and the interval between the beginning points and also between the terminating points is 13^{o}-$20'$. But the junction stars are not equi-distant from one another and hence the interval between the junction-stars is of varying length.

Polar longitudes of the junction-stars:
While calculating the time of conjunction of two planets, the interval between their samaprotavṛttas is required to be found by applying

akṣadrkkarma and ayanadṛkkarma to the longitudes of the planets as measured on the ecliptic. The same process is applicable to the conjunction of the Junction-star and the planet.

Polar Latitudes:

The latitude is measured on the circle through the kadamba of the ecliptic but in the case of the junction-star the latitude is measured on the dhruvaprotavṛtta as it is deflected away from the polar longitude.

The junction star, on the other hand, is a fixed star and moves only around the pole of the heavens and its longitude is referred to that point of the ecliptic where its dhruvaprotavṛtta meets the ecliptic.

Calculation the time of Conjunction:

The process for determining the time and place of conjunction of a planet with the asterism is almost the same as for the conjunction of the planets

In the case of asterism only one dṛkkarma i.e. the akṣadṛkkarma is required. As the longitudes of the asterism are polar, on ayanadṛkkarma is required. In the case of the planet, however, both kinds of calculations are required.

After knowing the places of the samaprotavṛttas of the planet and the asterism on the ecliptic, the time for conjunction should be calculated treating the motion of the asterism as zero because the asterism is fixed on its place.

When a planet or a star comes into close proximity of the Sun it becomes invisible. This phenomenon is known as heliacal setting (astamana). When the interval between the Sun and the planet increases so that the planet becomes visible again it is known as heliacal rising (udaya)

Three planets viz. Jupiter. Mars and Saturn have slower motions than the Sun. Therefore, they set when the Sun approaches them. When the longitudes of these three planets are more than that of the Sun, these planets set in the west. If their longitudes are less than that of the Sun, they rise again in the east.

The proper direction of the plenets and the Sun is eastward, whereas their daily revolution is westward. Thus the planets having greater longitude than that of the Sun rise and set later than the Sun. The planets become visible in the Sky after the setting of the Sun. As the Sun's distance from these planets becomes small, these planets are visible slightly above the western horizon after the Sunset. When the distance further decreases, the planet appears setting in the west and remains invisible in the successive period. When the Sun, owing to its faster motion. Goes further ahead on higher longitudes, the planets rise in the east earlier than the Sun. It is known as their heliacal rising.

To determine the heliacal rising or setting of a planet, the difference between the rising or setting of the Sun and the planet is required to be known.

The Somasiddhanta has laid down that if the rising or setting of a planet is in the eastern direction then the longitudes of the Sun and the planet at the time of Sunrise should be calculated. If either of these phenomena is in the west, then the longitudes at the time of Sunset should be calculated. Then the apparent longitude of the planet should be known by dṛkkarma.

Determination the Helical Rising and Setting

For determining whether a particular planet is heliacally rising or setting, it is required to be known at what maximum interval, the planets go under such a stage.

Planet	Maximum degrees of setting / rising
Mars	17°
Mercury	12° when sets in the west and rises in the east
	14° when sets in the east and rises in the west
Jupiter	11°
Venus	80 when sets in the west and rises in the east 100 when sets in the east, 10° when sets in the east and rises in the west
Saturn	15°

In the case of Marcury and Venus two different limits of visibility have been given for each. When these planets come on their inferior conjunction, their distance from the earth increases. Their discs appear smaller and the limits of visibility increase. When they come on the superior conjunction. They become nearer to the earth and their discs appear larger with the result that the limits of their visibility decrease.

Interval of Time:

With the help of the time degrees of the planet and the Sun and the time degrees of the maximum limit of visibility, the interval before or after the heliacal rising or setting can be known in terms of time.

One sign consists of 1800 kalās. The rising time of any portion of this sign will be proportionate to the rising time of the entire sign. Thus, we can put the proportion in the following form:

1800 : Rising time of the sign : : Daily motion: Reqd rising time.

$$\text{or Required time} = \frac{\text{Rising time of the sign} \times \text{Daily Motion}}{1800}$$

Difference in time-motions: One day : : Difference in Kalāṁśas : Required days.

$$\text{or Required days} = \frac{1 \times \text{Difference in Kalāṁsas}}{\text{Difference in time motions}}$$

$$\frac{\text{Difference in Kalāṁsas}}{\text{Difference in time motions}}$$

If the planet is retrograde the sum of the time motions should be taken.

The interval of time can also be found by converting the kalāṁśas into the corresponding arc of the ecliptic. In this process, the kalāṁśas are multiplied by 1800 and divided by the rising time of the concerned sign. The result will be the longitude on the ecliptic technically named by the Suryasiddhanta as kṣetrāṁśas.

The rising time of the Sign : Kalās of the sign: : Kalāṁśas : Required arc of the Sign

Or the required arc of the Sign

$$= \frac{\text{Kalās of the Sign} \times \text{Kalāṁsas}}{\text{Rising time}}$$

$$= \frac{1800 \times \text{Kalāṁsas}}{\text{Rising time}}$$

Rising and Setting of the Stars:

Stars are fixed and so they are approached by the Sun. Their setting takes place in the west and rising in the east. The time and setting should be calculated in the similar manner as of the planets except that in this case, only the motion of the Sun has to be taken into account.

Heliacal Rising and Setting of the Moon:

The rules for determing the helical rising and setting of the Moon are the same as applicable to other planets. The daily motion of the Moon is greater than that of the Sun. Therefore, its helical rising takes place cn the western horizon and setting on the eastern horizon. When the interval between the Moon and the Sun calculated on the time circle in the previous way (kalāṁśas) becomes less than 12 degrees, these phenomena take place.

Daily setting and Rising of the Moon:

In (śukla-pakṣa) the Moon becomes visible in the sky immediately after the Sun-set its position in the sky being dependent on its distance from the Sun. On the last day of the kṛsna pakṣa (i.e. amāvasyā) the Sun and the Moon are on the same longitude, the Moon rises with the Sun and remains invisible.

In the śukla-pakṣa the longitude of the Moon increases and it rises later than the Sun and consequently sets in the western horizon after the Sun-set. As the longitude of the Moon increases day by day the interval between the Sunset and the Moon set correspondingly increases. Thus, by knowing the difference in the longitudes of the Sun and the Moon, we can calculate the interval of time between the setting of the Sun and the Moon.

The rules for calculating the time after which the Moon will set or rise after the Sun-set in the śukla-pakṣa and kṛṣṇa pakṣa respectively are:

The longitudes of the Sun and the Moon at the time of the Sun-set should first be known. Six signs should be added to the respective longitude so as to know the difference in the points of the ecliptic on the eastern horizon. Then by applying the processes of akṣadṛkkarma and ayanadṛkkarma, the apparent longitude of the Moon is to be calculated. Then the ascensional equivalents in respirations of their interval (lagnāntarasu) will be found. This difference in ascensional equivalents should be converted into time degrees by dividing by sixty. If the Sun and the Moon are in the same sign. The ascensional equivalents can be treated as the time minutes.

Illuminated Portion of the Moon:

The method to find the measure of the illuminated portion is as follows:

The longitude of the Sun be subtracted from the longitude of the Moon, the result should be divided by 900, it will be the mean measure of the illuminated part of the Moon. This multiplied by the Moon's digits (aṅgulas) and divided by 12 gives the correct measure in digits of the illuminated part of the Moon. The illumination of the Moon is proportionate to its distance from the Sun. The last limit being 1800, The diameter of its disc is considered to be of 12 digits. Therefore, the proportion -

Revolution of 1800 : 12 : : Revolutions, equal to the distance : Corresponding illumination.

Therefore

The corresponding illumination

$$= \frac{12 \times \text{Difference in the Longitudes}}{\text{Rising time } 10800}$$

$$= \frac{\text{Difference in the Longitudes}}{900}$$

The correct illumination be found by the proportion

Therefore, the Correct illumination

$$= \frac{\text{Mean illumination} \times \text{Correct Diameter}}{12}$$

Pātas:

There are two pātas, namely the Vaidhṛti and the Vyatipāta. A position of the pāta comes when the Sun and Moon have the same declination, or in other words, when they are equi-distant from the equator. Such an occasion arises when the Sun and the Moon are at the same distance from either of the equinoxes or solstices either side.

When the Sun and the Moon are upon the same side of either solstice having equal declinations, the sum of their longitudes becomes 360. This position is known as Vaidhṛti.

When the Sun and the Moon having equal declination are upon the opposite sides of either solstice, the sum of their longitudes becomes 1800. This position is known as Vyatipāta.

Since the equality of the declinations has to be determined with respect to the apparent equinoxes or solstices, the degrees of precession (ayanāṁśas) should be added to the longitudes of the Sun and Moon. Then the declinations should be calculated for the time when the sum of the longitudes becomes 360 or 180.

The Time preceding and following the pata:

The pāta takes place when one body is in the odd and the other in the even quadrant. If the Moon is in odd quadrant i.e. in the first or third. The Sun should be in the second or fourth for the occasion of the pāta to take place. In the odd quadrant the declination increases. Whereas in the even quadrant it decreases. Thus, if the Moon is in the odd quadrant, its declination is on increase, whereas in the even quadrant, the declination of the Sun is on decrease, If the declination of the Moon in the odd quadrant is more than that of the Sun, it means the pāta has already taken place.

In case the correct declination of the Moon is known by taking the difference of latitude and the declination. The position is reversed, such a situation arises when the declinations of the Moon and the ecliptic are of opposite directions, In such a case, as the declination increases, the distance of the Moon from the equator decreases.

Repetition of Corrections for equalisation of Declinations:

For knowing the exact longitudes of the Moon and the Sun at which their declinations will be the same the process of approximation should be applied, after knowing the longitudes of the Sun and the Moon, when their sum will be either equal to 360º or 180º.

The sine of declination at the longitude of the proposed pāta should be multiplied by radius and divided by the sine of the greatest declination. Its arc should be added to the longitude of the Moon, if the pāta is to take place and subtracted, if it has already taken place.

Daily motion of the Moon : Daily motion of the Sun : : Given motion of the Moon : Required Motion of the Sun

Thus, the additional motion of the Sun will be found by multiplying the additional motion of the Moon by the daily motion of the Sun and dividing by the daily motion of the Moon. This additional motion should be added to or subtracted from the Sun's longitude as done in the case of the Moon.

The time of pāta before or after midnight:

If the finally corrected longitude of the Moon is less than that of its longitude at midnight, it would mean that the pāta would occasion before midnight; if more, it would take place after midnight.

Duration of the pāta:

Duration of the pāta is calculated in the manner analogous to the duration of the eclipse. Take the half of the sum of the diameters of the Sum and Moon. Multiply it by sixty and divide by the difference of the daily motions. Subtract it from the time of the corrected longitude, which is the middle of the pāta the result will be the beginning time of the pāta. If added, the result will be the time of its end.

Occurrence of the Pātas near Equinoxes and Solstices:

When the pātas take place in the proximity of the equinoxes. Sun being in the north and the Moon being in the south, there will be two patas in succession, the other being on the day of amāvasyā when the Moon will approach the Sun in the north. There will be no pāta near the solstices as due to the latitude of the Moon, the declinations cannot be equal.

Junctions of the Asterisms:

The last quarters of Aśleṣa. Jyeṣṭha and Revatī are the junctions of the asterisms. The first quarters of the asterisms succeeding the above asterisms are known as Gandanta. Thus the first padas of Māgha. Mūlā and Aśvinī are Gandantas.

Concluding Remarks

As other astronomical texts Somasiddhānta starts as a conversation between Soma (Candra) and Śaunaka, the son of Bṛhaspati. Śaunaka requests Soma to tell about the heavenly bodies. Soma answered that this knowledge can be acquired by them who are experts in Veda and its auxiliary literatures.

Why Veda? Somasiddhānta was compiled after Āryabhata and before Brahmagupta. At that time Veda was the store of knowledge of every side of life. It demands time, patience and knowledge of literature. Astronomical texts were rare at that time. If we consider Vedānga Jyotiṣa as the first astronomical text, then astronomical knowledge was very rare, probably due to this reason Candra made this comment.

The first chapter is devoted on madhyamādhikāra. Candra started with the concept of time. 'Gurvakṣara', the term was found first used in Somasiddhānta as a small unit of time. 10 gurvakṣara = 1 prāṇa

6 Prāṇa = 1 Vināḍi
6 Vināḍi = 1 nāḍi
60 nāḍi = 1 ahorātra
30 ahorātra = 1 māsa

Ahorātra means day-night and this unit of asuras is opposite from gods ahorātra.

In Indian astronomy, in seventh century CE, big number was imagined, siddnāntic texts are the proof. The combination of day and night for six months duration constitutes a divine day, three hundred and sixty such divine days constitute divine year. A divine or demonical year is equal to 360 solar years. These verses indicate the use of large number in Indian society.

The number we calculate.

6 × 30 = 180 days = 1 divine day
360 × 180 days = 1 divine year

Caturyuga is a large unit of time equal to 4320000 solar years and a manvantara is constituted by 71 Yugas. Let us imagine at the seventh century CE, Kalpa which is equivalent to 14 manvantaras was along with their used twilight. It is the unique feature of Indian astronomy.

The time division is very useful to understand the planets' revolution. It is now very well known that these numbers were written by words. There are many doubts about this number-concept. In the books of western scholars, except who studied the specific area of Indian astronomy and mathematics, the scholastic attitude of Indian astronomers is absent. But historians only acknowledge that concept of Zero (Śūnya) was introduced by Indian mathematician.

It is very interesting that Indian astronomers compiled books depending not only on observation but also knowledge of astro-physics. Example of this thought is the concept of apsis.

Imagination: If the planet is tied by the strings of wind (pravāha), it gets variation in position. Not only position the author explains the motion of the planet considering pravāha.

The rule is concerned with the relative positions of the mean and true planets. The verses explain that the speed of the planet is retarded near the apsis, the farthest point and is accelerated near the other side of it which is far from the earth.[1]

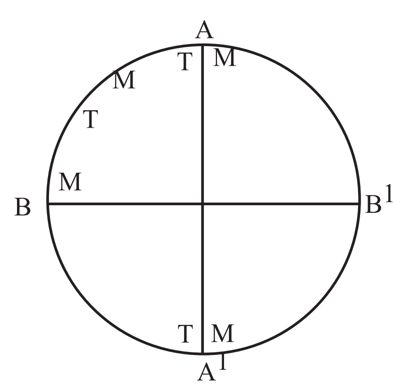


Fig. 1

Let A is the apsis and A[1], its opposite side. At A, the position of the true and mean planets is the same. As true planet T moves towards B in the eastward direction difference between these two planets is maximum. But when the true planet crosses B. It accelerates and covering the gap reaches A[1] where these two planets coincide. In the western post of the circle, the opposite action is shown. This pull and push action were not clearly explained by the author, but we get the hints of his thought about attraction and repulsion of the planets.

Moon's apsis in an age, four hundred and eighty-eight thousand, two hundred and three and in the opposite direction, two hundred and thirty-two thousand two hundred and thirty-eight.

The questions are how the author of Somasiddnānta find these data? Even other Siddhantic texts didn't throw any light on this matter. Western scholars tried to explain it as the influence of western thought. It is hard to imagine that astronomy at that age calculated of the apsis of Saturn 36 revolution of the nodes. But the verses prove this. To historians of astronomy it is very interesting area.

Pt. S.B. Dikshit, in his master piece, Bhāratiya Jyotiṣa Śāstra, told that the age of Somasiddnānta is in between 5th or 6th century CE. It is because Somasiddhānta noticed Romakasiddhānta and there are the few verses which are included in the Brāhmasphutasiddnānta. Romakasiddhānta was influenced by yavana, and this statement was accepted by the historians. Romakasiddhānta was first shown in the Pañcasiddhāntikā of Varahamihira. Here the author indicates that the position and motion of planets were calculated correctly. Romakasiddhānta deals with Sun, Moon and Rāhu.[2] It also gives solar eclipse, but not lunar eclipse. In chapter VIII of Pañcasiddhāntikā, the first verse demonstrates the decrmination of mean Sun in revolutions. It is obtained by multiplying the days from epoch by 150, deducting 65 from the product, and dividing by 54,787.

i.e. Mean Sun = (Days from epoch × 150 – 65) ÷ 54,787.

Pt. K. Sāstry explains it with numerical example for easy understanding. But another requirement is to search the historiography of Indian astronomy.

The madlyamādhikara of Somasiddnānta ends with a verse 'vakriṇaḥ phaṇipāḥ paścātprāgyāyī vyomargaḥ svakaḥ'. The peculiarity is that Somasiddānta was written in anustup metre and the editor did not find the other half of the verse from two manuscripts.

Somasiddhānta is an important text without mentioning the name of the author but analyzing the verses it can be assumed that the author was not only a scholar of astronomy and mathematics but was a language expert. Comparing other Indian astronomical texts, it is found that a verse which meaningwise is almost similar to a verse of other text, but his verse is exceptionally more lucid. The construction of this text is conversation type, Soma to Śaunaka. S B Dikshit noticed, a group of siddhāntas led by Sūryasiddhānta are one of the milestones of classical Indian astronomy. The Pañcasiddhāntikā included all siddhānas except Somasiddhānta. So, it can be concluded that Somasiddhānta was compiled later. The version of Sudhakar Dvivedi exceptionally good for understanding but there is some omission from the manuscript. Perhaps this compilation was based on a copy of single manuscript.

It is important to notice that many verses are similar but there are many contents to treat the subject differently. For example the tripraśnādhikāra chapter is based on mathematics but in this book mathematical treatment is not so detail. The indication is absolutely right but it demands detail analysis. There are so many areas which are in concise form but in Lunar eclipse chapter, number of verses is more than Sūryasiddhānta, and also in descriptive manner.

1. Sūryasiddhānta on Astrolinguistic study, Dr. Sudhinant Bharaduaj, Parimal Publication, Delhi, 1991) p. 160
2. Pañcasiddhāntikā of Varāhamhira with translation & notes, T.S. Kupanna Sastry, P.P.S.T. Foundation, Adyan, Madra, 1993, p. 181

Appendix

Astronomical Technical Terms

1. Adhikamāsa	:	A month gained by the lunar reckoning over the solar. This is located in that lunar month which does not contain a Samkramaṇa.
2.Agrajyā	:	The Hindu sine of the arc of the horizon in between the rising point of the Sun and the east point.
3.Akṣa(or) Pala	:	Latitude (Terrestrial)
4.Akṣa Dṛkkarma	:	The arc of the ecliptic between the point of intersection of the ecliptic with a secondary through the star to the prime vertical and the point of intersection of the ecliptic with the star's declination circle.
5. Akṣakarṇa	:	The hypotenuse of the gnomonic triangle when it's shadow is equal to what is called Viṣuvat-chāyā.
6. Akṣavalanam	:	The angle at the point of the star in between the declination circle of the star and a secondary to the prime vertical through the star.
7. Antyā	:	The Hindu sine of an arc of the celestial equator corresponding to Hṛti.
8. Asta	:	Setting or heliacal setting.
9. Ayanabindu	:	Solstice.
10. Āyana-Dṛkkarma	:	The arc of the ecliptic intercepted between its point of intersection with the star's declination circle and the secondary to the ecliptic through the star.
11. Ayanāṁśam	:	The arc of the ecliptic in between the vernal equinoctial point and the Hindu zero of the

			ecliptic i.e. the first point of the zodiacal sign called Aśvini.
12.	Ayanavalanam	:	The angle at the point of a star, between its declination circle and the secondary to the ecliptic through the star.
13.	Bārhaspatyamāna	:	The time taken by Jupiter to reside in a Rāśi, on the average, is called a jovian year. This falls short of a solar year.
14.	Bhāga	:	A degree.
15.	Cāpa	:	Arc.
16.	Carajyā	:	The Hindu sine of the arc intercepted between the east point and the declination circle of a rising star or planet or the Sun.
17.	Cāndra-māsa	:	The time between two consecutive full Moons or New Moons.
18.	Chāyā or Bhā	:	Shadow cast by the gnomon.
19.	Chāyābhuja	:	The projection of the shadow on the east-west line.
20.	Chāyākarṇa or Bhākarṇa	:	The hypotenuse of the gnomonic triangle whose two sides are the gnomon and its shadow.
21.	Chāyākoṭi	:	The perpendicular from the extremity of a shadow on the east- west line.
22.	Dhruva	:	The star near the celestial pole or the celestial pole itself.
23.	Dhruvaka	:	The celestial longitude.
24.	Dhruva-protavṛttam	:	The declination circle.
25.	Digjyā	:	The Hindu sine of the azimuth measured by the angle between the prime vertical and the vertical of a star or a planet.
26.	Dorjyā or Bhujajyā	:	Hindu sine of celestial longitude.
27.	Dṛgjyā	:	The Hindu sine of the Zenith distance.
28.	Dṛg-lambana	:	Total parallax.
29.	Dvāparayuga	:	Twice the period of a kaliyuga.
30.	Dyujyā	:	The Hindu cosine of declination or the radius of the celestial equator to be R equal to 3438 units.

31.	Dyujyā-vṛtta or Ahorātra-vṛtta	:	The diurnal circle of a star or a planet.
32.	Ghaṭi or Nāḍi	:	An interval of time equal to 24.'(minutes)
33.	Grahaṇa	:	Eclipse.
34.	Hṛti or IṣṭaHṛti	:	The Hindu sine of the arc of the diurnal circle from a point of the same up to the plane of the horizon.
35.	Kadamba	:	Pole of the ecliptic.
36.	Kadamba-protavṛtta	:	A secondary to the ecliptic through a star or planet.
37.	Kakṣamaṇḍala	:	The deferent of a planet or the circle with the earth as centre and radius equal to 3438 units.
38.	Kalā	:	The Hindu sine in the diurnal circle corresponding to the Sūtra (given bellow).
39.	Kalā or Liptā	:	A minute of angle.
40.	Kaliyuga	:	The period consisting of 4, 32,000 mean solar years.
41.	Kalpa	:	Dvāparayuga is twice Kaliyuga; Tretāyuga thrice and Kṛta four times. All these put together constitute a Mahāyuga. 71 Mahāyugas make one Manvantara. 14 Manvantaras with what are called Sandhi periods on either side equal to a Kṛtayuga or thousand Mahayugas make a Kalpa.
42.	Kramajyā	:	Hindu sine of an angle.
43.	Karṇa	:	Half of the duration of a tithi.
44.	Karṇāgrajyā	:	The Hindu sine Agrājyā
45.	Ketu	:	The diametrically opposite point of Rāhu. Rāhu also means the circular section of the earth's shadow at the Moon.
46.	Krānti-Vṛttam	:	Ecliptic.
47.	Kṣitija	:	The Horizon at a place.
48.	Lagna	:	The Rāśi which rises at any moment or the rising point of the ecliptic.
49.	Lambana	:	Parallax in longitude.
50.	Mahāyuga	:	The Sum of four yugas.
51.	Manvantara	:	A period equal to 71 Mahāyugas.
52.	Nakṣatra	:	A star. Also the time, this elapses as the longitude of the Moon increases by 13.5 degrees starting from the zero point of Aśvinī

53.	Nākṣatra-māsa	:	The time taken by the Moon to go from Aśvinī again to Aśvinī.
54.	Pāta	:	The point of time when the declinations of the Sun and the Moon are equal and of the same sign or the opposite sign. Also it means the point of intersection of two great circles.
55.	Prācī	:	East point.
56.	Prācyaparā	:	East-west line.
57.	Rāhu	:	The point of intersection of the Moon's path with the ecliptic (ascending point of the Moon's path). Also it means the circular section of the earth's shadow at the Moon.
58.	Rāśi	:	An arc equal to 30 degree (on the ecliptic).
59.	Śanku	:	Gnomon.
60.	Śanku-cchāyā	:	The shadow cast by the gnomon.
61.	Saura-māsa	:	The time when the Sun occupies one Rāśi.
62.	Tithi	:	The time taken by the elongation of the Moon to increase by 12 degree starting from zero.
63.	Trijyā	:	The Hindu sine of three Rāśi's or 90 degree equal to R or 3438 units.
64.	Udaya	:	Rising or heliacal rising.
65.	Vighaṭī or Vināḍī	:	One sixtieth of a ghaṭī.
66.	Vikṣepa	:	Celestial latitude.
67.	Viṣuvatbindu	:	Equinoctial point.
68.	Viṣuvat-Vṛtta	:	Celestial equator.
69.	Vṛtta or Maṇḍala	:	A circle.
70.	Yaṣṭi	:	R^2-Āyanavalanajā^2. Yaṣti has another meaning namely the length of the perpendicular from a point on the diurnal circle on the plane parallel to the plane of the horizon through the point of intersection of the diurnal circle with the unmaṇḍala.
71.	Yoga	:	The time which elapses when the sum of the longitudes of the Sun and the Moon to increase by 13 10/3 starting from zero.
72.	Yuti	:	Conjunction.

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