SIDDHĀNTASUNDARAḤ

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SIDDHĀNTASUNDARAḤ

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Key to Transliteration

VOWELS

अ a	आ ā	इ i	ई ī	उ u	ऊ ū
(b<u>u</u>t)	(p<u>a</u>lm)	(<u>i</u>t)	(b<u>ee</u>t)	(p<u>u</u>t)	(p<u>oo</u>l)
ऋ ṛ	ॠ ṝ	ऌ* ḷ	ए e	ऐ ai	ओ o
			(pla<u>y</u>)	(<u>ai</u>r)	(t<u>oe</u>)
	औ au				
	(l<u>ou</u>d)				

CONSONANTS

Guttural	क ka	ख kha	ग ga	घ gha	ङ ṅa
	(s<u>k</u>ate)	(block<u>kh</u>ead)	(<u>g</u>ate)	(<u>gh</u>ost)	(si<u>ng</u>)
Palatal	च ca	छ cha	ज ja	झ jha	ञ ña
	(<u>ch</u>unk)	(catc<u>hh</u>im)	(<u>j</u>ohn)	(hedge<u>h</u>og)	(bu<u>n</u>ch)
Cerebral	ट ṭa	ठ ṭha	ड/ड़ ḍa	ढ/ढ़ ḍha	ण ṇa
	(s<u>t</u>art)	(an<u>th</u>ill)	(<u>d</u>art)	(god<u>h</u>ead)	
Dental	त ta	थ tha	द da	ध dha	न na
	(pa<u>th</u>)	(<u>th</u>under)	(<u>th</u>at)	(breat<u>h</u>e)	(<u>n</u>umb)
Labial	प pa	फ pha	ब ba	भ bha	म ma
	(sp<u>i</u>n)	(<u>ph</u>iloso<u>ph</u>y)	(<u>b</u>in)	(ab<u>h</u>or)	(<u>m</u>uch)
Semi-vowels	य ya	र ra	ल la	ळ* ḷ	व va
	(<u>y</u>oung)	(d<u>r</u>ama)	(<u>l</u>uck)		(<u>v</u>ile)
Sibilants	श śa	ष ṣa	स sa	ह ha	
	(sh<u>o</u>ve)	(bu<u>sh</u>el)	(<u>s</u>o)	(<u>h</u>um)	

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.

Foreword

The knowledge of Astronomy in ancient India had reached to a remarkable height by Āryabhaṭ, Bhāskara-1, Brahmagupta, Bhāskarācārya, Jñānarāja and many others. Vedāṅga Jyotiṣa (1370 B.C.) is considered to be the first astronomical text where we found five-year Yuga system. This Yuga-system was continued to be followed till Paitāmahasiddhānta (80 C.E). After Paitāmahasiddhānta, Indian astronomy had started taking turn into a new Era. In the old Sūryasiddhānta (200 C.E.), the drastic change is noticeable – (i) five-year Yuga-system was no longer followed (ii) mathematical astronomy was linked with observational astronomy. Eventually, mathematical astronomy got prominence in Āryabhatīyam (499 A.D.). The primary source materials of ancient astronomy were coined in Sanskrit Language whereas medieval source materials are taken from Arabic and Persian manuscripts.

The present publication Śiddhāntasundará (1503 A.D.) is a later astronomical work composed by Jñānarāja, who followed Brahmasiddhānta in Śakalyaṁsahitā. Indian astronomical works are divided into different schools like brahmapakṣa, āryapakṣa, ardharātrikāpakṣa and saurapakṣa. Siddhāntasundara belongs to the last category. The text has two major sections – (i) grahagaṇitādhyāya (ii) goladhyāya. Grahagaṇitādhyāya focuses on mathematical aspect of astronomy and Goladhyāya deals with cosmology and allied matters. Here, he explained cosmology related myths found in the Purānas.

The critical edition is prepared by Dr. Jagatpati Sarkar and Sri Somenath Chatterjee. This book contains critically edited

Sanskrit text, notes in English and critical apparatus. Sri Somenath Chatterjee, an independent researcher on Indian astronomy and science have worked hard to prepare this critical edition. Two astronomical texts (i) Bramasiddhānta and (ii) Somasiddhānta of Somenath Chatterjee have already been published by the National Mission for Manuscripts. Hope he will continue his searching of Indian astronomical manuscripts to throw new light on the subject.

The Mission invites experts to come forward to work on Science related unpublished Indian manuscripts and to engage young researchers on the job so that rich scientific knowledge of our ancestors receives appropriate appreciation.

Prof. Pratapanand Jha
Director
National Mission for Manuscripts

Introduction

Introduction

Siddhāntasundara is a significant work of Jñānarāja, son of great scholar Nāganātha, containing all the previous knowledge of astronomy. The epochal positions which Jñānarāja has given in his work, Siddhāntasundara, are true for śaka 1425 or 1503 CE. This was evidently his date. Jñānarāja has written the astronomical book having two main parts Golādhyāya and Gaṇitādhyāya. Verses which are found in different manuscripts are different in number like madhyagatihetu chapter etc. Cintāmaṇi, the son of Jñānrāja, made a commentary on his book in detail and that commentary is available.

The Sidhāntasundra follows Brahmasiddhānta in Śākalyasaṁhitā which follows the Sūryasiddhānta. It gives the epochal positions of planets and annual rates of motion for finding the places of different planets. These positions and the rate of yearly motion of planets, completely follow the modern Sūryasiddhānta. The compiler explained an important term "'ayanāṁśa' as the difference between the sun's position calculated from the shadow cast by the noon sun and that obtained from calculation based on a karaṇa work".

Siddhāntasundara is a work having explanations of theory in different view from Bhāskarāchārya. The yantramālā chapter describes one new instrument. Vedāṅga Jyotiṣa is the first astronomical work compiled by Lagadha in 14th century BCE. But we get instances of the astronomical knowledge in Vedic texts and Purāṇas.

Evolution of Astronomical knowledge in Vedic period

The Vedas are the first literary documents in the history of mankind, and the Ṛgveda Saṁhitā forms the oldest part of the corpus of Vedic literature. Initially passed down through generations over centuries as oral tradition, this valuable treasure of the ancient world has been preserved in the form of manuscripts in different parts of India. Of course, none of the available manuscripts of the Ṛgveda Saṁhitā predates 14th century CE. However, a continuity of Ṛgvedic tradition is retained for more than four thousand years, recited by chanters, and transmitted from teachers to students in both oral and written form. No land on earth has such a long cultural continuity, even though there were ancient civilizations like the Babylonian, the Egyptian and the Chinese. Information regarding the Ṛgveda reached Europe in the 18th century CE. Various attempts were made to publish and make the translation in Latin, German, English, and French outside, and in Bengali, Hindi, Marathi, Telugu, Kannada, Malayalam etc. in India. The National Mission for Manuscripts has been taking lot of initiatives to conserve them. It is a matter of great satisfaction that it is through their effort that recently thirty manuscripts of Ṛgveda Samhitā lying in Bhandarkar Oriental Research Institute (Pune) have been nominated for inscription in UNESCO's Memory of the World Register. Despite these activities and important contributions made by scholars, both Indian and foreign, there is enough scope left to appreciate the extent of contribution of Vedic people in the field of mathematics and astronomy.

Among the four major Saṁhitās, the Ṛgveda, Sāmaveda, Yajurveda and Atharvaveda there is no doubt that the Ṛgveda occupies a prominent place and is regarded by Indians as revealed scripture and as such the fountainhead of their religious beliefs and practices, ethical and social codes, and spiritual knowledge. We get a history of the people known as Vedic people who were mostly referred to as the Indo-Aryans, and have passed through many a transitions from hunter-gatherer society to early food production-domestication of animals—community living – ritual practices—oral

tradition-computation abilities–abilities–observation of seasonal variation- fixation of time etc. and made positive contribution to society and culture. The Vedic people lived almost in the same river valley regions as those of the Harappans & Mohenjo-daro people, and they were designated sometimes as autochthonous groups like Proto-Brahmin, Proto Dravidian based on Harappan-Ṛgvedic and Mohenjo-daro Atharva-vedic cultural affinities or other characteristics, reshaped and resuscitated in village surroundings. The root, vid, means 'to know', and suffix, Veda, with major Saṁhitās and Brāhmaṇas indicate the knowledge of the early Vedic people. There was no idolatry, no temples for the gods. The concept of gods grew gradually. Assemblage of these groups might have taken place much early and the tradition of knowledge had passed through generations. We will discuss here from the time when they had established themselves in the Sarasvatī, Dṛśyavatī and Gaṅgā region following a tradition as old as 4000 BC if not earlier. Their thoughts and religious practices are available to us in the collections like Saṁhitās, Brāhmaṇas and Āraṇyaka-Upaniṣads. There is a great deal of unity and intermixture of materials among first two groups, and in general it is presumed that Samhitās are older than Brāhmaṇas, and Brāhmaṇas than Āraṇyaka-Upaniṣad. It is not unlikely that some of the Brāhmaṇas are older than or contemporaneous with some of the Saṁhitās and so on. The Āraṇyaka-Upaniṣads were a special type of literature dealing with soul, a mental adventure, a very distinctive new type of enquiry to know the inner world and was set to find truth about things. These early works were based on oral tradition and copied at a later stage as and when the language and grammars were reasonably standardized. The Agni (Fire) was considered a primordial God in the Ṛgveda beside others, however, and quite a large number of verses / prayers deal with agni, agnicayana, vedis (fire-altars), course and time for oblations, thereby explaining the basic tenets and philosophy of life. The activities give information on the system of counting, knowledge of shapes for altars, cardinal directions and their co-relation with reference to Sun, Moon, Stellar-

frame of zodiac of 28 or 27 nakṣatras (stars, group of stars, asterism or lunar mansions), east-west zodiacal points (equinoxes when day and night are equal), north-south zodiacal points (solstices when the day is longest or shortest), seasons and other related matters. These helped to develop numbers as big as 1018 based on a decimal scale, concept of natural units of time like dina (day & night), māsa (month), vastsara (year) based on a luni-solar system, idea of yuga (of 5, 6 or 7 years) to make an idea and compromise between various types of civil, tropical, lunar and sidereal years, and even an eclipse cycle of 18 years for finding proper times for more crops, plants, animals, arts, crafts and better knowledge of life including mathematics and astronomy.

The Vedāṅga literature, developed subsequently, are considered part of this tradition and contains expert extended knowledge on the construction of fire-alters including times for worship which shows great professionalism in some specific areas. The knowledge in these branches of study arose within the Vedic schools themselves as a necessary condition for mastering the Vedas and are handed down from generation after generation by teachers to his students (guru-śiṣya-paramparā) by a unique method of oral transmission (śrūti). The Vedic gods and rituals become secondary during the Vedāṅga phase and the life began to be interpreted in a different manner, following the age-old tradition more rationally. The early Vedic tradition of agnicayana, chandas, and calendar continued and the problems were handled more professionally which contributed largely to mathematics and astronomy. The agnicayana got a methodical treatment in the śulbasūtras, here specialists like śulbakāras (cord-markers or cord stretchers responsible for construction of alters of various shapes, śulba means cord) iṣṭakāras (brick-makers of specified size), chandakāras (for reciting of verses during ritual) etc. The śulba works give detail method of construction of geometrical figures and their transformation of one figure to another, make the cords ready for stretching by giving numbers by traditional methods, then improving it by their own knowledge by

ekarajjuvidhi, dvirajjuvidhi using triplets (a, b, c satisfying properties of right-triangle: $a^2 + b^2 = c^2$) expressed in integers, rational numbers and even irrational numbers. This prompted to make a general statement of the 'theorem on the diagonal', value of $\sqrt{2}$, several values of π which are unique of its kind if compared with the contemporary cultures. The metrical problems in connection to chandas likewise extended the knowledge for detection of different layers of 2, 3, 4, 5, 6. Syllabic chandas based on two sounds (laghu, short and guru, long), leading to the binomial expansion (meru-prastāra technique by commentator Halāyudhya). The Ārca Jyotiṣa and Yajus recensions of the Vedāṅga Jyotiṣa adopted the 5-year yuga system starting it in Winter solstice from the beginning of Dhaniṣṭhā nakṣatra. The nakṣatra was conceived, not as star grups, but as a space in lunar zodiac (longitude) and is equal to 13 5/9 days. The coordinates of yogatārā (junction star) of each nakṣatra space have also been attempted along with the positions of full moons in a yuga, beside others. Some of these aspects appear to be original and unique in their approaches and methodology for finding a solution.

The Jyotiṣa (Astronomy) in Later Vedic Tradition

The Jyotiṣa tradition of this phase is followed from the RVJ and YVJ recensions of the Vedāṅga Jyotiṣa (VJ) compiled by Lagadha with provided the priests with means to compute the prescribed times for performing sacrifices.

The main architect of both RVJ and YVJ versions is ascribed to Lagadha (RVJ.2; YVJ.43), though Weber (1862) in his edition has left the YVJ verse as unnumbered at the end. There is evidence that the versions have been compiled by his disciple Suci, Somakara and others. Weber's "Uber den Veda, Namens Jyotisha" published in Berlin contains an edition of the complete text based on the comparison of a great number of manuscripts, the gloss on the text by Somākara, translation of the text based on Somakara's edition, and his own notes based on large number of sources like Gargasaṁhitā and

other texts. The edition and the interpretation have been reassessed and a large number of publications have been brought out in the last hundred years or more by scholars like Thibaut (1877), Dvidedi (ed.1908), Shamāsāstry (1936) , Kuppanna Sastry and K.V Sarma (ed. 1984), Yajnik (1985) and others. The effort was initially made to edit, emend and to interpret the text. Comparative analysis of both RVJ and YVJ recensions have also been attempted by Dixit (1957), Cakravarty (1975) besides Yajnik and Kupanna Sastry and others. After Kuppanna Sastry brought out the critical edition published by the Indian National Science Academy (Delhi, 1985), a lot of interest has been created and a series of interesting papers have been brought out by Abhyankar (1993), Kak (1998), Iyengar (2005), Gondhalekar (2008), etc. The edition of Kuppanna Sastry has been used here for critical assessment for our purpose. The RVJ recension consists of 36 verses and the YVJ of 44 verses. Both RVJ and YVJ recensions have about 30 verses in common with some variations in readings.

The astronomical elements, and the position of equinoxes, according to Kuppanna Sastry, indicate that they carry information of Saṁhitās and Brāhmaṇas and was conceived between 1370 BCE to 1150 BCE. However, for historical reasons, the date of compilation is adduced to about 500 BCE.

As regards the purpose of Vedic ritual (yajñas), the VJ emphasized thus

> 'The Vedas have indeed been revealed for the purpose of the performance of yajñas. But the yajñas are to be performed in different segments of time as appropriate. Therefore, only he who knows the science of time, namely jyotiṣa, understands fully the performance of yajñas' (RVJ. 36; YVJ.3).

Units and their significance

Yuga: 5-year yuga is conceived. The names are: Samvatsara, Parivatsara, Idavatsara. Anuvatsara, and Idvatsara. These were known to other scholars with some variants in certain places.

Solar month (saura-māsa): It is defined here as one-twelfth of a year and is equivalent to 30 days;

Sāvana dina: It is a civil or natural day from sunrise to sunrise; in a year there are two ayanas (northward or southward), each having 183 days, total being 366 days; for the whole course, the increase or decrease is 183 × 4/61 nāḍikās = 12 nāḍikās or 6 muhūrtas (RVJ.7; YVJ.8);

1 sāvana day = 30 muhūrtas (including day and night); day length at equinoxes = 15 muūrtas; shortest day at Winter solstice-12 muhūrtas; longest day at Summer solstice = 18 muhūrtas.

Sāvana month: It is equivalent to 30 sāvana days.

Synodic month (cāndramāsa) and lunar phases: One yuga has 62 synodic months or 1860 tithis; in other words, 1 synodic month = 30 tithis. There were 30 phases or tithis in a synodic or lunar month; 15 following full moon (purṇimā), presently indicated by K1, K2, K3…… K15 (Kṛṣṇa-pakṣa, dark fortnight), and 15 following New moon (amāvasyā) indicated y S1 S2, S 3…S15 (Śukla pakṣa, bright fortnight).

Tithi: It is defined as one-thirtieth of a synodic month;

Adhika (or Intercalary) months: There are 62 synodic months, hence it is clear that there are two intercalary months in a yuga of 5 years; i.e. after 30 months, an extra (adhika) month is added to complete the half-yuga.

Pakṣas or Parvas: Each synodic month has 2 pakṣas or parvas; in one yuga of 5 years (or in 62 synodic months), one yuga has 62 × 2 = 124 pakṣas or parvas; each pakṣa or parva having 15 tithis; each day is divided into 124 parts, which again divided into 4 bhāga or pāda, each pāda being 31 parts.

The verse (RVJ.4; YVJ.13) gives a rule for calculating parvas (or parva-rāśis), which says that parva rāśi = $[(n - 1) \times 12 + m]\ 2 + 1$ + extra 2 (for every 60 parva gone), Where n = no. of years of the yuga referred, and m = no. of months. An example for calculating Parva-rāśi before the point of time of starting Anuvatsara Karttika Bahula Navami is given as 91, for $n = 4$, $m = 9$.

Kṣaya or hīna-parvas: A yuga had 1830 (= 61 × 30) days and 1860 (= 62 × 30) tithis in VJ. Normally, 30 tithis were dropped as kṣaya-tithis, and the dropping of one tithi in every 61 tithis in a yuga is the answer. However, YVJ.12 has hinted that a parva-tithi (purṇimā or amāvasyā) is to be dropped if it lasts for less than one pāda (31 parts) of a day. Evidently, amāvasyās at the end of 14 even Parvas (4, 8, 12, 16, 20, 24, 28, & 66, 70, 74, 78, 82, 86 and 92), and purṇimās at the end of 16 odd-parvas (33, 37,41, 45, 49, 53, 57, 61 & 95, 99, 103, 107, 111, 115, 119 and 123), total being 30, are to be dropped. Various corrections have been offered by different scholars which have led to 15-, 19-, 30-, 95- years yuga cycles.

Ṛtu: Six ṛtus or seasons in a year are recognized; consecutive ṛtus occur at an interval of 2 synodic months and 2 ṛtus, covering 30 ṛtus in 62 synodic months in a yuga. Each ṛtu covers 27/6 or 4½ nakṣatras, or in other words, the Sun or Moon, moving through 4½ segments, is related to a rtu (RVJ.9d; YVJ.10d). In a 5 year yuga, there are 30 ṛtus and 62 synodic months; 1st ṛtu in a yuga is Śiśira and the first ṛtu-month is Tapas (Tait S.IV.4.11.1; RVJ.7; YVJ.6), Tapas and Tapasya being the month of Śiśira; the consecutive ṛtus occur at an interval of 2 synodic months and 2 ṛtus; obviously, it says that the 8th ṛtu falls on 15th tithi which is purṇimā (YUJ.11).

Nakṣatra: Number of nakṣatras is 27; also conceived as a 1/27th space of the stellar zodiac (or ecliptic) or 360° (or an arc space of 13°20); the Sun also stays 366 days in the ecliptic, the Sun covers each nakṣatra in 366/27 = −13 5/9 days; the ecliptic division of 12 rāśis of 30° each were not known at the time of Vedāṅga Jyotiṣa; however, the word ‘rāśi’ was used in VJ (RVJ4;YVJ.13) in the context of lunar phase but not in connection to ecliptic division.

Aṁśas: The nakṣatra or asterismal segment is divided into 124 parts, and one aṁśa is equal to 1/124th segment of the nakṣatra, or in other words, one aṁśa represents the 124th segment or alternately an (hour) angle of nakaṣra; it is used for calculation of New moon and full moon in connection to Jāvādi nakṣatras.

However, the verse (RVJ.10; YVJ.15) gives a rule to calculate the aṁśa of Sun and Moon of each nakṣatra and at the end of a particular parva. One yuga cycle has 62 lunar months (lunations) and 67 sidereal months; 1 lunation = 67/62 = 1(+ 5/62) sidereal months, and in one sidereal month Moon passes through 27 nakṣatras. So in 1 lunation of Moon passes through 27 × 67/62 = 27 (1 + 5/62) = 27 + (27 × 5)/62) = 29 + 11/62 or $29^{22/124}$ nakṣatras, i.e. the separation of successive New (or Full moons is 2922/124 nakṣatras, and the separation of a New and Full (or Full and New) Moon is the half, that is (14 + 73/124) or i.e. $14^{73/124}$ nakṣatras each.

At New moon, the Moon is with the sun and the bhāṁśas are the same. At Full moon, the Moon is opposite to the sun i.e. 13/12 nakṣatras away or 13 nakṣatras and 62 bhāṁśas away. The parva ends with a full moon, dina the sutra says that the Moon's bhāṁśa is found by adding 62.

The Sun, in each yuga of 5 solar years, passes through 27 × 5 = 135 nakṣatra segments in 62 synodic months or 124 parvas, so each parva passes through 135/124 = 1 + 11/124 nakṣatra-segments, i.e. at the end of 1 parva, the Sun's bhāṁśas is 11, then the Moon's bhāśas will be (11 + 62) = 73. Obviously, at the end of 93 parvas, Sun passes through (20 + 31/124), i.e. Sun's bhāṁśas w r t nakṣatra Śraviṣṭha = 31, and Moon's bhāśas = 31 + 62 = 93.

Lagna: Lagna at the end of any parva is the rising point of Sun with reference to Śraviṣṭha asterism or zodiac;

Lagna = (bhāṁśa of the Sun w r t Śraviṣṭhā × 27)/124. At the end of 93rd parva = (31 × 27)/124 = (6 + 93/124), i.e. 93 bhāṁśas of Bharaṇī; this is the rising point (lagna).

Day Division: 1 day = 30 muhūrtas (or 24 hours) = 60 nāḍikās (1 nādikā = 24 minutes) = 603 kalās (1 nādikā = 10 1/20 kalās); 1 kalā = 124 kāsthas; 1 kastha (RVJ.16; YVJ.38). For nādikā measure, discussion of Clepsydra may also be seen.

Tithi & Nakṣatra: In a 5-year yuga cycle, there were 10 ayanas in 62 synodic months, so one ayana had 6 synodic months and 6 tithis,

so every 7th tithi comes in the beginning of the solstice. Both RVJ 8. And YVJ.9 say:

'The 1st, 7th and 13th tithis of the bright fortnight and the 4th and 10th of the dark fortnight are at the beginnings of the first five ayanas. These occur twice' (i.e. these five are to be repeated for the next five ayanas) [RVJ9a-c: YVJ10a-c].

'The nakṣatras at the beginning of the ayanas are Śraviṣṭhā, Citrā, Ārdrā, Pūrva Proṣṭhapadā, Anurādhā, Aśleṣā, Aśvinī, Pūrvāṣādā, Uttarphālgunī and Rohiṇī' (RVJ8 a-c; YVJ 9a-c) (Vide Table 1)

Table 1: Successive tithi & Nakṣatra at the beginning of the Ayana in a 5-year cycle

Sl No.	Name of the 5-years cycle	Winter solstice	Summer solstice
1.	Samvatsara	Maghā S1-Śraviṣṭhā	Śravaṇā S7-Citrā
2.	Parivatsara	Maghā S 13 Ādrā	Śravaṇā K4-P. Proṣṭapadā
3.	Idavatsara	Maghā K10-anurādhā	Śravaṇā S1-Aśleṣā
4.	Anuvatsara	Maghā S7-Aśvinī	Śravaṇā S13-Pūrvaṣādā
5.	Idvatsara	Maghā K4-Uttaraphālgunī	Śravaṇā K10-Rohiṇī

The period of 5-years, 62 lunations and 1830 days in a Yuga was supposed to recur regularly from the same initial point of Winter solstice day fixed by the heliacal rising of Dhaniṣṭhā/Śraviṣṭhā. Tithi and Nakṣatra may, however, differ, in case the 1st 2nd and 4th year of the 5-year cycle were taken to be of 12 lunations each, the 3rd and 5th year of 13 lunations each, in order to fit the intercalated lunar years completely with the sidereal years of the cycle. To detect the changes of rising of stars at solstices was not easy to the naked eye or any instrument available at that time, but changes in Moon could easily be verified. After completion of the cycle, the same initial phase of the Moon will occur on 1832nd day, not on 1831st day as pointed out before, for which 1 day's intercalation was recommended.

Beginning of 5-year yuga cycle.

Both Ṛg-vedic and Yajur-vedic recensions of Vedāṅga Jyotiṣa have said:

> 'When the Sun and Moon occupy the same region of the sky (rise) together with the asterism Śraviṣṭhā/Dhaniṣṭhā, at that time begins the yuga, and the (synodic) month of Maghā, the (solar), month called Tapas, the bright fortnight (of the synodic month, here Maghā), and their northward course (uttaram ayanam)'. (RVJ.5; YVJ.6)

> 'When situated at the beginning of the Śraviṣṭhā segment, the Sun and the Moon begin to move north. When they reach the midpoint of Aśleṣa segment, they begin moving south. In case of the Sun, this happens always in the month of Maghā and Śravaṇā respectively'. (RVJ.6' YVJ.7)

In this context, Sastry notes that. 'This is done for civil calendric purposes, which demanded such simplification, just as, in modern times, the year is taken by us now to have 365 days ordinarily, with one day more in four years, calling it leap year, with its own further exceptions. This serves only as a framework only for a religious calendar. So, the Yuga cannot begin exactly at the first point of Śraviṣṭhā segment generally in every cycle unless corrected'.

Naskṣatra, Bhāṁśa, New moon Full moon in a Yuga

The Vedāṅga Jyotiṣa had also followed system of 27 nakṣatras with the same names and were adept in finding the New moon, Full moon along with nakṣatras. Only difference is that it had started the 5-year yuga-cycle from the New Moon of Śraviṣṭhā, known as a 'zero point'. The nakṣatras in this cycle are counted in VJ (RVJ25-28) as usual (with their presiding deities), as follows:

> 1. Dhaniṣṭhā/Śraviṣṭhā, 2. Śataviṣāj, 3. (Pu) Proṣṭhapadās, 4. (Utt). Bhādrapada, 5. Revatī, 6. Asvayujau, 7. Bharanī, 8. Kṛttikā, 9. Rohiṇī, 10. Mṛgaśīrsa, 11. Ārdrā, 12. Punarvaśu, 13. Puṣya, 14. Aśleṣā, 15. Maghā, 16. (Pu.) Phālgunī, 17. (Utt.) Phālguni, 18. Hastā, 19. Citrā 20. Svātī, 21. Viśākhe, 22. Anurādhā, 23. Jeṣṭhyā, 24. Mulā, 25. (Pu) Āṣāḍas, 26. (ut) Āṣāḍas, 27. Śrāvaṇa.

The word nakṣatra, was not meant the actual constellation in VJ, but 27 equal space of the ecliptic.

The reference of New Moon at Śravisthā nakṣatra mark the Winter solstice in the VJ. This indicates that the method of derivation of New and Full moon at different nakṣatras were known.

1 Lunation = 67/62 sidereal months, and in one sidereal month Moon passes through 27 nakṣatras. So in 1 lunation of the Moon passes through 27 × 67/62 = 29 22/124 nakṣatras, i.e. the separation of successive new (Full) moons is 29 22/124 nakṣatras, and the separation of a New and Full (or Full and New) Moon in 14 73/124 nakṣatras each. One nakṣatra (space) is subdivided into 124 bhāṁśas. Obviously in a yuga of 62 synodic months, the New/ Full moon will occur at an interval of (14 nakṣatras 73 bhāṁśas). (Table 2).

Table 2: New moon and Full moon of 62 Synodic months with nakṣatra and bhāṁśa in the 5-year yuga cycle; nakṣatra no = 27, bhāṁśa no = 124

	New moon			Full moon		
	Nakṣatra	Bhāṁśa		Nakṣatra	Bhāṁśa	
No	no.	no.	Nakṣatra	no.	no.	Nakṣatra
1.	0	0	Śravisṭhā	14	73	Maghā
2.	2	22	Pu. Proṣṭhapadā	16	95	Utt. Phālgunī
3.	4	44	Revatī	18	117	Citrā
4.	6	66	Bharaṇī	21	15	Anurādhā
5.	8	88	Rohiṇī	23	37	Mūlā
6.	10	110	Ārdrā	25	59	Utt. Asāḍa
7.	13	8	Aśleṣā	0	81	Śravisṭhā
8.	15	30	Pu. Phālgunī	2	103	Pu. Proṣṭhapadā
9.	17	52	Hastā	5	1	Asvayujau
10.	19	74	Svāti	7	23	Kṛttikā
11.	21	96	Anurādhā	9	45	Mṛgaśīrṣā
12.	23	118	Mūlā	11	67	Punarvaśu
13.	26	16	Śravaṇā	13	89	Aśleṣā
15.	3	60	Utt. Prosthapadā	18	9	Citrā

	New moon			Full moon		
	Nakṣatra	Bhāṁśa		Nakṣatra	Bhāṁśa	
No	no.	no.	Nakṣatra	no.	no.	Nakṣatra
16.	5	82	Asvayujau	20	31	Viśākhe
17.	7	104	Kṛttikā	22	53	Jyeṣṭhā
18.	10	2	Ārdrā	24	75	Pu. Asāḍa
19.	12	24	Puṣyā	26	97	Śrāvana
20.	14	46	Maghā	1	119	Śatabhiṣāj
21.	16	68	Utt. Phālguni	4	17	Revati
22.	18	90	Citrā	6	39	Bharani
23.	20	112	Viśākhe	8	61	Rohini
24.	23	10	Mulā	10	83	Ārdrā
25.	25	32	Utt. Asada	12	105	Puṣyā
26	0	54	Śravisṭhā	15	3	Pu., Phālguni
27.	2	76	Pu. Prosthapadā	17	25	Hastā
28.	4	98	Revati	19	47	Svati
29.	6	120	Bharani	21	69	Anurādhā
30.	9	18	Mragsirsa	23	91	Mulā
31.	11	40	Punarvasu	25	113	Utt. Asadā
32.	13	62	Aśleṣā	1	11	Śatabhiṣāj
33.	15	84	Pu. Phālguni	3	33	Utt. Prosthapadā
34.	17	106	Hastā	5	55	Asvayujau
35.	20	4	Viśākhe	7	77	Kṛttikā
36.	22	26	Jyeṣṭha	9	99	Mrgasirsā
37.	24	48	Pu. Asada	11	121	Punarvasu
38.	26	70	Śrāvaṇa	14	19	Maghā
40.	3	114	Utt. Prosthapadā	18	63	Citrā
41.	6	12	Bharani	20	85	Viśākhe
42.	8	34	Rohini	22	107	Jyestha
43.	10	56	Ardrā	25	5	Utt. Asada
44.	12	78	Pusyā	0	27	Sravisṭhā
46.	16	122	Utt. Phālguni	4	71	Revatī
47.	19	20	Svātī	6	93	Bharaṇī

	New moon			Full moon		
	Nakṣatra	Bhāṁśa		Nakṣatra	Bhāṁśa	
No	no.	no.	Nakṣatra	no.	no.	Nakṣatra
48.	21	42	Anuradhā	8	115	Rohiṇī
49.	23	64	Mūlā	11	13	Punarvasu
50.	25	86	Utt. Asadā	13	35	Asleṣā
51.	0	108	Sravisṭhā	15	57	Pu. Phālgunī
52.	3	6	Utt. Prosthapadā	17	79	Hastā
53.	5	28	Asvayujau	19	101	Svatī
54.	7	50	Kṛttikā	21	123	Anuradhā
55.	9	72	Mṛgaśīrsa	24	21	Pu. Aṣāḍa
56.	11	94	Punarvasu	26	43	Srāvaṇa
57.	13	116	Asleṣā	1	65	Satabhisaj
58.	16	14	Utt. Phalgunī	3	87	Utt. Prosthapadā
59.	18	36	Citrā	5	109	Asvayujau
60.	20	58	Visakhe	8	7	Rohiṇī
61.	22	80	Jyesthā	10	29	Ardrā
62.	24	102	Pu. Asāḍa	12	51	Puṣyā

Jāvādi system, an indicator of New and Full moon:

The Vj gives the Jāvādi (Jau + ādi) system, the abbreviated list of nakṣatras, with Śravisṭhā as Zero point in a 5 years-yuga (RVJ.14: YVJ.18), as follows:

> 1. Jau (Aśvayujau), 2. Drā (Ārdrā), 3. Gah (Bhagah: Pū. Phalgunī), 4. Khe (Viśākhe), 5. Śve (Viśvedevāh: Utt. Āṣāḍa), 6. Hih (Ahirbudhyah: Utt. Proṣṭapada), 7. Ro (Rohiṇī), 8. Ṣā (Aśleṣā), 9. Cit (Citrā), 10. Mū (Mūlā), 11. Sa (Śatavisaj), 12. Nyah (Bharanyah), 13. Sū (Punarvasū), 14. Mā (Aryamā: Utt. Phālgunī), 15. Dhāh (Anuradhā), 16. Nah (Śravaṇa), 17. Re (Revatī), 18. Mr (Mṛgaśīrṣa), 19. Ghāh (Maghāh), 20. Svā (Svāti), 21. Pah (Āpah: Pū. Āsāḍa), 22. Jah (Ajaejapāt: Pu. Proṣṭhapadā), 23. Kr (Kṛttikā), 24. Ṣyah (Puṣyah), 25. Ha (Hasta), 26. Jye (Jyeṣṭhyā), 27. Ṣṭhyāh (Śravisṭhā).

The arrangement at an interval of five nakṣatras (Jāvādi nakṣatra) and the significance of their arrangement was originally

not understood. The significance becomes evidently clear when the New moons and the Full moons of Table 2 are arranged as per serial order of their bhāṁśas, which indicate the Full and New moon and their corresponding nakṣatras in a yuga cycle (vide Table 3).

Table 3:

	New moon/Full moon in a yuga, New moon occurred in Sravistha		
No.	Nakṣatra no.	Bhāṁśa no.	Nakṣatra (Jāvādi)
1.	5	1	Asvayujau, Full moon
2.	10	2	Ārdrā, New moon
3.	15	3	Pū. Phālgunī, Full moon
4.	20	4	Viśākhe, New moon
5.	25	5	Utt. Āṣāda, Full moon
6.	3	6	Utt. Proṣṭpadā, New moon
7.	8	7	Rohinī, full moon
8.	13	8	Aśleṣā, New moon
9.	18	9	Citrā, Full moon
10.	23	10	Mūlā,New moon
11.	1	11	Śatabhiā, Full moon
12.	6	12	Bharaṇī, New moon
13.	11	13	Punarvasu, Full moon
14.	16	14	Utt. Phālgunī, New moon
15.	21	15	Anurādhā, Full moon
16.	26	16	Śravanā, New moon
17.	4	17	Revatī, Full moon
18.	9	18	Mṛgasirṣa , New moon
19.	14	19	Maghā, Full moon
20.	19	20	Svatī, New moon
21.	24	21	Pū. Āṣāda, Full moon
22.	2	22	Pū. Prosthapadā, New moon
23.	7	23	Kṛttikā, Full moon
24.	12	24	Puṣyā, New moon
25.	17	25	Hasta, Full moon
26.	22	26	Jyeṣṭha, New moon
27.	0	27	Śraviṣṭhā, Full moon

At new moon, the Sun and Moon are in conjunction, the solar and lunar bhāṁśa number is same. At full moon, the solar bhāṁśa is known, the lunar bhāṁśa number can easily be calculated, the main purpose being to find the suitable time for performance, It is true serious attempts were definitely made to find a theoretical system, but to what extent the system was correct and whether they had failed depends on how the priest felt or could make up while performing the sacrifices. Two passages from the Śatapatha Brāhmaṇa (Sat. Br. IX 1-5), for example, give enough hint about the situation when the new and Full moon differed, as was seen in the sky, from the calculated one:

> "He observes fast thinking 'today is the day of new moon' and then the Moon seen in the west and the sacrifice departs from the path of sacrifice" (New moon occurs one day earlier than the calculated date).

> "Some people enter upon first when they still see the Moon thinking 'tomorrow he will not rise' and in the morning he rises over again" (New moon is delayed by one day than the calculated date).

This shows that the theoretical framework for determining tithi and nakṣatras were just made but possibly not strictly relied on. This is obvious since the formulas were drawn on the basis of the mean motions of Sun and Moon.

How to find the coordinates of the Full moon at a particular nakṣatra on a specified date in a yuga? Presently, these are calculated with reference to Zero-point at the First point of Aries. But in VJ, the yuga was conceived from Winter solstice at Śraviṣṭha, and the corresponding Full moon and New moons were suggested as per Jāvādi nakṣatra (i.e Asvini, identified as Piscium) and in serial order of bhāṁśas. The Vedic Āryas, on the other hand, had given the list of nakṣatras from Kṛttikā at Vernal equinox and might have used it as origin and Zero-point for coordinates. Unfortunately. We are not in a position now to know which exactly their zero point was. To appreciate the Vedic system from the present perspectives, modern scholars have made a survey to fix up the coordinates for the

New and Full moon with reference to Vedic nakṣatras and bhāṁśa numbers, an excellent summary of which are made by Gondelekar (2009).

The methodology was fixed up to find the solution in two steps. Step 1: the dates of the New moon at or within one day of the Winter solstice between 1900 AD and 2000 AD from available calendars, and the corresponding dates for 62 Full moons; separations are noted along with names and width of the nakṣatra-sector starting with Kṛttikā, Full moon number, bhāṁśa number and ecliptic longitude (Table 4);

Table 4: The width of the nakṣatra sectors (in degrees)

Nakṣatra	FM	bhāṁśa	L	FM	bhāṁśa	L	WNS
Kṛttikā	10	23	10.17	35	77	15.98	13.34
Rohiṇī	23	61	27.49	48	115	33.45	13.69
Rohiṇī	48	115	33.45	60	7	21.23	14.03
Mṛgaśīrṣa	11	45	38.32	36	99	44.53	14.26
Ārdrā	24	83	55.91	61	29	50.48	12.47
Punarvasū	12	67	67.90	37	121	73.74	13.41
Punarvasū	37	121	73.74	49	13	61.69	13.84
Puṣyā	25	105	85.34	62	51	79.22	14.05
Aśleṣā	13	89	96.13	50	35	91.45	10.75
Maghā	1	73	107.91	38	19	102.49	12.45
Pūrva Phālgunī	14	11	125.68	26	3	113.58	13.89
Pūrva Phālgunī	26	3	113.58	51	57	119.71	14.08
Uttar Phālgunī	2	95	137.33	39	41	131.45	13.50
Hasta	27	25	143.26	52	79	149.37	14.03
Citrā	3	117	166.12	15	9	154.32	13.55
Citrā	15	9	154.32	40	63	160.53	14.26
Svati	28	47	171.62	53	101	177.76	14.10
Vaśākhe	16	31	183.87	41	85	189.36	13.61
Anurādhā	4	15	195.82	29	69	201.47	12.97
Anurādhā	29	69	201.47	54	123	207.27	13.32
Jyeṣṭhā	17	53	212.80	42	107	218.70	13.55

Nakṣatra	FM	bhāṁśa	L	FM	bhāṁśa	L	WNS
Mūlā	5	37	224.49	30	91	229.90	12.42
Purvaāṣāḍhā	18	75	242.20	55	21	235.78	14.74
Uttaraāṣāḍha	6	59	254.28	31	113	259.81	12.70
Uttarasadha	31	113	259.81	43	5	247.40	14.25
Śravaṇā	19	97	271.29	56	43	265.19	14.01
Śraviṣṭha	7	81	282.63	44	27	277.04	12.84
Śraviṣṭhaj	20	119	300.29	32	11	288.25	13.82
Śraviṣṭhaj	32	11	288.25	57	65	294.02	13.25
Pūrva-Proṣṭapadā	8	103	312.37	45	49	305.56	15.64
Uttara-Proṣṭapadā	33	33	317.99	58	87	323.20	11.96
Revatī	21	17	329.53	46	71	335.34	13.34
Asvayujau	9	1	340.56	34	55	346.52	13.69
Asvayujau	34	55	346.52	59	109	352.28	13.23
Bharaṇī	22	39	358.21	47	93	3.71	12.62

Step 2: After obtaining the dates of the Winter solstice, (i.e. the date of minimum declination of the Sun each year) by Step 1, efforts were made by Pingree and Morrissey (1989), and Abhayankar (1991) to find the dates of the New moon at of within one day of the Winter solstice between 1500 BC and 500 BC first by calculating the separation between the Sun and the Moon for each date of conjunction (i.e. within 5°), and the corresponding 62 Full moon dates (i.e. When the Sun and the Moon were in opposition or about 180° apart) along with ecliptic longitude by taking into account the modern orbital parameters of the Earth and the Moon. The full moon number, bhāṁśa at each Full moon for each nakṣatra sector, ecliptic and equatorial coordinate of the Full moons for both the periods, coordinates for the centre of the nakṣatra sectors along with magnitudes of yogatarās were also calculated. The dates of the Full moons were, however, calculated in Julian days.

The coordinates of each Full moon of two different periods were averaged to find the spread for the mean value. The nakṣatra number in both the calculation match perfectly, with only exception in the bhāṁśa number. This is possibly due to variation in the length of

synodic month in the two periods (Fixed value for the period 1900 to 2000 AD, and variable value during 1500 BC to 500 BC due to changes in the speed of the Moon in its orbit.

Clypsydra, the water-clock

The Vedanga Jyotisa, in both of its YVJ and RVJ recensions, have referred to Clepsydra, the water-clock for measuring time without any specification whether it was an in-flow or out-flow type. However, it appears that it is an out-flow type with a hole at the bottom for water to flow out, though the shape of the vessel is not described. The VJ says.

> 'Two nāḍikās are equal to one muhūrta; the ādhaka is fifty palas; from the ādhaka; the kumbhaka increases by three kuṭapas' (RVJ. 17, Eng tr. Sastry)

> 'A vessel which holds (exactly) fifty palas of water is the measure called ādhaka; from this is derived the drone measure (which is four times the ādhaka; this lessened by three kudava measures (i.e. three-sixteenths of an ādhaka) is the volume measured (in the Clepsydra) for the length of one nāḍikā of time (YVJ.24, Eng. tr. Sastry, p 37)

In some edition māṣaka has been used. Weber pointed out that 'māṣaka' might have been a corruption for ādhaka

The ādhaka, palas, droṇa, kudavas and kumbhaka are different volume measures, and they are related as : 1 ādhaka = 50 palas = 16 kudavas; 1 droṇa = 4 ādhakas = 200 palas.

The nāḍikā and muhūrta are the time measures, and are related as 1 day = 30 muhūrtas, 1 muhūrta = 2 nāḍikās, and 1 nadika = 10 1/20 kalas (RVJ 16; YVJ 38). In modern notation, 1 muhūrta = 4/5 hours = 48 minutes, 1 nādikā = 24 minutes, 1 kala = $(24 \times 20)/201 = 2$ 26/67 minutes. The Commentator Somākara recognized Clepsydra of VJ as a copper vessel (tāmraghata), whereas, Fleet suggested that it may be earthen water-jar, kumbha-ghaṭa and the size may be to the extent of a droṇa (= 200 palas). As regards category, whether it is out-flow or in-flow type, both Dikshit and Fleet recommended it

as an out flow type but do not clarify how the pressure of the water column in the clepsydra was maintained.

Day-length: The VJ records the increase and decrease of night time thus:

> 'The increase of day-time and decrease of night-time (is the time equivalent of) one prastha of water (in the clepsydra per day) during the northward course (of the Sun). They are in reverse during the southward course. (The difference is) 6 muhūrtas during an ayana (half year) (RVJ, 7, YVJ,8).
>
> (The number of days) elapsed in the northward course of remaining in the southward course is doubled, divided by sixty-one, and added to twelve; the result is the length of daytime (in terms of muhūrtas) (RVJ, 22; YVJ.40)

Both the verses suggest the day length in winter and summer solstices by 6 muhūrtas. The second verse gives a rule which says that the length of day-time in Winter solstice day as 12 muhūrtas (or $9^h\ 36^m$) and night-time as 18 muhūrtas (or $14^h\ 24^m$).

It is referred that the day-length increases following a relation; $(12 + 2/61\ n)$ muhūrtas, here n is the number of day after or before the winter solstice.

The length of the day-time becomes 15 muhūrtas after 3 months (at the Vernal equinox), and 18 muhūrtas after 6 months (at the Summer solstice), The day and night time- length follow a reverse order during southern journey. The day-time and night-time maintains a ratio 12:18 i.e 2:3.

Dikhit used the formula:

Sin (ascensional diff.) = tan ϕ. tan δ, to find the latitude of the observer, where ϕ = latitude of the observer, and δ declination of the Sun, and ascensional difference – half of length of day-time, i.e. of the rise of 3 muhurtas (2^h24^m) = $1^h\ 12^m$ = 18 (since $1^h\ 12^m \times$ 150 / hour). This gives tan ϕ = sin 18° / tan 23° 53′ = 0.3090169 / 0.442791 = 0.6978844, which fixes ϕ = 34° 54′ N.

Civil, Sidereal and Solar day:

The RVJ gave one vatsara (solar year) = 366 civil days; one yuga (of 5 years) = 62 synodic months = 67 sidereal months = 1830 civil days. Pingree interpreted that the 'day' in the RVJ is not the 'civil day', but the 'sidereal day, and he conjectured that one solar year = 366 sidereal days = 365 civil days. The YVJ has clearly defined that the number to sidereal days in a yuga is the number of 'days' plus five, i.e. the yuga has 1830 + 5 = 1835 sidereal days, and this statement shows that the '1830 days', referred to, is actually the 'civil day'. Pingree further referred for both Paitāmahasiddhānta (of Visnudharmottarapurāna) and Āryabhatiya of Āryabhata which had expressed the length of the yugas in sidereal days and suggested that it was a misunderstanding on the part of the RVJ. Ohasi has correctly argued that the use of sidereal days in Āryabhatiya is based on the rotating theory of the earth, and there is no reason to believe that the Paitāmahasiddhānta (of Visnudharmottara-purāna) is an earlier work. The interpretation of RVJ, is absolutely correct, and possibly Pingree's interpretation is based on a preconceived notion that VJ had been under influence of the Egyptian-Persian year of 365 days. Moreover, the sidereal days were never used for civil purposes in ancient India. It has already been discussed that the dates of sacrifices in Vedic India were fixed up from the observation of Full and New moon, lunar phases and moon's rising time, that is why the construction of Darsikyapaurnmasiki vedi was given so much importance. Moreover, season was determined by the position of the Full moon. On the other hand, the determination of solstices and equinoxes was neither so season specific nor depends on Sun's position. From modern perspective, 62 synodic month = 62 × 29.53 days = 1830.90 days; and 67 sidereal months = 67 × 27.3217 = 1830.55 days, which indicates, 1 yuga = 1830 civil days. Unless this is so, there would have a great panic. If Pingree's argument that one yuga has 1825 civil days is taken to be true, the difference of 5 days' error in the determination of Full or New moon is beyond and

permissible limit. However, difference of 5 days' error for determination of season or seasonal sacrifices will not course a panic, since the inaccuracy could always be adjusted by comparison with the actual season at every beginning of yugas. There is no such calendar in ancient Egypt or Mesopotamia, and Pingree's hypothesis of foreign origin in baseless.

Adhikamāsa or Intercalation in VJ (for Synodic and Tropical years): Both RVJ and YVJ state that when the Sun and he moon occupy the same region of the zodiac together with the asterism Sarvistha, at that time begins the yuga, the (synodic) month of magha, the solar (seasonal) month of tapas etc. the Sun and the Moon begin to move north. Starting of the New moon at winter solstice every year in the motion of maghā or the season tapas every year at the same point is absolutely impossible. The anomaly in the VJ is similar to that of Taittirīya saṁhitā (Tait. SVII.4.8). It appears that the calendar in VJ is just a mathematical interpretation of the earlier rules which were based on the observations of solstices, phases of the Moon etc.

What VJ has done it has reduced the knowledge to a simple rule based on 5 solar years of 1800 ($= 5 \times 360$) solar days, 1830 ($= 5 \times 366$) civil days, 1830.90 ($= 62 \times 29.5306$) lunar days, 1830.55 ($= 67 \times 27.3217$) sidereal days. There is a lack of synchronization between solar and lunar days, i.e. the tropical and synodic years in a yuga, which is due to difference between the length of lunar day and solar day. That is why, it has recommended two extra months or lunation' intercalation (adhikamāsa) to be added at half- yuga and another at the yuga-end (yvj.37). The length of 1830 civil days in a yuga is very fundamental to VJ, almost all parameters and algorithms of VJ are based on the number. It is not a naturally occurring number like a month is a year. There is absolutely no doubt that VJ made this number to adjust it for intercalation scheme. This is similar to the scheme of intercalation adopted by the caturmāsyāyajins as described in Tait S.I. 10.8, following from Tait S.VII 4.8 In this context the remarks of Gandhalekar is extremely interesting.

He says, "What is perhaps surprising is that the surviving recensions of VJ do not mention the correction that is necessary for every eight yuga to stop the run-away accumulation of the difference between the number of days in five tropical years and a yuga".

Metonic and Saros cycle (Intercalation for Synodic and Tropical year):

Various attempts were also made outside India to synchronize the synodic and the tropical year.

Authentic scholar Meton (c 432 BC) adopted a 19 year cycle for adjusting synodic years with tropical year, possibly based on Babylonian observations. Moon's phase after 19 synodic years with additional 7 months (235 lunation) recurring to the same day of the Tropical year. The arithmetic rule that was devised was basically a synchronization of the synodic year with tropical year by adding seven extra month to a 19 year cycle. The rational is as follows:

Length of the synodic month	=	29.5306 days
Mean length of a synodic year (12 × 29.5306) 19 synodic (lunar) year	=	354.3672 days
With 7 additional months (i.e. 235 lunation)	=	6939.6910 days
Mean length of the tropical year	=	365.2422 days
19 tropical years 19 × 365.2422	=	6939.6018 days

The Metonic cycle suggested 19 tropical years of 235 lunation (= 6939.6910 days). This 19 years cycle was approximated to a whole number of 6940 days (125 months of 30 days + 110 months of 29 days) = 6940 days.

The Saros cycle (after the ancient Babylonian astronomer, c.290 BC), likewise, suggested a period of 223 lunation or 6586 days (18 years cycle, 18 years 11 days or 18 years 10 days to be precise, including four or five leap years in the interval) for adjustment of synodic and solar years or as the number of lunar or solar eclipse cycle[16].

For Metonic cycle, Gondhalekar has calculated the difference in days between the accumulated number of days in tropical years and in the corresponding synodic years, and difference at the end of each tropical year over a period of 500 years. Although every year the (corrected) synodic year differs in length from the corresponding tropical year, the difference does not diverge over hundreds of years. It undoubtedly offered a lunar calendar with a definite rule for inserting intercalary months to keep in step with the cycle of the season. It also gave an accurate average length of the tropical year of 365.25 days. The scheme was very successful and it formed the basis of the calendar adopted in the Selucid Empire (Mesopotamia) and was used in the Jewish calendar and the calendar of the Christian church.

Confusion of 19-year cycle in VJ: Holay (1994) for the first time reinterpreted some of the verses (4, 8, 9, 14, 15 & so) of RVJ and suggested that VJ might have followed a 19 year cycle . The explanation was re-examined by Chandra Hari (2004) who had also supported this hypothesis. However this does not appear to be tenable because VJ has always maintained a 5- year cycle (pancasaṁvatsara) and nowhere it has referred to 19 year cycle. Abhayankar, called the method of Holay as unconventional, and strongly disagreed with the views of Holay and Chandra Hari. Abhayankar dismissed it as a preconceived notion and superimposed interpretation even if the explanation is extremely ingenuous. The explanation given by Abhyankar are so follows:

The Vedāṅga Jyotiṣa had a luni-solar calendar based on lunar months. It makes use of nominal yuga of 1860 tithis. As the units of angle and time obtained from YVJ is also in RVJ, it is obvious that the two versions complement each other. The YVJ yuga of 5 years is accepted by Holay, so in RVJ yuga, which is also of 5 years. The yuga concept is nominal, and the 5-year yuga has a year of 372 tithis or 366 days. Lagadha knew that the year contains 371 tithis, and 1860 tithis are covered in 1831 days and not in 1830 days. An extra tithi per year is nominal and good enough for practical purposes

of seasonal sacrifice. Only there is shift of religious functions with respect to seasons, to be corrected systematically. Such shifts of ± 15 days are allowed even in modern pañcāṅga. So Lagadha has provided corrections which make the calendar more accurate by means of 15, 30 and 95 year cycles. Further RVJ 12 has followed a 15 year cycle which is also a unique feature of the Vedic calendar and thrown enough light on the evolution of Vedic calendar. Indians were also aware of a 95 years cycle, as shown by Kak (1993), which is also a modified 5- year cycle and it has nothing to do with the metonic cycle.

About Siddhāntasundara

According to David Pingree it is the last Siddhāntic text having contemporary knowledge of astronomy. But it is not true. Pt. Samanta Chandraskhar, also known as Patani Samanta wrote an astronomical text Siddhānta darpaṇa, which contains astronomical knowledge with more accurate result. Siddhāntasundara was compiled by Jñānrāja around the beginning of the 16th century CE after 350 years of compilation, Siddhāntaśiromaṇi of Bhāskarāchārya. Prof Minkowaski pointed out that a major siddhānta or astronomical treatise come after a long period time. Jñānarāja stated that this text followed Brahamasiddhānta of Śākalyasaṁhitā. This is because this text has tried to make itself traditional more deductively. It is demonstrative also.

The structure of Sidhāntasundara is not same with Brahmasiddhānta. According to Pingree, this text is mainly divided into two parts golādhyāya and grahagaṇitādhyāya; grahagiṇtādhyāya has twelve chapters and golādhyāya contains six chapters.

The chapter divisions of grahagaṇitādhyāya are as follows:

Chapter 1. Madhyamādhikāra (on mean motion)
Chapter 2. Spaṣṭādhikāra (on true motion)
Chapter 3. Tripraśnādhikāra (on diurnal motion)
Chapter 4. Parvasambhuti (on the occurrence of eclipses)
Chapter 5. Candragrahaṇādhikāra (on lunar eclipses)

Chapter 6. Suryagrahaṇādhikāra (on solar eclipses)

Chapter 7. grahodayastādhikara (on rising and setting of the planets)

Chapter 8 Nakṣatrachāyāghatisādhanādhikara (on time from the shadow of stars)

Chapter 9. Sṛñgonnatyādhikara (on elevation of the horns of the moon)

Chapter 10. Grahayogādhyāya (on planetary conjunctions)

Chapter 11. Tārāchāyābhadhruvadya (on stars shadows, and the pole stars)

Chapter 12. Pātādhyāya (on the occurrence of pātas)

Golādhyāya contains six chapter as follows:

Chapter 1. Bhuvanakoṣa (on cosmology)
Chapter 2. Madhyagatihetu (on rationale of true motion)
Chapter 3. Chedyaka (on drawing projections)
Chapter 4. Maṇḍalavarṇana (description of the great circles)
Chapter 5. Yantramālā (on astronomical instruments)
Chapter 6. Ṛtuvarṇana (description of the seasons)

All manuscripts which are consulted are not in equal sequence. But the division made by Pingree can be accepted.

Grahagaṇitādhyāya is a vital part of this work as Cintāmani presented who was the son of Jñānrāja. In this section all the previous knowledge of astronomy is mentioned. The next portion of the term ‘gaṇitādhyāya’ indicates that mathematical knowledge is involved with the planetary motion. But most of the manuscripts consulted are not bothered with this term. But Pingree rightly made the term grahagaṇitādhyāya because two manuscripts indicates that mathematical knowledge is involved with planetary motion. The section grahagaṇitādhyāya has 337 verses and golādhyāya contains 236 verses. The main source of this book is Brahmasiddhānta in Śākalyasaṁhitā. According to Jñānrāja, the accurate result can be

obtained from Brahmasiddhānta. In this text nārada got lesson from Brahma, and this entire knowledge written down in the name of Śākalya.

Chapter wise content division:

Section	Chapter	Number of verses
grahagaṇitādhyāya	1. Madhyamādhikāra	90
	2. Spaṣṭādhikāra	50
	3. Triprasnādhikāra	46
	4. Parvasambhūtyādhikāra	07
	5. Candragrahaṇādhikāra	42
	6. Sūryagrahaṇādhikāra	16
	7. Grahodayāstadhikāra	19
	8. Nakṣatrachāyādhikāra	23
	9. Sṛngonnatyādhikāra	18
	10. Grahayutyādhikāra	09
	11. Patādhikāra	17
Golādhyaya	1. Bhnvanakoṣādhikāra	79
	2. Madhyagatihetu	31
	3. Chedyaka	23
	4. Maṇḍalavarṇana	17
	5. Yantramālā	50
	6. Ṛtuvarṇanaṁ	36

Indian astromomical heritage: A Short introduction

Astronomical observation is the beginning of scientific attitudes in the history of mankind. According to Indian tradition, there existed 18 early astronomical texts (siddhāntas) like Sūrya, Paitāmaha and many others. Varāhamihira compiled five ancient astronomical texts in a book named pañchasiddhāntikā, which is now the link between early and later siddhāntas. Indian scholars had no practice of writing their own names in their works, so, it is very difficult to identify them. Āryabhata is the first name noticed, in the book Āryabha-

tiya. After this point most astronomers and astro-writers wrote their names in their works. Āryabhata is the first Indian astronomer who stated that the rising and setting of the Sun, the Moon and other heavenly bodies was due to the relative motion of the Earth caused by the rotation of the Earth about its own axis. He also established the 'yuga' theory (one Mahāyuga = 432000 years). Varāhamihira compiled Pañchasiddhāntika and wrote Bṛhatsaṁhitā. Brahmagupta is the most distinguished astronomer known to us. His two major works are i) Brāhmasphutasiddhānta and ii) Khandakhyādaka. Bhāskara I was the follower of Āryabhata. His three known works are Mahābhāskariya, Laghubhāskariya and Āryabhatiyabhāṣya. Vateśvara follows Āryapakṣa and Saurapakṣa. His master work is Vateśvarasiddhānta. Śripati, in his Siddhāntaśekhara, gives the rules for determining the Moon's second inequality. Bhāskara II wrote the most comprehensive astronomical work in Indian astronomy. The result of these works is the account of the Indian astronomical heritage. A very few of these manuscripts have been translated in English but many are yet to be done. So, it is necessary to translate these astronomical texts into English with proper commentary for modern scholars. Main contributors to Indian astronomy during the 5th to 12th CE is as follows.

Āryabhata I (b 476 CE): Āryabhata was the pioneer of modern mathematical astronomy in India. The Āryabhateeyam (Āryabhatiya) was a popular work and was studied throughout India. It was mentioned by Varāhamihira of Kapitthaka (near Ujjain) in the sixth century, by Bhāskara I of Valabhi (near Kathiawar) and Brahmagupta of Vinmal (in Rajasthan) in the seventh century and by Govindasvāmi of Kerala in the ninth century. The Āryabhatiya measured the day from one sunrise to the next, where in his other work Āryabhatasiddhānta (which is not available but existence is proved from other sources) measured the day from one midnight to the next. The astronomical parameters obviously differed because Āryabhata I, as observed by a few scholars, wanted to improve them on the basis of his observations. Āryabhata I's rules are very short and

cryptic in style. The knowledge is codified systematically in this text for the first time into two major sections, gaṇitapāda (mathematical section including geometry) and golāpāda (celestial sphere section dealing with astronomy). The elementary results of course are given in two other sections, gitikāpāda (elementary data on astronomy and sine table) and kālakriyāpāda (section on reckoning time). Aryabhata I's fundamental operations in arithmetic, like square, squaring, cube, cubing, square root and cube root are unique in the ganitapāda. In the astronomy part, Aryabhata I says that he does not believe in the theory of creation and annihilation of the world. For him, time is a continuous process without beginning or end. In modern time the basic of steady state theory of cosmology makes such a statement. Āryabhata I's theory on the helical rising and setting of the planets is like so: "when the Moon has no latitude, it is visible when situated at a distance of 12 degrees (of time) from the Sun. Venus is visible when 9 degrees (of time) distance from the Sun. The other planets, taken in the order of decreasing sizes, are visible when they are 9 degrees (of time) increased by two".

Varāhamihira: Three major works of Varāhamihira are the following; a) Pañchasiddhāntikā, b) Bṛhatsaṁhitā, c) Bṛhatjātaka. In the Pañchasiddhāntikā, five siddhāntas are included – Pauliśa, Romaka, Vaśiṣṭha, Sūrya and Paitāmaha. The rule of computing eclipses is very vividly explained.

Brhamagupta: Two well-known works are: a) Brāhmasphutasiddhānta, b) Khandakhyādaka. Brahmagupta is respected for his remarkable boldness and insistence on observational verification and accuracy of results. Parallax in modern astronomy is known as lambana in Indian astronomy. Brahmagupta's method of computing lambana is based on evaluating five Rsines. In eclipse calculations, the difference lambanas of the Sun and the Moon are required and as such sometimes this difference is called lambana. Al Biruni recognizes Brahmagupata's contribution to astronomy especially in respect to eclipses. Bhaskara I: He composed mainly three works; a) Mahābhāskariya, b) Laghubhāskariya and c) Āryabhatiyabhāshya. In addition to them, another part exists containing a general introduction including the life and works of Bhaskara I.

He is the follower of Aryabhata I and his works provide us with a detail exposition of the astronomical methods taught by Aryabhata I.

Vateśvara: As a follower of Āryabhata, Vateśvara compiled Vateśvarasiddhānta, composed of all contemporary knowledge of astronomy. He became famous as a critic of Brahmagupta. Vateśvara consulted the works of earlier writers and utilized their contents but it should not be inferred that everything that Vateśvara gives in the Vateśvarasiddhānta is derived from the anterior works. There is plenty of material in this text which is original. The other feature of this book is the sequence of the contents. It is mostly Vateśvara's own contribution.

Bhāskarāchārya: He is the most famous astronomer and mathematician of the classical age of Indian astronomy. His masterpiece Siddhāntshiromani consists of four parts; Lilāvati (arithmetic), Bijaganita (algebra), Grahaganitādhyāya (mathematical treatment of planets), Golādhyaya (celestial knowledge). In addition to the Siddhāntsiromani he wrote another four books; Karanakutuhala, Srvatobhadrayantra, Vaśiṣṭhatulya and Vivahapatal. The three books are not found today. All the books are written in verses. In Siddhāntsiromani, 1500 Sanskrit verses explain contemporary astronomical knowledge. In the mathematics part the author has not given any direct proof of any theorem. These are included in the problems. Lilavati was the most famous book on mathematics at that time. Lilavati and Bijgaṇita were used as standard text books for next 600 years throughout India. Many scholars wrote commentaries on these books. Lilāvati was translated into other languages such as Persian and English. Bhāskarāchārya has given the names of all the numbers in multiples of 10. These books can be understood by students of twelfth standard but in Siddāntsiromani, grahagaṇitādhyāya or golādhyaya chapters cannot be understood without basic knowledge of astronomy. Bhāskara had a special interest in astronomy as these two chapters (books) together have 1000 verses. He was not only a theoretical astronomer but expert sky-observer. For smooth sky observing he developed astronomical instruments included in golādhyāya. The names of the instruments are Golā, Nadivalaya, Yasti, Śanku, Ghaticā, chapa etc.

This period 5th CE to 12th CE was the golden age of Indian astronomy and mathematics, starting in the year 500 with Āryabhata and ending with Bhāskarāchārya in in the year 1200 CE. Therefore,

this account may be helpful to further knowledge of this period. After this period Indian knowledge started to decline rapidly; Nalanda University was destroyed and there was not a single university in India over next 600 years. The history of Indian astronomy is not suffering for lack of sufficient literature. We have a huge number of documents in the Devnagari, Tlugu, Grantha and other scripts and in Sanskrit language. These are being translated into English, but a lot is needed to be done. The classical period is the golden era for Indian astronomy. This account is not sufficient but a hint only. Siddhāntasundara was compiled collecting previous knowledge of astronomy.

Special features of the Siddhāntasundara

Siddhāntasundara was compiled by Jñānarāja following the older texts especially style of Siddhāntaśiromaṇi of Bhāskarāchārya, the content of this book follows Brahmasiddhānta. But the special feature is the inclusion of peculiar problems in the chapter triprśnādhikāra. As for example

Siṁhāsanāsīnām inatvam āptaṁ
mitraṁ viditvādyvtir uttarāśām /
yāte bhavat pūrvanṛpaprabho yas
tasyāśupuṁ so vada yānamānam //

The feature is its poetic manners. It started from siddhāntaśiromaṇi where Bhāskarāchārya followed the previous famous poet Kālidāsa to describe ṛtu in longer verses praising nature but verses create a conflict which is understandable after reading the verses more than one time (upamā). Another remarkable point is to introduce a new astronomical instrument which is not found in previous texts.

Why Siddhāntasundara is important?

After Bhaskaracharya's siddhantasiromani Indian astronomers began to write commentaries of existing treatises. Jñānarāja started to write this treatise on first half of sixteenth century CE. It is a

major astronomical text after Siddhāntaśiromani. Jñānarāja followed Brahmasiddhānta as its contents and followed Siddhāntaśiromani as its style. Jñānarāja secured Brahmasiddhānta and the followers of Sūryasiddhānta are the main stream of Indian astronomy. He mentioned eight treatises, followers of Sūryariddhānta and he compiled the treatment of Brahmasiddhānta in Śākalyasaṁhitā because he thought it is the best one. Dr. Pingree noticed that it is the last siddhānta written in the first half of 16th century CE but another siddhānta is found name Siddhāntadarpaṇa of Patani Samantaof Orissa, called him Indian Tycho.

Manuscripts collected:

A.1 Govt. collections, G 7922: Folio 1a–13b,
The Asiatic society, Kolkata, incomplete; script Devanagri, Size 26 cm × 11.5 cm;
A. 2 Govt. collections G & 210, 1a–27b, the Asiatic society, Kolkata, Incomplete, Script; Size; 35.5 × 18 cm;
B. 3. BORI, 219 of A 1882 – 83, Folio – 19 verses: 400 incomplete, script: Devnagri, Language – Sanskrit
B. 4. No 107 of 1866-68 Folio – 96 BORI. Complete.
B. 5 No 881 of 1884-87 ff.8 incomplete line: 9, letters: 40, BORI, Pune.
B. 6. No 880 of 1884-87, ff.- 20 incomplete, golādhyāya. BORI, Pune.
B. 7. No 860 of 1997091 ff. 26 incomplete, pātādhyāya, BORI, Pune.
B. 8. No 26 of 1869 – 70 grahagaṇitacintāmani. Notes of siddhāntasundara, written by Cintāmani, ff. 58, BORI, Pune.
M0. No 657. 1941, Royal Asiatic Society, Bombay, ff. 97 complete.
A - Found from the Asiatic society, Kolkata
B - Bhanderkar Oriental Research Institute, Pune.
M – The Royal Asiatic Society, Mumbai

Sri Somenath Chatterjee

Edited Text

ग्रहगणिताध्याय़ः

अथ ग्रहगणिताध्याये मध्यमाधिकारः

दिङ्नातंगसुतंगपञ्चवदनं विश्वैकलम्बोदरं
चुडारत्नसहस्त्रभूधरमहाहारं सुनीलाम्बरं ॥
स्वांतध्वांतहरं कलानिधिधरं कोटिनरुक्सुदरं
वाराहोपमवाहनं गणपतिं वंदे परं शङ्करं ॥ १ ॥

अथ युगैः शशिशैलमितैर्मनुर्विधिदिनेमनवस्तुचतुर्दश ॥
कृतसमाससमसन्धियुतैश्च तैस्त्रिसमयेषु सहस्त्रयुगं दिनं ॥ २ ॥

अयुतनिहतदंतवेदवर्षैर्युगमथ तच्चरणाः कृतादयः स्युः ॥
युगगुणयुगलेंदुभिः पृथगघ्नायुगदशमांससमाः समास्तुसौराः ॥ ३ ॥

याताः पितामहदिने मनवः षडस्मिन्स्युःसप्तविंशर्तियुगानि युगत्रिपादाः ॥
नन्दाद्रिचंद्रदहनाः कलिवत्सराश्च सच्छलिवाहनशकप्रभवे प्रयाताः ॥ ४ ॥

प्रागुक्तसृष्टिशरद खरसत्रिनिघ्ना हीना दिधेर्दिनगते खगभुक्तियाताः ॥
स्युस्ते नवाद्रिकुगुणाष्टगजेषु पंचनन्देदवः शकमुखे सशका अभिष्टाः ॥ ५ ॥

सौरवर्षमुखसिद्धखेचरा एकवर्षगतिभिर्विशोधिताः ॥
उच्चपातसहिताःक्रियादिगा यद्गुणाभिरिह ते गताब्दकाः ॥ ६ ॥

विधेर्दिनादौ युगपत्समस्तं भूत्वा ग्रहाःप्राग्गमनप्रवृत्ताः ।।
इतीरितं वेदविरोधिनस्ते ब्रह्मार्कचन्द्रादिमताद्विभिन्नम् ।। ७ ।।

ब्रह्मा प्राह च नारदाय हिमगुर्यच्छौनकायाखिलं
मांडव्याय वशिष्टसंज्ञकमुनिःसूर्यो मयायाहवत ।।
प्रत्यक्षागमयुक्तिशालि तदिदं शास्त्रं विहायान्यथा
यत्कुर्वन्ति नरा न निर्वहति तद्विज्ञानशून्याश्चिरं ।। ८ ।।

मुनिप्रणीते मनुजैः क्वचिच्चद्दृश्यतेंतरं ।।
तदा तदेव संसाध्यं न कार्यं सर्वमन्यथा ।। ९ ।।

यथा वेदोक्तमंत्रेषु न वीर्यं दृश्यते क्वचित् ।।
तत्पुरश्चरणं कुर्यान्न कार्यं सर्वमन्यथा ।। १० ।।

तदंगीकृतमस्माभिर्विज्ञानं मुनिसंमतं ।।
दृक्समं वासनावेद्यमनुभूय मुहुः पुरा ।। ११ ।।

रससुरत्रिनभश्चरबाणभू परिमिता हि युगेधिकमासकाः ।।
यमशराकृतिकुंजरखेषुदृक्समयुगावमसंचय ईरितः ।। १२ ।।

तरणिचंद्रमसोभगणांतरं भवति तद्विधुमाससमुच्चयः ।।
रससुरामरसिंधुगुणेषुभिः परिमितः सयुगे मुनिसंमतः ।। १३ ।।

लक्षाहताःपक्षशराक्षपंचचंद्रा युगे स्युर्दिवसाःखरांशोः ।।
चांद्रो दिनौघः खगजाभ्रपूर्णपूर्णाभ्ररामाभ्रनृपप्रमाणः।। १४ ।।

अष्टद्व्यष्टात्यष्टिखेटाद्रिकुध्रबाणक्षोण्यः स्युर्युगे भूदिनानि ।।
तारावारा दंतिदस्त्रोरगाद्रिरामद्विद्विद्वीपिपंचेंदु संखाः ।। १५ ।।

अवनिवासरचांद्रदिनांतरे ऽवमदिनानि वदंति विदः सदा ।।
रविनिशाकरवासरसंचयांतरसमाधिकमासकवासराः ।। १६ ।।

भगणवर्जितभभ्रमसंमितिर्भवति खेचरभूदिनसंचयः ॥
इह सुरुढतया न हि वासना निगदिता सुधिया स्वधियैव सा ॥ १७ ॥

सूर्यसौम्यसितपर्यया युगे पूर्णपूर्णखखदंतसागराः ॥
षटसुरत्रिशरगिर्यगेषवः शीतरश्मिभगणा बुधैः स्मृताः ॥ १८ ॥

दंतदंतिरसरंध्रदृग्यमामंगलस्य युगमंडलोन्मितिः ॥
खांगखागगुणगोद्रिभूमयो रौहिणेयचलतुंगपर्ययाः ॥ १९ ॥

पूर्णलोचनयमाध्बिषट्गुणा गीष्पतेर्भगणसंमितिर्मता ॥
ऋत्वगत्रियमदृक्खपर्वता भार्गवाशुभगणा युगे मताः ॥ २० ॥

मतंगांगपंचांगवेदेन्दुसंख्यंपतंगप्रसूतस्य चक्रप्रमाणम्
त्रिखाश्वीभनागाब्धयश्चक्रमानं विधोर्मन्दतुंगस्य पूर्वेद्युभुक्त्या ॥ २१ ॥

भुजंगाग्निदृग्दंतदस्रा विलोमाः स्मृताः पर्ययाः सैहिकेयेंदुपाते॥
सहस्राहताः कल्पजाता भवेयुस्त एवाथ सूर्योच्चचक्राणि कल्पे ॥ २२ ॥

शैलमंगलगुणाः कुजादथो वेदशुन्ययमला मृदूच्चजाः नागषट्गुणमिताः ॥
खखग्रहाः पंचपावकशरा नवाग्नयः ॥ २३ ॥

कल्पे यातानां कुजाध्वस्तगानां पारावारैकद्विसंख्याक्रमेण ॥
अष्टेभाम्नाया युगाद्रीन्दवोथ रामाभ्रांकाः पक्ष षट्कांग तुल्याः ॥ २४ ॥

ब्रह्मार्कशीतगुवशिष्टपुलस्त्यमुखैस्तंत्रेषु ये समुदिता भगणास्त एते ॥
अत्रोपपत्तिममलां सुगमामपूर्वां वक्ष्येधुना भगणसाधनबोधकत्रीम् ॥ २५ ॥

अंभः समीकृतमहीतलसंस्थितस्य च्छायादिनार्द्धघटिकासु समस्यशंकोः ॥
याम्योत्तरा भवति सैव तदुत्थमत्स्यपुच्छास्यतस्त्वपरपूर्वदिशौ भवेताम् ॥ २६ ॥

स्तंभस्य शोभनतरुप्रभवस्य मूलधारा यथा यमकुवेरदिगायता स्यात् ॥
लंबोपमस्य सुसमस्य तु पूर्वभागेकीलं निवेश्य नलिकां शिथिलां च कीले ॥ २७ ॥

याम्योन्नरामथ तया प्रविलोक्य सूर्यं तुर्यादियंत्रत इहोन्नतभागमानं ।।
ज्ञात्वा विशोध्य नवते र्नतभागकाः स्युस्तत्स्वाक्षकांतरयुति समभिन्नदिंक्ते ।। २८ ।।

क्रांत्यंशास्तज्याजिनज्याविभक्ता त्रिज्यानिघ्नी तद्धनुर्दोर्लवाः स्युः।।
तिग्मांशोस्तद्वासरे रात्रिवक्त्रे दृष्ट्वाधिष्ण्यं कल्पयेत्त त्पदं हि ।। २९ ।।

एवं सूर्यं सायनं प्राग्विदित्वा स्पष्टं भूयो वासरेन्यत्रभुक्तिः ।।
स्पष्टा भान्वोरंतरे तल्लघुत्वे यावान्सूर्यस्तत्समं तस्य तुंगं ।। ३० ।।

मध्या भुक्तिः स्याद्दलं स्पष्टतस्तद्भुक्ताल्पत्वानल्पसंख्यायुतेर्यत् ।।
पृथ्वी भूक्तिः स्यात्तदा स्पष्टतुल्यो मध्यार्कस्तं राशिपूर्वं विदित्वा ।। ३१ ।।

ततः प्रतिदिनं मध्यगत्या मध्यं प्रचालयेत् ।।
कालांतरेण तनमध्यस्फुटयोरंतरं फलं ।। ३२ ।।

साम्यं यत्र भवेन्मध्यस्फुटगत्योः परं फलं ।।
ज्ञेयं तज्यासमं व्यासदलं नीचोच्चमंडले ।। ३३ ।।

एवं यावान्भवति सविता राशिभागादिरुपस्तावान्यैः
स्यात्सविकलदिनैस्ते भभोगाभिधाः स्यु ।।
एभिश्चैको भवति भगणश्चेत्तदा भूदिनैः किं कल्पे
साध्या इति बुधजनैः पर्ययास्तेनुपातात् ।। ३४ ।।

याम्योदग्वलयागतं शशधरं तुर्येण पूर्वोक्तवद्विद्ध्वा
सायकसंस्कृतापम इतिज्ञेयोथतत्कालजाः ।।
याता रात्रिघटिः स्फुटिक्रृतघटी यंत्रेण बुद्ध्वा रवेः
कार्यं मध्यविलग्नमग्रविधिता लंकोदयैः प्रस्फुटं ।। ३५ ।।

तन्समो हिमगुरायनदृष्टिकर्मसंस्कृत इतीरितमार्यैः ।।
प्रस्फुटापं खमध्यलग्नकापक्रमांतरमिषुर्हिमगोः स्यात् ।। ३६ ।।

दक्षिणबाणाभावे यश्चंद्रो भगणशोधितः पातः ॥
पुनरप्येनं पातं ज्ञात्वाकालांतरे गतिः कार्या ॥ ३७ ॥

सूर्योच्चवद्विधूच्चं मादं ज्ञेयं गतिस्तथैवास्य ॥
अनया भगणाः साध्या महायुगे ब्राह्मणकल्पे वा ॥ ३८ ॥

वक्रवक्त्रखचरैकपर्यये पूर्ववद्दिनगणं समानयेत् ॥
तन्महत्वलघुतैक्यखंडकं तेन कल्पभगणांश्च साधयेत् ॥ ३९ ॥

वेधसिद्धखगमध्यमांतरे मंदशीघ्रफलसंस्कृतिः सदा ॥
व्यस्तशीघ्रफलसंस्कृता सती केवलं भवति मंदंफलं ॥ ४० ॥

निजांशुनीचोच्चसमे खगेंद्रे फलस्य नाशेपि न मध्यतुल्यः ॥
स्फुटग्रहः स्यादत एव मंदमुच्चं ग्रहस्याप्यपरं च किंचित् ॥ ४१ ॥

स्वशीघ्रनीचोच्चसमेषु न स्याच्छीघ्रं फलं व्योमचरेषु नूनं ॥
तदा स्फुटो यः स मृदुस्फुटोथ तन्मध्ययोरंतरमत्र मादं ॥ ४२ ॥

सौरारमंत्रिषु रवेः पुरतः स्थितेषु मध्यग्रहात्स्फुटखगोल्पक एव दृष्टः ॥
पृष्ठस्थितेष्वधिक एव ततस्त्रयाणां पूर्वैश्चलोच्चमिनतुल्यमिति प्रदिष्टं ॥ ४३ ॥

मंदाभावे मंदनीचोच्चतुल्यं खेटं ज्ञात्वा तन्मितिः साधनीया ॥
दैत्येयज्ञौ लग्नतुल्यौ कुजस्थौ ज्ञेयौ ताभ्यां तद्गतिः साधनीया ॥ ४४ ॥

यावत्कालं सूर्यतोग्रस्थितौ स्तस्तावद्दृष्टौ पृष्ठसंस्थौ सदा तौ ॥
तस्मात्ज्ञेयाः पर्ययाः सूर्यचक्रैस्तुल्याः कल्पे साधनार्थं ज्ञभृग्वो ॥ ४५ ॥

सितोदयाद्यतघटिप्रमाणं स्वछाययोत्थं गणितेन यस्मात् ॥
तद्भूमिगर्भस्थनरद्युयातं तथा घटियंत्रसुसाधितं स्वं ॥ ४६ ॥

अंतरेण दिनयातयोर्यदा योजनानि कुदलोन्मितानि चेत् ॥
किं तदा द्युनिशनाडिकामितेः कक्षिका फलमिहानुपाततः ॥ ४७ ॥

तन्महत्वलघुतैक्यखंडकमध्यमा सितचलोच्चकक्षिका ॥
भाजिता गगनकक्षिका तया शुक्रतुंगचलपर्ययोन्मितिः ॥ ४८ ॥

एवमेव बुधशीघ्रपर्ययान्साधयेदिति सुवासना स्मृता ॥
मंदतुंगखगपातपर्ययाः पूर्वसूरिवचनेन साधवः॥ ४९ ॥

गतिसमुद्भवयातसमागणस्तरणिभिर्गुणितो गतमासयुक् ॥
खगुण संगुणितः सतिथिःपृथङ्निगदिताधिकमाससमाहतः ॥ ५० ॥

इनदिनाप्तगताधिकमासकैगर्गनवह्निगुणैः सहितः पृथक् ॥
युगभवावमवासरताडितः शशिदिनाप्तगतावमशोधितः ॥ ५१ ॥

द्युमणिमध्यमसावनमानजो दिनगणो रविवासरपूर्वकः ॥
क्षयदिनाधिकमासकशेषतोधिकतया वयवं हि परित्यजेत् ॥ ५२ ॥

यातःसौरसमागणो रविगुणश्चैत्रादिमासान्वितस्त्रिंशतघ्नः
सतिथिर्भवंतिदिवसाः सौराः पृथकस्थैस्तु तैः ॥
संसाध्याधिकमासकान्दिनमयैस्तैर्युक्पृथक्स्थो ॥
गणश्चांद्रः स्यादनुपातजैः क्षयदिनैर्हीनोर्भवेत्सावनः॥ ५३ ॥

स्यान्सौरवत्सरमुखं क्रियसंक्रमादौ तच्चैत्रमासमुखयोर्विवरेधिशेषं ॥
त्यक्तेन तेन रविवत्सरवत्कृतः स्यादह्नां गणो मधुसितादिगतोन्यथासौ ॥ ५४ ॥

न्युनाहशेषं तु निशीथमध्यतिथ्यंतयोरंतरंगं सदैव ॥
त्यक्तेन तेनेह निशीथकाले दिवागणोस्माद्ग्रहसाधनं च ॥ ५५ ॥

भगणसंगुणितेष्टदिवागणात्फलमिलादिवसैर्वलयादिकं ॥
भवति मध्यरवौ रजनीदले सति दशाननपत्तनके ग्रहः ॥ ५६ ॥

साङ्घ्रिशक्रशतशोधितो भवेच्छालिवाहनशकोव्दसंचयः॥
संगुणः खगगुणेन योजितः क्षेपकेण शरदि ध्रुवोभवेत् ॥ ५७ ॥

भादिर्दुणः शशधरे श्रुतयो दिनेशाः षट्सिंधवोबंरयुगान्यहिसागराश्च ॥
भौमे रसाः शशिभुवोब्धियमा नवांगवर्गो बुधेथ शशभृ द्युगपक्षतुल्याः ॥ ५८ ॥

पंचाब्धयो धृतय ईज्यगुणस्तु रूपं खं भूयमाः षडथ शुक्रगुणो महीध्राः ॥
पंचेन्दवः शिवमिता द्विसरा मतंगवेदाः शनेः खमिनसूर्यखबाणसिद्धाः ॥ ५९ ॥

इन्दूच्चके भूः खभूवः कुवेदाः खं वेदवाणास्तमसोथ शून्यं ॥
नंदेंदवश्चंद्रयमा महेशाःसिद्धाः समेशेथ दिनादिकोयं ॥ ६० ॥

रुपं पंचैके कुरामाः कुरामाःसिद्धास्तिथ्यादिर्गुणश्चांद्रशुद्धौ ॥
रुद्रा रामा रामबाणाश्च सिद्धाः कल्पाष्दाप्ताः पर्ययास्ते गुणाः स्युः ॥ ६१ ॥

क्षेपा रवे रसखशक्रमहीध्रवेदा नंदा नवेषुदहना द्वियुगानि चंद्रे ॥
रुपं त्रयो युगगुणाः क्षितिजेग्निवेदा बौधे चलेर्णवखतत्त्वपुरंदराश्च ॥ ६२ ॥

जीवे यमेंद्रनृपसूर्यमिताः सितोच्चे पूर्णेदंवो युगमिताः सदलाक्षरामाः ॥
मंदे यमौ नवभुवो द्वियमा मुनिक्ष्मा उच्चे नगादिशररामपुरंदराश्च ॥ ६३ ॥

पातेबरं हरमिता नवरामसंख्या रामेषवः शरदिने श्रुतयो धृति श्च ॥
रामेषवः खमितिवारमुखोथ शुद्धौ तिथ्यादिको यमनवाश्वियुगाग्नयः खं ॥ ६४ ॥

चैत्रादियाततिथयो विगतर्तुशुद्धिहीनाः समाधिघटिरहिता दिनौघः ॥
वारोव्दपाद्रविसमार्द्धगणांतरालं कल्प्पो दिनौध इति खेचसाधनार्थं ॥ ६५ ॥

द्युप्रौघ स्वगगनषड्लवेन हीनो खव्यंशा निजनग भागलिप्तिकाद्याः ॥
वेदाप्त द्युचयविलिप्तिकोनितास्तेखेटानां फलमिनगोलयोक्रणं स्वं ॥ ६६ ॥

दिनगणो गुणचंद्र गुणः पृथक् दशगुणो नगवह्नि नगोद्धृतः ॥
फलयुतः स विधुर्लवपूर्वको दिनगणाहि लवोनविलिप्तिकः ॥ ६७ ॥

निजनिशाकरनेत्रलवान्वितं दिनगणस्य दलं लवपूर्वकं ॥
विचरणद्युगणेन च संयुतं विकलिकासु भवेत्क्षितिनन्दनः ॥ ६८ ॥

द्युगणसंगुणितार्णवसम्मितिर्वुधचलोच्चलवाः खशरा हतात् ॥
द्युगणतो नव लब्धकलान्विता विकलिकासु गणेन च शोधिता ॥ ६९ ॥

दिनगणस्त्रिगुणो नख भाजितो दिनगणात्पतितोविकलारुणं ॥
शरसमाहतवासरसंचयोन्मितकलादि पुरंदरपूजिते ॥ ७० ॥

सितचलेर्कफलं स्वदलान्वितं गतशता शगणाष्ट लवेन युक् ॥
खगुण हृद्युगणो लवपूर्वको गणखभूप लवाद्यकलः शनि ॥ ७१ ॥

दशाप्तो दिनौघो लवाद्यं विधूच्चं स्वकीयत्रिभागो नताहर्गणेन ॥
कुवेदां शयुक्तेन युक्तं कलासु क्रमायातमब्जस्य पातं प्रवक्ष्ये ॥ ७२ ॥

दिग्गुणितस्त्रिहृतो दिनसंघः स्वाकृतिभागवियुक्कलिकाद्यं ॥
चंद्रतमः स्वफलेन युतोनाः स्वध्रुवका उदयेद्युखचराः स्युः ॥ ७३ ॥

अज्ञातग्रहभुक्त्या विज्ञातग्रहमितिर्गुणिता ॥
ज्ञातग्रहभुक्तिहृता लब्धमविज्ञातखेटःस्यात ॥ ७४ ॥

अलब्धोधिमासः स्फुटो लभ्यते चेत्तदा खत्रि वृद्ध्या हि शुद्धिर्विशुद्धा ॥
ततः साधनियो अब्दमध्ये दिनौघः प्रयाताधिमासास्तदा रूपहीनाः ॥ ७५ ॥

सूर्यसंक्रमसंपर्काच्छशिमासस्य शुद्धता ॥
तद्वियोगादशुद्धत्वमधिकत्वं च जायते ॥ ७६ ॥

एकचेदवनिदिनंदिनमणेस्यन्मध्यगत्वातदाराशौकिं
कंस्याद्राविशावनंयदितदाचक्रेकिमेवंविधोर्मासा
दभ्यद्दिकोरवेरधिमाःस्पान्सर्द्दंतोन्मितैः ॥ ७७ ॥

मेषार्कसंक्रमो यत्र चांद्रमासे प्रजायते ॥
स मासो मधुसंज्ञः स्यान्माधवाद्या वृषादिभिः ॥ ७८ ॥

चांद्रैद्वादशमासकैश्च तिथिभिः श्रीकंठ संख्यैस्तथा नाडिभिस्त्रि
भिरग्निसायकपलैः स्यात् सौरवर्षं यतः ॥
एकस्मिन् रविवत्सरे यदाधिकं स्यादब्दवृद्ध्या ततो
मासैः सार्धरदोन्मितैरधिकमासस्त्रिंशत्तिथिर्मघ्यमः ॥ ७९ ॥

एकं चेदवनिदिनं दिनमणेः स्यान्मध्यगत्या तदा राशौ किं
रविमासकोथ हिमकृन्मासस्तु गत्यन्तरे
एकं स्याद्रविशावनं यदि तदा चक्रे किमेवं विधोर्मासा
दभ्यधिको रवेरधिकमास तत्सार्धदंतोन्मितैः ॥ ८० ॥

दर्शाग्रतो मंडलनाडिकांतं मासः स सूर्येंदुसमागमान्तः ॥
तदंतरे चेद्रविसंक्रमः स्यान्तदा स शुद्धस्त्वधिकोन्यथासौ ॥ ८१ ॥

इदं यदुक्तं क्षितिगर्भगाणां कुपृष्टगानामथ संप्रवक्ष्ये ॥
यःसाधितो दर्शविरामकालः स्फुटो भवेल्लंबनसंस्कृतोत्र॥ ८२ ॥

यतः स्फुदे दर्शविरामकाले दृक्सत्रसंस्थौ रविशीतरश्मि ॥
कुपृष्ठगानामथ निश्चयेन स्यातां हि तद्गोलविदो वदन्ति ॥ ८३ ॥

खाभ्रखाभ्राष्टभुभिर्गतंयत्कालेस्पष्टमेतस्य यातैष्ययोरल्पकं
तद्भुवा पावकैः सिद्ध संख्यै र्हतंदृग्यमैः खाग्निभिः खांककै रद्रिभिः ॥ ८४ ॥

नंदनिघ्नायुतेना ग्नभागैर्युताः सूर्यसौरवनीजाःपरे वर्जिताः ॥
दृकसमत्वं ग्रहाणामनेन स्फुटं प्राहदामोदरार्य एवं बुधः ॥ ८५ ॥

लंकातः शरसूर्ययोजनगताकन्याथ कान्तीरदैः
स्वामीखाष्ट मितैनखैस्तु सगरोमल्लारिरक्षेंदुभिः पर्यल्र्यष्टमि रुत्तरत्रदशभिः
स्याद्वत्सगुल्मं पुरं ततः खाक्षै रुज्जयिनीपुरं दशकुभि स्तस्मातकुरुक्षेत्रकं ॥ ८६ ॥

तस्मान्मेरुर्योजनैस्तत्वनागै एवंभुमेर्मध्यखा निरुक्ता ॥ ८७ ॥ (half verse)

स्वपुरसुरनगांतयोजनैः स्यात्परिधरवनिगोले कल्पितः प्रस्फुटोसौ ॥
अवनिपरिधिमानं लंबजीवाविनिघ्नं त्रिभबनगुणभक्तं तस्य मानं निरुक्तं ॥ ८८ ॥

रेखापुरस्वनगरांतमेरुयोजनाख्यैः खेचारिणां दिनगतिर्गुणिता विभक्ता ॥
स्पष्टेन भूपरिधिनाप्तकला धनर्णं मध्यग्रहे निजपुरेपरपूर्वसंस्थे ॥ ८९ ॥

प्रोक्ता मयातिसुगमा न समीरितान्यैर्या वासनाकृतिषु विस्तृतिशंकयेह ॥
संक्षिप्य यद्वहु विहाय पिबंति सारं स्वल्पं सुधांशुवलयं विबुधा रसंज्ञाः ॥ ९० ॥

इत्थं श्रीमन्नागनाथात्मजेनप्रोप्कं तंत्रे ज्ञानराजेनरम्ये ॥
ग्रंथागाराधारभूते प्रभूते सूयादीनां मध्यमानं निरुक्तं ॥

इतिश्रीसकलसिद्धांतवासनाविचारचतुरचीन्तचमत्कारिणि
सिद्धांतसुंदरेमध्यमग्रहानयनाधिकारः प्रथमः ॥

अथ ग्रहगणिताध्याये स्पष्टाधिकारः

अथ जननविधानयानपाणिग्रहणमुखेष्वखिलेषु मंगलेषु ॥
स्फुटतरखचरैः फलं प्रधानं स्फुटमत एव वदामि तद्विधानम् ॥ १ ॥

पंचाकृतयो नवाब्धिवेदा भूशैलर्तुमिताः खनंदनागाः ॥
बाणाभ्रभवाः शरेंदुविश्वे विंशत्यक्षभूवोंकभूहयक्ष्माः ॥ २ ॥

आशांकभुवस्त्रिगोभ्रपक्षाः सप्तर्त्वाकृतयः कुरामसिद्धाः ॥
भूतेभशराश्विनोर्द्धजीवाः पिंडर्क्षाणि नवाक्षपिंडसंख्याः ॥ ३ ॥

वस्वद्रिनवाश्विनोब्धिनागत्रिंश च्छैलनगेंदुरामसंखाः ॥
अंगेषुरदाः कुदस्रदेवाः पक्षाद्रित्रिगुणाः क्रमेण जीवाः ॥ ४ ॥

गोभ्राब्धिगुणाः कुवह्निवेदलोका मंगलवह्निवेदरामाः ॥
आसां तु विलोमतोंतरैक्यैस्तुल्याः स्युर्विपरीतमौर्विकाख्याः ॥ ५ ॥

वृत्ते चक्रकलायुते परिधिषणंदां शकैरंकिते प्राग्रेखो
भयचिह्नयोरुपरिगा जीवा विधेयाः क्रमात् ॥
ताःस्युस्तत्र गजाब्धिभिः परिमितास्तत्रैव तासां
धनूंष्वाचिंतानि धनुर्गुणांतरागता ज्ञेयोत्क्रमज्या तथा ॥ ६ ॥

आद्यं खडं भगणकलिकाषण्नवत्यं शतुलं बाहुः कर्णस्त्रिभवनगुणः
कोटिराभ्यामियं चेत् त्रिज्याकर्णे भवति शरदृंनेत्रतुल्ये
किमेवं लब्धं स्थूलं प्रथमपरयोर्जीवयोरंतरालं ॥ ७ ॥

कोटिर्दिग्घ्री त्रितिथि विहृता जायते चांत
रालंत तन्संयुक्तान्प्रथमदलतः साध्यभूयोतरं वा ॥
यद्यातैष्यांतरयुतिदलं ज्यांतरं तत्स्फुटं स्यादेवं
सर्वाण्यपि गुणदलान्युद्भवंति क्रमेण ॥ ८ ॥

यो मूलमौर्विदलतोखिलानि जीवादलान्यानयति क्रमेण
मन्यामहे तं गणितज्ञचक्रभचक्रचाराकलने ध्रुवेंद्रम् ॥ ९ ॥

पदानि चत्वारि सराशिवृत्तेमुख्ये पदेज्योपचयः क्रियादेः ॥
भवे द्वितीयेपचयस्तृतीये वृद्धिःचतुर्थेपचयोभुजे च ॥ १० ॥

भुजांशकोना नवतिस्तु कोटिस्तयोः कलाः पंचयमाश्विभक्ताः ॥
फलोन्मिता ज्या विगतैष्यजीवांतरघ्नशेषाद्धरलब्धयुक्स्यात् ॥ ११ ॥

जीवां विशोध्य शरनेत्रयमघ्नशेषाद्यातैष्यखंडविवरेण हृतान्फलं यत् ॥
यावत्तमाभवतिशोधितमौर्विका तत्संख्याहताक्षनयनाश्वियुतं धनुःस्यात् ॥ १२ ॥

शराक्षीणि सिद्धास्त्रिदस्राः कुदस्त्रा नवांका नृपास्त्रींदवः खेन्दव श्च ॥
तथांगानि रामा लघुज्यांतराणि
भुजांशा नवाप्ता गतज्याथ शेषं ॥ १३ ॥

अयाताहतं गोहृतं यातखंडै र्युतं ज्या भवेदत्र खंडानि जह्मात् ॥
नवघ्नावशेषादयाताप्तलब्ध विशुद्रांकनिघ्नांकयुक्तं धनुः स्यात् ॥ १४ ॥

मादं केंद्रं मंदतुंगो नखेटः शीघ्रं केंद्रं शीघ्रतुंगं खगोनं ॥
शीघ्रे केंद्रं मेषजूकादिसंस्थे स्वर्णं मांदेस्वं धनं स्वं फलं स्यात् ॥ १५ ॥

मार्तंडस्य मृदूच्चनीचवलये शक्राः परिध्यंशकाः
शीतांशोर्दशनाः कुले शरनगाःसौम्ये खरामां शकाः ॥
गीर्वाणेंद्रगुरो सुरा दिनकराः शुक्रस्य तानाः
शनैः केंद्रे युग्मपदांता ओजपदगे वित्र्यंशशक्ता रवेः ॥ १६ ॥

त्र्यंशोनाः शशिनो रदाः क्षितिसुतान्नेत्राद्रयोष्टाश्विनो दृक्
वह्निप्रमितास्तु शंकरमिता मातंगवेदाः क्रमात् ॥
भौमाच्चंचलनीचतुंगवलये भागाः शराग्न्यश्विनो
गीर्वाणेंदुमिता नभोनगसमाः पक्षांगनेत्रोन्मिताः ॥ १७ ॥

गोरामा इति युग्मकेथ विषमे भौमाद्रि वह्न्यिश्विनो दंतक्ष्मा यमपर्वता
गगनषण्नेत्राणि पूर्णाब्धयःदोर्ज्या केंद्रभवाहता निजपरिणाहांतरेणाहृता व्या
सार्द्धेन फलोनयूक्परिधयःस्त्वोजाधिकोनाः स्फुटाः ॥ १८ ॥

स्फुटपरिधिगुणे स्वकोटिदोर्ज्ये भलवहृते निजकोटिदोः फले स्तः ॥
मृदुभुजफलकार्मुकं हि मांदं भवति फलं कलिकामयं ग्रहस्य ॥ १९ ॥

यद्वा खगानां लघुकेन्द्रदोर्ज्या वेदा हता सप्तरसैर्विभक्ता ॥
फलं कलाद्यं परिधिघ्नमेवं सुखार्थमेतन्मुदुसंज्ञकं स्यात् ॥ २० ॥

त्रिज्याशुकोटिफलयोर्मृगकर्कटादौ केंद्रे क्रमेण युतिरंतरकं विधेयं ॥
तद्वर्गबाहुफलवर्गयुतेश्च मूलं कर्णः कुगर्भखचरांतरसंमितः स्यात् ॥ २१ ॥

आसन्नमूलेन हृतात्स्ववर्गात्लब्धेन मूलं सहितं द्विभक्तं ॥
भवेत्तदासन्नपदं ततोपि मुहुर्मुहुः स्यॉत्स्फुटमूलमेवं ॥ २२ ॥

त्रिज्यागुणं भुजफलं चलकर्णभक्तं तल्लब्धकार्मुककलाः फलमत्र शीघ्रं ॥
एकेन सूर्यशशिनौ मृदुनाखिलेन स्पष्टौ परे फलचतुष्टयसंस्कृताः स्युः ॥ २३ ॥

मध्ये स्वचंचलफलस्य दलं धनर्णं कृत्वा ततो मृदुफलं दलितं च तत्र ॥
तत्संभवेन मृदुना सकलेन मध्यो मदंस्फुटः स्फुटतरोखिलचंचलेन ॥ २४ ॥

सम्यक्मंदफलस्फुटाच्चलफलं यत्साध्यते तत्स्फुटं न ज्ञेयः
प्रथमं मृदुस्फुटतरो मध्यग्रहात्केवलात् ॥
तस्मादाशुफलार्धंमंदजफलाभ्यां संस्कृतान्मध्यामाज्जातं मंद
फलं भवेत्स्फुटमलं किं चित्रमत्र क्रमे ॥ २५ ॥

मंदकेंद्रगतिरत्र दोर्गुणज्यांतरेण गुणिताद्यखंडहृत संस्फुटैः
परिधिभिः समाहता भांशहृन्मृदुगतेः फलंभवेत् ॥ २६ ॥

नक्रकर्किमुखकेंद्रतः फलेनोनयुंनिजगति र्मृदुस्फुटा ॥
तां विशोध्य चलतुंगभुक्तितः शेषमत्र चलकेंद्रजा गतिः ॥ २७ ॥

साहताशुफलकार्मुकागमे ज्यांतरेण विहृताद्य जीबया ॥
कर्णहृत्रिभगुणाहता च्युता शीघ्रतुंगगतितो गतिः स्फुटा ॥ २८ ॥

न शुद्ध्येद्यदा सा विलोमं विशोध्यावशेषं विलोमा गतिः खेचराणां ॥
महब्धीरवींद्वोर्न शीघ्रोच्चनिचे तथा वक्रता नेति पूर्वैः निरुक्तं ॥ २९ ॥

अथवामृदुचंचलंफलंलिखीतंसिद्दमितेषुकोष्टकेषु ॥
मृदुचंचलकेंद्रदोर्विभागैकरणीयसुगमंज्यकात्र ॥ ३० ॥

अतिदूरगतः स्वशीघ्रतुंगात्कुरुते वक्रगतिं ग्रहस्तदानीं ॥
चलकेंद्रलवा इमेब्धिभूपाः कृतशक्राः खगुणेंदवस्त्रिभूपाः

शररूद्रमिताः कुजादितस्तैरहिताः खंगुणाः स्वमार्गभागाः ॥
गदिताधिकहीनभागलिप्ता विहृताः केंद्रजवैगतागताहाः ॥ ३१ ॥

सौरं बाहुफलं हतं स्वगतिभिः सर्वर्क्षलि
प्तोद्धृतं स्वर्णं दोः फलवत्ग्रहे स्फुटरवेरभ्युऊद्गमे स्यादतः ॥
संयुक्तायनभागभास्करभावा जीवा जिनज्या हता
त्रिज्याप्तापमसिंजिनी धनुरतः क्रांतिर्भवेत्गोलदिक् ॥ ३२ ॥

सचलनदिनमालिदोर्गुणो यस्तुहिनकरांगविभागयुग्दिगाप्तः ॥
अनुपमगुणमेव तं युगघ्नमसमगुणं परिभावयंति संतः ॥ ३३ ॥

क्रांतिज्याकृतिवर्ज्जतात्रिभवनज्यावर्गतो यत्पदं ॥
द्युज्या सा पलभागुणोपमगुणःसूर्यैः हृतः कुज्यका ॥
द्युज्याप्ता त्रिभजीवया विगुणिता कुज्या चरज्या भवेत्
चापं चरमुद्गमास्तमनयोस्तद्व्यक्षसाक्षांतरं ॥ ३४ ॥

खेटस्पष्टगतिर्हता चरपलैः षष्ट्यु द्धृता खेचरे स्वर्णं
प्राप्तविलिप्तिका दिनमणेरस्तोदये गोलयोः ॥
नाड्यः पंचभुवश्वरेण सहिता हीना उद्गोगोलके
गोलज्ञै र्द्युनिशादलेनिगदिते व्यस्ते तु ते दक्षिणे ॥ ३५ ॥

खरकरवहि तामृतांगभागा द्युमणिभि रंगमितैःपृथग्विभक्ताः ॥
गततिथि करणान्यतो विशेषान्निजहरतोप्यनुपाततस्तुनाड्यः॥ ३६ ॥

करणमथ विरूपमद्रिशेषमसितचतुर्दशवासरोत्तरार्द्धन ॥
स्थिरशकुनिचतुष्पदाह्वनागप्रभृतिचतुष्टयमेव योजनीयं ॥ ३७ ॥

इंदोर्लवाः सरविचंद्रलवास्त्रि निघ्ना भक्ता पृथक्च खयुगै र्गतभानियोगाः ॥
शेषं त्यजेन्नख हतं खखनाग तस्ततषष्ट्या हतं स्वगतिहृद्धदिकास्तदीयाः ॥ ३८ ॥

नैकत्रोद यतः कुजे ग्रहविरामारंभदेशौ कुतस्तिर्यक्त्वाद्
डुमंडलस्य न समास्तस्मादिमे भोदयाः ॥
एक द्वि त्रि भ शिंजिनीकृतिनिजक्रांतिज्यका वर्गतो वि
श्लेषोत्थपदानि भत्रयगुण क्षुणानि तान्याहरेत् ॥ ३९ ॥

स्वस्वद्युज्यकयाप्तचापमितयः स्वाधो विशुद्धाः क्रमादेवं
राश्युदयाःक्रमोत्क्रमगताः प्राप्ता निरक्षेपुरे ॥
एक द्वि त्रि गृहोद्भवैश्वरदलैरूनाधिकाः स्युः क्रमाद्व्यस्तस्थैरुदया
स्वकीयविषये षण्णं विलोमा घटात् ॥ ४० ॥

पादोनार्कलवा पमांतरतयैवात्यंततिर्यक्स्थिता
वाद्यं तौ क्रियमीनयोरुदयतः स्वल्पैः स्वकीयैः फलैः ॥
तौतमंदापमभागकांतरतया गोकुम्भयोरुद्गतौ वेदा
पक्रमभागकांतरगतौयुग्मैणयोर्विस्तृतैः ॥ ४१ ॥

राश्यन्तत्रयमौर्विका भवलये कर्णा निजोन्मंडलोक्रांति
ज्यास्तु भुजा द्युरात्रवलये तत्कोटिचापोदयाः ॥
भास्वद्भोदयभोग्यपूर्वभफलन्युनेष्टना डीपलव्यो
माग्न्याभिहतेरशुद्धभपलैराप्तं लवाद्यं तनुः ॥ ४२ ॥

मेषाद्यैरविशुद्धपूर्वभवनैःयुक्स्वायनांशोनितंल
ग्नंसायनसूर्यलग्नविवरे कालं पलादिर्भवेत् ॥
रात्रौ षट्भ्ययुतार्कतस्तु समयो लग्नं तु कार्यं यदा
तावेकर्क्षगतौतदंतरलवैर्निघ्नोदयःखाग्नि हृत् ॥ ४३ ॥

कालःस्यादथतत्समुन्छतरणेःकालःस्फुटःस्यान्ततस्त
त्कालोभ्दवभास्वतःपुनरयंसंधितःप्रस्फुटं ॥ ४५ ॥

विषुवद्वलयाच्चलत्यजादिः स्खलितेस्मिन्प्रवहानिले पुरस्तात् ॥
अतिचारिणि चापरत्र याति प्रतिवर्षं न समास्ततोयनांशाः ॥ ४४ ॥

मध्यप्रभार्ककरणागतसूर्ययोर्यड्भागांतरं भवति सायनभागसंख्या ॥
वर्षांतरेण कलिकांतरमत्र दृष्टं प्रत्यक्षतस्तनुचरापमसाधनार्थं ॥ ४५ ॥

यत्सूक्ष्मभानयमाद्यमुनिप्रणितं तद्दृश्यभांतरघटी
विषमत्वतःस्यात् या वासना निगदितात्र पुरातनोक्ता
तैराशिकादिसुगमापि न दोषदा स्यात् ॥ ४७ ॥

तत्संस्कृतादपमलग्नचरादिसाध्यम्त्रिशद्घटीपरिमितं
दिनमीक्षनीयं तद्वासरार्कविषुवद्दिनसूर्यर्योर्यत् ॥
भागांतरं भवति सायनभागसंक्या॥तत्संस्कृतादपमलग्नचरादिसाध्यम् ॥ ४६ ॥

इत्थं श्रीमन्नागनाथात्मजेनप्रोक्ते तंत्रे ज्ञानराजेनरम्ये ।
ग्रंथागाराघारभूते भुक्ते जातास्पष्टता खेचराणां ॥
इति श्रीमत्सकलसिद्धांतेवासनाविचारचतुरचिन्तचम
त्कारिणिसिद्धांतसुदरेस्फुटगतिसाधनंनामाध्यायः ॥

॥ श्रीलंबोदरोजयति ॥

अथ ग्रहगणिताध्याये त्रिप्रश्नाधिकारः

सद्वासनाकुसुमसंचयसुंदरस्य चंचद्विशालतरगोलतरोः परस्य ॥
दिग्देशकालकलनाफलसाधनार्थं त्रिप्रश्नसंज्ञमधिकारमथाभिधास्ये ॥ १ ॥

अंभः समीकृतमहीतलसंस्थितस्य च्छाया दिनार्धघटिकासु समस्य शंकोः ॥
याम्योत्तरा भवति सैव तदुत्थमत्स्यपुच्छास्यतस्त्वपरपूर्वदिशौ भवतां ॥ २ ॥

उत्तुंगभागसमभूमिगवृत्तकेंद्रकीले निवेश्य शिथिलां सरलां शलाकां ॥
प्रोद्यत्दिवाकरमुखीं परिधौ तदग्राद्वस्ताग्रकाजनितचापलवैर्दिगैंद्री ॥ 3 ॥

स्याद्वारुणी कथितकेंद्रगताथ केंद्रकीलप्रभा रविवशेन विशत्यपैति ॥
तत्रापरेंद्रककुभौ भवतः क्रमेण सौम्या ध्रुवे भवति चेति हरिद्विधानं ॥ ४ ॥

कन्यामीनांतस्थिते सायनांशे भानौ मध्याह्न प्रभा क्षप्रभेयं ॥
बाहुः कोटिर्नाक्षकर्णोत्रकर्णः क्षेत्रेष्वांद्यं क्षेत्रमक्षोद्भवेषु ॥ ५ ॥

आभूम्यक्षात्लंबसूत्रं पलज्याबाहुः कर्णो भूमिगर्भाक्षमध्ये ॥
त्रिज्या लंबज्यात्र कोटिर्निरुक्ता पृथ्वीगर्भादक्षजीवाग्रगेयं ॥ ६ ॥

पूर्वं ज्ञाता कुज्यका वाहुरुपा क्रांतिज्या स्यात्कोटिरग्रात्रकर्णः ॥
एको बाहुः कुज्यकान्योपमज्या भूरग्रा स्याल्लंब उद्वत्त शंकुः ॥ ७ ॥

आद्याबाधाग्रादिखंडं हि कोटिः कर्णः क्रांतिज्या तथोद्वृत्तनादोः ॥
अन्वावाधा बाहुरूद्वृत्तशंकुः कोटिकर्णः कुज्यकैवेह जात्यै ॥ ८ ॥

सममंडल संगताद्दिनेशादवलंबः समवृत्तशंकुरुक्तः ॥
अयमत्र हि कोटिग्रकादोः श्रवणस्तद्धृतिरेव जात्यमन्यतः ॥ ९ ॥

उद्वृत्तशंकुरहितः समनाथ कोटिः कुज्योनतद्धृतिमितः श्रवणस्तथात्र ॥
अग्रादिखंडमिह दोरिति जात्यमन्यात्खंडद्वयं समनुरस्ति हि तद्धृतेश्च ॥ १० ॥

अयमांशकशिंजिनी भुजो वावनीजीवो नीततद्धृतिस्तु कोटिः ॥
सममंडलशंकुरत्र कर्णः समवत्तोत्तरयाम्यगेपि सूर्ये ॥ १९ ॥

एतेषु चान्यतमदोः श्रुतिकोटिमानैस्त्रैराशिकेन परजात्य भुजादिसाध्यं ॥
दोः कोटिवर्गयुतिमूलमश्रुतिः स्यात्तद्वहुवर्गवियुतेः परमत्र कोटिः ॥ १२ ॥

शद्यवक्षभे कोटिभुजौ क्रमेण चेदक्षकर्णश्रवणे तदानीं ॥
त्रिज्यामिते काविंतिलंबजीवापलज्यकेस्तःकिल कोटिबाहुः ॥ १३ ॥

उत दिनदलभा श्रुतौ भुजो भा भबति तदा त्रिभमौर्विकाश्रुतौ किं ॥
फलमितनतभागमौर्विकास्याः समुदितवत्पलभागकाःप्रसाध्याः ॥ १४ ॥

उन्नाग्रकाग्राप्रथमांत्यखांडारक्षश्रुतिःसंगुणिताक्षभाप्ता ॥
क्रांतिज्यका स्यादथ तद्वृतिश्चत दूर्ध्वखंडंक्षितिमौर्विकाच ॥ १५ ॥

उन्नाग्रकाग्राप्रथमांत्यखंडान्यर्का गतान्यक्षभ्योद्धृतानि ॥
अग्रादिखंडं समना तदूर्ध्वखंडं तथोद्धृत्तनरः क्रमात्स्युः ॥ १६ ॥

॥ अथ देशविषयाःप्रश्नाः ॥

सिंहासनासीनमिनत्वमाप्तं मित्रं विदित्वाद्युतिरुत्तमाशां ॥
यातोभवत्पूर्वनृपप्रभो यस्तस्याशुपुंसो वद यानमानं ॥ १७ ॥

॥ सूत्रं ॥

स्थानद्वयोद्भुतपलांतरालं
मनुघ्नमेवं गतियोजनानि ॥

अत्रार्कः सिंहार्द्धे आद्या छाया द्वितीया पूर्वछाया ।
अत्रक्रांतिज्यान्नयोर्द्विचंद्र हृतयोरित्यादिना वक्ष्यमाणप्रकारेण ॥
क्षभातोक्षांशोनानीय जातानि योजनानि ॥ १८ ॥

॥ अपिच ॥

नक्तमुखेस्तमिते सति हंसे मानसतश्चलितो मुनिराजः ॥
ईशदिशि द्युतिमीशसमानां पश्यति तत्र वदाक्षजभां मे ॥ १९ ॥

॥ अथ सूत्रं ॥

क्रांतिज्यानरयोर्द्विचंद्र हृतयोर्वर्गान्तरं दृग्गुणंहारः
स्यान्नरषड्लवेन गुणितो बाहुर्भवेन्मध्यमः ॥
क्रांन्तिज्याभुजवर्गयोश्च विवरं नेत्र घ्नहाराहतं
यत्तन्मध्यमवर्गहीनयुगतो मूलं च मध्योन युक् ॥ २० ॥

शंकौ क्रांतिगुणाधिकाल्प इह यल्लब्धं हरेणा क्षभा स्या
द्दिग्ज्यागुणिता द्युतिः श्रवणहृद्बाहुर्भवेदिष्टदिक् ॥

दिग्ज्या त्रिज्यकया यदा द्युतिमिते किं स्यात्प्रतितौ भुजः ॥
शोध्यं शुध्यति नो तदोत्क्रमतया शोध्यं स्वबुद्धाखिलं ॥ २१ ॥

क्रांतिज्यानरयोरित्यत्र वासनाश्लोकः ॥
अव्यक्ताक्षभयानयेत्रतलं तद्वाहुसंस्कारतः ॥
स्वादग्ना रवि वर्गयुक्तपलभावर्गोक्षकर्णे कृतिः ॥
क्रांन्तिज्याकृतिसंगुणार्क कृतिहृत्सा ग्राकृतिस्तत्समा
पूर्वाग्राकृतिरत्र साम्यकरणद्बीजक्रियातोक्षमा ॥ २२ ॥

न्यासःसूर्यः राशिलघुज्याप्रकारेणास्य
क्रांतिज्या नरःदिग्ज्या लब्धाक्षभा अक्षांशा ॥ 23 ॥

॥ अपि च ॥

कन्यायाः करपीडनं प्रकरुते पूर्वेंद्रतुल्यप्रभो
मित्रस्तीव्रकरः सदम्बरमणिस्तारावधुमध्यगः ॥
साचार्यज्ञकवी रथाश्वनृपतिर्यस्मिनसखे तत्पुरं
धारायाः कतियोजनैर्भवति मे तद्ब्रूहि वह्नेर्दिशि ॥ २४ ॥

दिंड्यौर्बी रवि सद्गुणा त्रिभगुणस्वाक्षद्यतिभ्यां हृद
व्यक्तोग्रार्कहतिः पलद्युतिहृता व्यक्तोथ मध्यो भवेत् ॥
व्यक्ताव्यक्तयमाहतिः शशियुतस्याव्यक्तवर्गस्य
यमूलंहारइतिरितो हरहृतो मध्योर्धितः स्यात्फलं ॥ २५ ॥

व्यक्ता व्यासदलोत्थवर्गविवरं योज्यं फले वर्गिते व्यक्ते
व्यासदलाल्पकेधिकतरे कार्यो वियोगस्तयोः ॥
तन्मूलं फलयुग्वियुक्हरहृतं प्रागुक्तवद्दृग्ज्यका
तच्चापांशहताचतुर्दशमितिः स्युर्योजनान्यंतरे ॥ २५ ॥

अज्ञातपत्तनपलज्यकया विनिघ्नी विज्ञातपत्तनपल श्रुतिरर्कभक्ता ॥
अग्राभवेदिह तयांतरयोजनज्या सूर्याग्रयेति यदि सेष्टदिशीह दृग्ज्या ॥ २६ ॥

॥ अत्रार्कः ॥

५।१०।०।०छाया१४कर्णः१५।२६॥
लघुज्यायाः नरः१०४क्रांतिज्या२२अक्षभा२।
अक्षकर्णः१२।उक्तवल्लब्धा दृग्ज्या११८योजनानि५५०॥
भूगोलं परिकल्प्य गोलमखिलं खस्वस्तिके स्वं पुरं
तस्मादिष्टपुरं दिगंशकगते दृंमडले कल्पयेत् ॥
दृग्ज्या तत्र पुरद्वयांतरलवैस्तक्तोटिजीवा नरो बाहुस्त
न्सममंडलांतरलबाःशंकोस्तलं साग्रका ॥ २७ ॥

अपसरलवमौर्व्या त्रिज्यया दिग्ज्यका
दोरपसृतिलवमौर्व्याव्यक्तया किं तदा स्यात् ॥
फलमितभुजहीना संयुता वाग्रका स्यान्नरतलमिह सौम्ये याम्यभागे क्रमेण ॥ २८ ॥

यदि रविमितकोटिः स्वाक्षभायास्तदा का नरतलमितबाहौ कोटिजीवात्र लब्धम् ॥
अविदितभुजजीवावर्गहीनस्त्रिवर्गो ह्यपसृतिलवकोटिज्याकृतिःपूर्वकोद्याः ॥ २९ ॥

कृत्या समेति हि समीकरणे प्रयोज्या बीजक्रियापसरभागभुजज्यकार्थं ॥ ३० ॥

॥ अपि च ॥

रामारातिपुरात्पुरारि हरितं रामांकभागाश्रिते सन्मित्रे
स्तमिते गतः स हनुमनशल्याविशल्येच्छया ॥
दृष्ट्वा तिष्टदथाद्रि तुल्यपदभां श्रीकंठकाष्टोन्मुखीं
तद्यानं वद कोविदेंदु कलिकासंजीवनेर्को सिचेत् ॥ ३१ ॥

अत्र सायनार्कः ॥५।
क्रातिज्या२२।४८। अक्षभा११ लब्धयोजनानि९८० ॥

अपिच१।१
।सिंहासनस्थं समवृत्त भुक्त्या पुरंदराशां परिपूरयंतं ।।
ज्ञाते पुरे विष्णुपदेनमंतं पश्यामि मित्रं समयेन केन ।। ३२ ।।

।। सूत्रं ।।

सूर्याग्रया कथितवत्परि साधनीया दृग्ज्या तयाभिमतदिक्द्यति नाडिकाश्च ।
इच्छादिशं विशति तासु घटिषु भास्वछाया तयाभिमतादिक्परिसाधनीया ।। ३३ ।।

।। अपि च ।।

गोदातीरगतात्मतीर्थविषये सत्र्यंशवेदाक्षभे
भानोर्भं हरिसंगतस्य हर दिग्भागाश्रितां ब्रुहि मे ।।
त्र्यंशोनांगमिताक्षभापि शिवदिक्कशी कियद्योजनै
रेकेनानयने न तद्वद सखे वांछामि वाराणसीं ।। ३४ ।।

।। अत्रार्कः ।।

४११५क्रांतिज्या४७दिग्ज्या११२अव्यक्तः१।व्यक्तः१३२मध्यः५१०हारः२
फलं१२०।
४०मूलं१५०द्दग्ज्या३०छाया१
अथानेन प्रकारेण अंतरयोजनानि१२२६ अपि च ।।

।। सूत्रं ।।

अपसरांशककोटिगुणोर्कहृत्पलभया गुणितः परिसंस्कृतः
निगदिताग्रकया त्रिगुणाहतोपसरदोगुणहृत्खलु दृग्ज्यका ।। ३५ ।।

धारापुरे दिनकरे मकरेंधकारे चोरोहरन्नृपतुरंगवरं गतोरम् ।।
साशीति पंचशतयोजनगोर्कतुल्यां पूर्वप्रभां गणयति स्वदिशा भ्रमेण ।। ३६ ।।

॥ रविः९०॥
क्रांतिज्या६५छाया१२कर्णः१७यथोक्तकरणेन लब्धा दिग्ज्या२११२ ॥
॥ अथ कालसाधनं ॥

गोलक्रमाच्चरदलज्यकया युतोना त्रिज्या तथावनिगुणेन निजद्युजीवा ॥
अंत्याहृती तरणिबिंवनिजोदयास्तसूत्रांतरे परिणते त्रिगुणद्युमौर्योः ॥ ३७ ॥

गोलक्रमाद्दिनदृले स्वपलापमांशविश्लेषयोगभुजकोटिगुणौ विधेयौ ॥
दृग्ज्यानरौनरहतार्कगुणात्र दृग्ज्याछाया तदर्क कृतियोगपदं श्रुतिः स्यात् ॥ ३८ ॥

मध्यांत्यका द्युनिशवृत्तनतासु वामजीवोनिता निगदिताभिमतांत्यकासौ ॥
द्युज्याहता त्रिभगुणेन हृता हृतिः स्यान्सार्कहता स्वपलकर्णहृदिष्टशंकुः ॥ ३९ ॥

भास्वद्रुणात्रिभगुणान्नरलब्धमिष्टछाया श्रुतिर्भवति वाममतो नतं स्यात् णना
भास्वद्रुणात्रिभगुणात्श्रुतिलब्धमिष्टशंकुःपलश्रुतिगुणोर्कहृतोहृतिः स्यात् ॥ ४० ॥

इष्ढा हृतिस्त्रिभगुणेन हता द्युजीवाभक्तांत्यकाथ पतितद्युदलांत्यकायाः ॥
शेषस्य वामधनुरेव नतासवः स्युस्तद्वर्जितं द्युदलमुन्नतनाडिकास्ताः ॥ ४१ ॥

याम्योदृग्वलयद्युरात्रवलयस्पर्शे दिनार्धंततोप्यं
त्यास्तोदयसूत्रगा हृतिरपि द्वे कर्णरूपे स्मृते ॥
लंकास्वोदयसूत्रयोश्च विवरे कुज्या चरज्याथ वा द्युज्यात्रि
ज्यकयोस्तदूनयुतयो हृत्यंके गोलयोः॥ ४२ ॥

मध्येष्टांत्यकयोर्नतोत्क्रमगुणः स्यादंतरंतेन सा हीनां
त्पाभिमता भवेद्धृतिरियं द्युज्यारव्यवृत्ते कृता ॥
कोटिश्चेत्पलकर्णके रविमिता तत्किं हृतौ स्यान्नरस्त्रिज्या
तेन यदा श्रुति रविमिते शंकौ किमिष्टा श्रुतिः ॥ ४३ ॥

त्रिज्याधिकस्य यदि वामधनुर्विधेयं त्रिज्यां विशोध्य परिशेषधनुः क्रमेण ॥
संयोजितं शतगुणर्णावबाणसंख्यैः स्याच्छापमुत्क्रममयं गुणचापयुक्ता ॥ ४४ ॥

यत्सिद्धांतशिरोमणौ समुदितं मध्यांत्ययोन्ना हतः
संभक्तश्चरजीवया दिनदले शंकुर्भवेद्वाथ सः ॥
अक्षक्षेत्रजकोटिभिर्विगुणितस्तत्कर्णभक्तो हृतित्स्रवं
विषुवद्दिने व्यभिचरत्यस्मान्मयानोदितं ॥ ४५ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्ते तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथागाराधारभूते प्रभूते त्रिप्रश्नोयं कालदिग्देशसिद्धै ॥
इति श्रीमन्सकलसिद्दांनसुदरेवासनाविचारचतुरचिन्तचत्कारिणि

सिद्दांतसुदरेत्रिप्रश्नाध्यायः ॥

अथ ग्रहगणिताध्याये पर्वसम्भुत्याधिकारः

गोरामै खगुणैर्जिनैः शशियमैः व्यशं चतुर्धा नखैः
राकृत्यां गयमैः सुरैः शरयुगै स्त्र्यश्वै द्विशत्या निलात् ।
सांशं खाभ्रयुगैः शतेन खरसैस्तानैस्त्रिधाब्ध्यब्धि
भिर्द्वक्षैर्द्व्यद्रिमितैरदेंदुभिरयुक्खेनेंद्रचंद्रैः पलैः ॥ १ ॥

वाराद्यं रविभागतं दिनमणिः स्याद्भुक्तराश्यादियुक्
पर्वांतेस्य गतिर्दिनादथ फलं पातस्य लिप्तामयं ॥
रूपं द्वौ त्रितयं युगानि च शरास्त्रेधा रसाः पर्वताः
भास्वत्कें द्रभुजांशदिग्लवकृतं पातेन्ययाथातिस्फुटः ॥ २ ॥

तत्त्वेंद्रो न शकाहता नवभुवो भुबाहवस्त्र्यग्नयो देवा
स्ते सहिता युगैस्त्रिभिरधो दंतैर्लवाद्यं तमः ॥
संक्रांत्यर्कनखां शकेन गुणभू भागाधिकेनाधिकं बाणः
पातयुतार्कदोर्लवदलं त्रिघ्नं स्वखाग्न्यंशयुक् ॥ ३ ॥

बिबं भानोः शरहृतगतिः स्वार्कभागोनिता स्या
दिंदोर्बिवं नवयुगरसास्तारकाभोगभक्ताः ॥

त्रिघ्नं तत्स्यान्सदशमलवं भूमिभासार्कभुक्तेः
शैलं शेनं युगनगहतं बिंबमिंदोर्गतिः स्यात् ।। ४ ।।

पर्वान्तस्तद्रहितसहितः स्पर्शमोक्षाख्यकालौ
मानैक्यार्धं शरविरहितं छन्नमानं वदन्ति ।। ५ ।।

बिंबैक्यार्धेषु जकृतिवियोगात्पदं षष्टिनिघ्नं भक्तं भुकत्यो
र्विवरकलिकाभिः स्थितेर्नाडिकाः स्युः ।
दर्शांते स्वमृणं नतंयुगहतं स्वाहर्दलेनाहृं
पश्चात्पूर्वविभागयोरिति मुहुः स्पष्टे त्रिभोनंतनुः
तक्रांत्यंशपलांशसंस्कृतिलघुज्या दिग्विभक्ता स्वयाधो
युक्ता नतिरर्कपर्वणि तया बाणं परिस्कारयेत् ।। ६ ।।

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्ते तंत्रे ज्ञानराजेन रम्ये
ग्रंथागाराधारभूते प्रभूते युक्त्यायुक्ता पर्वसंभू निरुक्ता ।

।। इतिश्रीमन्सिद्धांतसुंदरेपर्वसंभूतिनामाध्ययः ।।
।। छ ।।

अथ ग्रहगणिताध्याये चन्द्रग्रहणाधिकारः

ग्रहणकारणतार्कशशांकयोर्वदनपुच्छविभक्तशरीरिणः ।।
अपमवृत्तविमंडलयोगयोर्निवसतवस्तमसो मुनिभिः स्मृता ।। १ ।।

श्रुतिपुराणविरोधिजनैः स्मृता रविविधुग्रहयोः शशिभुभयोः ।।
करणताक्रमतस्तु न राहुणा ग्रहणमित्यपि ते स्वमते जगुः ।। २ ।।

दशरथात्मजसायकसंहतो दशमुखो यदपीति विदो जगुः ।।
दशरथप्रभवेण दशाननो हत इहापि पुराणविदस्तथा ।। ३ ।।

आछादकौ यद्यपि भूप्रभेंदू तथापि राहोरिह कारणत्वं ॥
यतोयमाकृष्यशरेण चंद्रं संछादकच्छाद्ययुतिं करोति ॥ ४ ॥

यस्योदिता तैर्विधुपातसंज्ञा स एव राहुः कथितो महद्भिः ॥
तस्याप्यनं गीकरणेरवीन्द्र स्यान्मासि मासि ग्रहणं सदैव ॥ ५ ॥

पिधानयोग्येवनिभेंदुबिंबे राहोरिस्त्रे ग्रहणक्रियायां ॥
अतः पुराणागमसंहितासु नोक्ते तु वेदे किल सूचिते ते ॥ ६ ॥

खखेषुषट्योजनसंख्यमैनं स्याद्बिंबमब्जस्य खनागवेदाः ॥
तत्स्पष्टगत्या निहतं विभक्तं स्वमध्यभुक्त्या स्फुटमानमेवं ॥ ७ ॥

इनावनीव्यासवियोगनिघ्नं शशांकबिंबं रविबिंबभक्तम् ॥
फलोनभूव्याससमा कुभासौ शरेंदुभक्ता कलिकादिका स्यात् ॥ ८ ॥

बिंबोदयप्राणमितिं विदित्वा चंद्रार्कयोर्मध्यगतौ तया घ्नी ॥
कक्षा द्युरात्रासुहृता स्वबिंबे स्युर्योजनानीत्यनुपातयुक्त्या ॥ ९ ॥

या सूर्यनिर्गतमरीचिकुपृष्टयोगात्सूचीसमा भवति भा ख इनाद्भषट्के ॥
तद्विस्तृतेः परिमितिर्विधुकक्षिकायां दीपप्रभागणितवद्विबुधैः प्रसाध्या ॥ १० ॥

इनाचतीव्यासदलांतरं चेत्कोटिर्दिनेशश्रुतितुल्यभायाः ॥
तदेंद्रदुमध्यश्रवणप्रमाणछायाभुजे केति फलं भवेद्यत् ॥ ११ ॥

तच्चंद्रदेशेवनिभाप्रमोत्थव्यासार्द्ध हीनार्धकुविस्तृतिः स्यात् ॥
इत्यत्र कर्णावपवर्त्य जातावर्केन बिंबे गुणभागहारौ ॥ १२ ॥

तिथ्यंतनाडीहतभुक्तिलिप्ताः पूर्णांगभक्ताः स्वफलेन हीनः ॥
राहुः शशी तौ सहितौ भवेतां तिथ्यंतकाले समलिप्तिकौ तौ ॥ १३ ॥

स्वर्भानूनितशुभ्रभानुजभुजाजीवाभ्रतारा हता
त्रिज्याप्ता शशिसायकः स वितमः शीतांशुगोलोत्थदिक् ॥
ग्राह्यग्राहकमानसंयुतिदलं स्यात्शायकेनोनितं छन्नं
ग्राह्यविहीनमेतदुदितं खग्राससंज्ञं बुधै ॥ १४ ॥

बिंबयोगदलबाणवर्गयोरंतरालपदमभ्रषट्गुणं ॥
अर्कचंद्रगतिभाजितं भवेच्चंद्रप्रर्वणि फलं स्थितेर्दलम् ॥ १५ ॥

मानखंडविवरार्धमर्दकं तद्वदेव भवतीह मध्यमं ॥
स्पर्शमोक्षसमयोत्थसायकान्सधितं स्थितिदलं स्फुटं निजं ॥ १६ ॥

तिथ्यंतकाले स्थितिहीनयुक्ते स्पर्शाख्यमोक्षौ भवतः क्रमेण ॥
एवं विमर्दार्धविहीनयुक्ते संमिलनोन्मीलनसंज्ञकालौ ॥ १७ ॥

भूमार्केंद्रं क्रांतिवृत्ते तथेंदोः केंद्रं बाणाग्रेथ तत्क्षेपवृत्ते ॥
स्पर्शमानैक्यार्धतुल्यांतराले मध्यग्रासे बाणतुल्यांतरे स्तः ॥ १८ ॥

तस्मान्मानैक्यार्धतुल्योत्र कर्णकोटिर्बाणो वर्गविश्लेषमूलं ॥
दोः स्यात्स्थित्यर्धं कास्बित्य तदेवानुपातान्नाडीरूपं व्यर्कचंद्रस्य मार्गे ॥ १९ ॥

स्पर्शाद्वमुक्तेरथ वेष्टकाले चेत्साध्यते ग्रासमितिस्तदानीं ॥
निजस्थितीष्टांतरनाडिकाघ्नी व्यर्केंदुभुक्तिः खरसैर्विभक्ता ॥ २० ॥

फलं भुजस्तत्समयोत्थबाणः कोटिः श्रुतिस्तत्कृतियोगमूलं ॥
कर्णोनमानैक्यदलप्रमाणमुद्दिष्टकाले स्थगितं विचित्यं ॥ २१ ॥

पूर्वापरा या स्ववसेन बिंबे तन्निष्टयूर्वग्रहमध्यमोक्षैः ॥
प्रयोजनं द्रष्टुरतोथ तेषां दिक्साधनार्थं वलनानि वक्ष्ये ॥ २२ ॥

एकमक्षवशतो वलनं स्याद्यद्द्वितीयमयनद्वयजातम् ॥
इंदुबाणवशतश्च तृतीयं सूर्यपर्वणि तु यन्नतिसंज्ञं ॥ २३ ॥

पूर्वापरायापमपवृत्तगत्या संछादको यन्न नयैव बिबं ॥
शुन्ये शरे छादयतीत्यतो यत्तस्वीयपूर्वापररेखयोः स्यात् ॥ २४ ॥

मध्यें तरं तद्वलनं ग्रहस्य स्पष्टंमयेति प्रकटं प्रदिष्टं ॥
बाणोदये तद्वलनाग्रतस्तं दत्वा वदेन्स्पर्शविमोक्षकाष्ठां ॥ २५ ॥

सायनांशखचरात्रि भाधिकाद्दोर्ज्यका जिनलवज्ययाहता ॥
भाजिता त्रिभगुणेन तद्धनुः सत्रिराशिखगदिक्तदायनं ॥ २६ ॥

नतगुणाभिहता पलकर्णहृद्विषुवती फलचापलवोन्मितं ॥
पलभवं वलनं तदिदं भवेच्चलनमक्षवशादयनोद्भवे ॥ २७ ॥

समविभिन्नदिशोर्युतिरंतरं वलनयोरवशेषगुणो हतः ॥
त्रिभगुणेन हतो निजमानयोर्युतिदलेन भवेद्वलनं स्फुटं ॥ २८ ॥

याम्योदृग्वलयेयनादिगखगं बोधाय कल्पत्र या
बिंबप्रागपरापमंडलपथाट्स्यान्सैव पूर्वापरा ॥
व्यक्षेतोयनसंधिगे न वलनं खेटेतुलाजा दिगे
तत्पूर्वापररेखयोश्च परमक्रांतांत्यंश तुल्यांतरं ॥ २९ ॥

अवांतरस्थे खचरेनुपातात्तदायनं स्याद्वलनं निरक्षे ।
साक्षेक्षतस्तच्चलतीति पूर्वै पलोद्भवं तद्वलनं प्रयुक्तं ॥ ३० ॥

कल्प्यापवृत्तं सममंडलाभं याम्योत्तरस्वक्षितिजे ततो ये ॥
तद्योगतस्तत्क्षिति जावधिः स्यात्तदायनाख्यं वलनं स्वदिक्कं ॥ ३१ ॥

याम्योदग्वलयस्थिते दिविचरे या बिंबपूर्वापरा व्यक्षे
सैव निजात एव वलनं नोत्पद्यतेत्राक्षजं ॥
स्वक्ष्माजे तु तदंतरं पलगुणो मध्येनुपातेन
यत्तत्प्रोक्तं वलनं बुधैः पलभवं तेनायनं संस्कृतं ॥ ३२ ॥

परितो ग्राह्मकेंद्राद्यन्मानैक्यार्धेन मंडलं ॥
द्रष्टुर्ग्राहककेंद्रस्पृक्सूत्रसक्तं तदाग्रहः ॥ ३३ ॥

स्पर्शदिक्को विलोमेन दत्वा शरमितांगुलं
ततो बिंबाग्रपूर्वाशापर्यंतं वलनं स्फुटं ॥ ३४ ॥

पर्वान्तः किलसाधितो भवलये सूर्यंदुचिह्नान्तरा
त्तस्मिन्बिम्बसमागमो न हि यतश्चंद्रः शराग्रे स्थितः ॥
तस्मादायनदृष्टिसंस्कृतविधोरानीततिथ्यंतके
बिंबैक्यं भवतीति किं न विहितं पूर्वैर्न विद्मो वयं ॥ ३५ ॥

फलंभुजस्तत्समयोच्छबामःकोटिःशुतिस्तक्रतियोगमूलं ॥
कर्णोनमानक्यदलप्रमाममुद्विष्टकालेस्छगितंविचित्यं ॥ ३६ ॥

दोर्ज्या सत्रिभसायनांशकविधोर्लध्वी त्रिचंद्रा हता दंताप्ता
यम् शिंजिनीह निहता बाणेन सा त्रिज्यया ॥
भक्ता लब्धकला विधौ धनमृणं भिन्नैकदित्वके शरक्रांत्योरायन
दृष्टिकर्मविहिताच्चंद्रात्तिथिः पर्वणि ॥ ३७ ॥

ग्राह्मस्य केंद्रात्परितः प्रकल्प्य मानार्धयोगांगुलसूत्रवृत्तं ॥
दिक्साधनेस्मिन् वलनं प्रदेयं यथादिशं स्पर्शभवं विघोः प्राक् ॥ ३८ ॥

तन्मौक्षिकं पश्चिमतः खरांशोर्व्यस्तं ज्यकावच्च शरौ तदग्रात् ॥
रेखा सुदीर्घा वलनाग्रयोर्या तिर्यक्च रेखात्र तु मध्यबाणः ॥ ३९ ॥

केंद्राद्यथादिक्शरचिह्नकेषु यथा भवेत् ग्राहकबिंबकेंद्रं ॥
स्पर्शेथ मध्यग्रहणे च मोक्षे तथा तथा दिंनियमो विचिंत्यः ॥ ४० ॥

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पूर्वापरायास्ववसेनबिबेतन्निष्टपूर्वग्रहमध्यमोक्षैः॥
प्रयोजनंद्रप्रुरतोथतेषांदिकसाधनार्थनानिवक्षे ॥ ३६ ॥

एकमक्षवशतोवलनंस्पाघद्वितियमयनद्वययातं ॥
इदुबणवशतश्पनृतीयंसूर्वषर्वणितुवन्नतिसंज्ञं ॥ ३७ ॥

पूर्वापरायामपवृन्तगत्यासंछादकोयन्ननयैवबिबं॥
शुन्येशरेछादयतीत्यतोयन्तस्वीयपूर्वापरेगयोन्स्यात् ॥ ३८ ॥

मध्येतरंयद्वलनंग्रहस्यस्पष्टंमयेतीप्रकटंप्रदिष्टं ॥
बाणेदयेतद्वलनाछरंतंटृत्वावदेन्स्पर्शविमोक्षकाष्टं ॥ ३९ ॥

सायनांशखचराप्रिभाधिकाद्दोर्ज्यकाजिनलवज्ययाहता ॥
भाजितात्रिभगुणेनतद्दनुःन्सत्रिराशिखगदिक्रदायन ॥ ४० ॥

नतगुणाभाहतापलकर्णहद्दिषुवतिफलचापलवोन्मितं ॥
पलभवंलनंतदिदंभवेच्चलनमक्षवशाद्वलनेयने ॥ ४१ ॥

पर्वान्तः किलसाधितोभवलयेसूर्यदुचिह्नान्तरा
त्तस्मिन्बिम्बसमागमो न हि यतश्चंद्र शराग्रे स्थितः ॥
तस्मादायनदृष्टिसंस्कृतविधोरानिततिथ्यंतके
बिबैव्यंभवतीतिकिनविहितंपूर्वैर्नविघ्नोवयं ॥ ४२ ॥

तन्मौक्षिकंपश्चिमतःखराशोर्व्यस्तंज्यकावच्चसरोतदग्रात् ॥
रखासमुत्छावलनाग्रयोर्यातिर्यक्रेखात्रनुमध्यबाणः ॥ ४३ ॥

चंद्रोपरागेन्यदिशःस्यरास्युःर्शत्यबाणाग्रगतेथसूत्रे ॥
आमध्यबामंपरिलिख्यकेंद्रादिबांतरार्द्धेनविधायवृन्तं ॥ ४४ ॥

तद्विसूत्रद्वयसंयुतिभ्यांवृन्तद्वयंग्राहकखंउकेन ॥
ततग्राह्माबिबेसमन्दितंस्पान्संमीलनोन्मीलनमत्रचित्यं ॥ ४५ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्ते तंत्रे ज्ञानराजेन रम्ये
ग्रंथागाराधारभूते प्रभूते संपूर्णोयंचंद्रग्रहणपर्वाधिकारः ।
इतिश्रीमन्सकलसिद्धातचासनाविचारचतुरचिन्त
चमत्कारिणिसिद्धांतसुंदरेचंद्रग्रणाधिकारः ॥

अथ ग्रहगणिताध्याये सूर्यग्रहणाधिकारः

भूपृष्टगर्भगनरौ न समानकाले चंद्रावृत्तं दिनकरं प्रविलोकयेतां ॥
दृकसूत्रकं रविगतं क्षितिगर्भगस्य दर्शान्त एव विधुरेति न पृष्टगस्य ॥ १ ॥

तत्सूत्रयोरपमवृत्तगमंतरालं तल्लंबनं नतिरिहोत्तरदक्षिणं यत् ॥
नो लंबनं भवति मध्यविलग्नतुल्ये भानौ द्वयं न सममंडलमध्यगेस्मिन् ॥ २ ॥

चेन्मध्य लग्नजनितांशमितेरभावः ॥
स्वीयोदये युग घटीमितलंबनं स्यात् ॥
तत्साधितं सुमतिभिर्बहुधानुपातैः सूर्योदयेपि समयेभिमते मुनींद्रैः ॥ ३ ॥

पर्वांतेवनिगर्भगोदयकुजे भानौ भवेद्भुदलं ॥
कोटिर्भास्करयोजनश्रुतिभुजे कर्णस्वसूर्यांतरम् ॥
तत्किं स्यादरविचंद्रयोजनमयश्रुत्यन्तराले भुजे
कोटिर्लंबन योजनानि परमज्या संगुणान्याहरेत् ॥ ४ ॥

शीतांशुकर्णेन कला भवन्ति पादोनतानाः खरसा हतास्तु ॥
गत्यंतराप्ताघटिकाचतुष्कं स्याल्लबनं मध्यममुद्गमेस्ते ॥ ५ ॥

पर्वांतसायनतनुज्यकया जिनांशजीवा हताथ विहृता निजलंबमौर्व्या ॥
लब्धं निजोदयगुणोत्रखमध्यलग्न क्रांत्यशकाक्षलवसंस्कृतिजा नतज्या ॥ ६ ॥

सा संहतोदयगुणेन हृता त्रिमौर्व्यातल्लब्धवर्गनतभागगुणोत्थवर्गौ ॥
विश्लेषितौ पदमतो भवतीह दृष्टिक्षेपस्तु तत्रिभगुणोद्भववर्गयोर्यत ॥ ७ ॥

विश्लेषमूलमिह दृग्गतिसंज्ञशंकुर्हारो भवेत्रिभगुणार्धकृतिर्नरास्रा ॥
मध्याह्नलग्नंतपनांतरमौर्विकाया हारेण लब्धमिह लंबननाडिकाः स्युः ॥ ८ ॥

दर्शे विलंबनमिदं स्वमृणं विधेयं नून्याधिके सति विवस्वति मध्यलग्नात् ॥
राशित्रयो न तनुभानुविशेषजीवा वेदा हता त्रिगुणहृल्लघुलबंनं वा ॥ ९ ॥

तद्वित्रिभोद्भवसमुन्नतमौर्विकाघ्नं त्रिज्या हृतं स्फुटमिति प्रवदंति केचित् ॥
दृक्षेपादपहृतात्खनगैर्नतिः स्यान्मध्यज्यकादिगिति तत्परिसंस्कृतेषु ॥ १० ॥

स्पष्टोसकृत् स्थिरविलंबनसंस्कृतोपिदर्शस्तदुद्भवशरो नति संस्कृतोस्मात् ॥
ग्रास स्थिती स्थितियुतोनितदर्शतस्तु कार्यं विलंबनमनेन पृथक्स्फुटेस्मिन् ॥ ११ ॥

स्पर्शोथ मुक्ति समयः क्रमतः स्थितिस्तस्तन्मध्यकालविवरे तरणिग्रहेत्र ॥
धूम्रोल्यके र्धिततनावसितोथ बभ्रुः सर्वग्रहे विधुरिनस्तु सदैव कृष्णः ॥ १२ ॥

॥ अथ वासनाश्लोकाः॥

दर्शांतोदयलग्नकापमगुणादग्रानुपातद्वया
न्संचारादुदयज्यकेति गदिता दृग्ज्या खमध्योदयात् ॥
त्रिज्यायामुदयज्यकामितभुजस्तत्किं भवेद्दृग्ज्यया लब्धं
दोरपवृत्तपूर्वपरया तन्मध्यलग्नज्ययोः ॥ १३ ॥

यद्वर्गांतरतः पदंनिगदिता कोटिः स दृक्षेपकस्तत्कर्णस्त्रि
गुणस्तयोरथ भुजः सा दृग्गतिः शंकुवत् ॥
मध्याह्नोदयभास्करांतरगुणेत्रिज्यामिते लंबनं चत्वारः
किमभीप्सितेथ यदि तत्रिज्यामिता दृग्गतिः ॥ १४ ॥

इष्टायां किमिति त्रिराशिकयुगे त्रिज्या हरौ तद्हति
वेदै रप्यपवर्तितैकभवनज्या वर्गतुल्यः पुनः ॥
दृग्गत्याप्यपवर्तितोत्र भवति छेदाह्वयस्तद्धृता
लग्नार्क्कांतरमौर्विकास्फुटमिदं नाद्यादिकं लम्बनम् ॥ १५ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्ते तंत्रे ज्ञानराजेन रम्ये
ग्रंथागाराधारभूते प्रभूते युक्त्या युक्तःसूर्यग्रहणपर्वाधिकारः

अथ ग्रहगणिताध्याये ग्रहोदयास्ताधिकारः

उदपतिरहरिश्चाहुरन चारः खगेंद्रो हरिहरियदेनं लंघयनभानुरग्रे ॥
अतिगतिरथसूर्यादग्रतः पश्चिमायामुदयति समयां शैव्यस्तमस्तं गतोस्मात् ॥ १ ॥

आखंडलदिशिमंगलमत्रिमंदाः सूर्योहिताः स्युरुदिताश्चलकेंद्रभगौः ॥
नागाश्विभि र्मुनुमितै र्मुनिभूमि रेतैश्चक्रेच्युतै निगदितो सूमयः परस्यां ॥ २ ॥

भास्वौ तेरधिकहीनगती सितचुकछतोस्तमयतः परपूर्वभागे ॥
सिद्धै र्वियद्विषयकै र्मुनिशैलचंद्रैःचेपेंषु भूपरिमितिः क्रमशः परत्रा ॥ ३ ॥

तौपूर्वतोगुणगजेंदुभि रक्षपूर्णादस्त्रै रसामरमितैर्द्वशरामसंख्यैः ॥
उक्ताधिकोनकलिकाश्चलकेंद्रभूक्त्या भक्ता भवंति दिवसाविगतागताख्या ॥ ४ ॥

भौमातग्रहा दिनकरारुत च दिनेशाः सूर्याः खचंद्रगुणाताःशरमध्यलिप्ताः॥
पाताः स्वचंचलफलैः परिसंस्कृताः स्युर्व्यस्तैः स्पुटामदुफलेनसितज्ञ पातौ ॥ ५ ॥

खेटः स्वपातरहितः सित सौम्ययोस्तु शीघ्रोच्च मस्यभुजमौविकयाविनिघ्ना ॥
विक्षेपमध्यमकलाश्चलकर्णभक्ताः स्पष्टं भवंति गतपातखगेंद्र दिक्काः ॥ ६ ॥

राशित्रयाद्यखचरादयमज्यकाया ॥
स्पष्टेषुणाविणाविगुणितात्रिगुणेन भक्ताः
लब्धाः कलापमबाणसार्मान्यः ॥
दिक्कोकार्यारुणं धनमिहायनदृक्ग्रहः स्यात् ॥ ७ ॥

अक्षप्रभाहतशराद्रवि भिर्विभक्तान्सौम्येशरेफलमेणंद्गमेस्ते ॥
याम्येधन र्णमिति चाक्षजदृष्टिर्मदृक्कर्म संस्कृत खगोह्युदयास्तलग्नं ॥ ८ ॥

द्दिकार्यमुत्क्रमगुणेन च यैर्निरुक्तं ते ब्रह्मसौरशशिसंमतयुक्तिभिन्नाः
कालांशकाहिमकरानपनान गक्ष्मा विश्वे शिवा नमितास्तिथयः ॥ ९ ॥

क्मेणद्राकेंद्रभाग विदिते दिवसे विधेयोदृकखेचरोदिनमणेरुदयास्तकालेचंद्राशुदृष्टिख गयो
रधिकविलग्नं कल्पे दिनकरोंतरनाडिकाः प्राक् ॥ १० ॥

तर्काहतारसयुजे परतोंशकास्युः प्रोक्ताधिकायदिगतोभ्युदयोन्यथैष्यः ॥
अस्तोन्यथा समुदितागतकालभागविश्लेषजातकलिकाः खरवराम निघ्नाः ॥ ११ ॥

अर्कोदयोनविहृता निजसप्तमेन पश्चात्फलं गतिवियोगहतं दिनैस्तैः ॥
वक्रजवैक्यविहतं खचरोदयास्तौ ज्ञेयौदिवाकरवशात्परप्तर्वभागे ॥ १२ ॥

प्राच्यांयदासमधिः खलु दष्टिखेटस्वल्पोथ वा वरुणक्दखचरः खरांशोः ॥
उष्टेष्टकाललवयोगमितेर्गनैष्यं साध्यं दिनादिकमिहास्तमनौदयार्थे ॥ १३ ॥

मध्यक्रांतिलवाग्रकेभवलये स्यात्सात्यवेटचिहं तदा
तद्विंबंशरमंडले स्फुटनिजक्रांत्यग्रके तिष्टति ॥
नैकस्मिन्समये ततोस्तुदयः स्याद्विंबंतचिन्म
योर्द्दक्कर्मद्दितयं क्रतं शरवशादक्षायनोत्छंग्रहे ॥ १४ ॥

दक्खचरोष्टाकरयोरुदयास्तकालभागांतरं भवति कावास्ते एव ॥
चक्रेषुरुपरहिताः पृथुबिंबभावादन्योपत्तिरखिलासुगमात्र नोक्ता ॥ १५ ॥

लंकाकुजेयनागतं ग्रहचिह्नमेति याम्योन्तक्षितिजगौ हि तदा कदंबौ ॥
तत्सन्मुखे निजशरे ग्रहबिंबमस्मद्धिब च चिह्नमुदितंसमकालमत्र ॥ १६ ॥

तस्मादिहायनगतद्युचरेयनाख्यं दृक्कर्मतोद्भूवतिनोवलनं तदा खं ॥
व्यक्षे यदा क्रियदाक्रियतुलादिगतं स्वचिह्नमूर्ध्वाधरौ जिनलवज्यकयाकदंबौ ॥ १७ ॥

तन्सन्मुख स्वविशिखाग्रमते स्वबिंबे चिह्नंकुजेपरमिहायनदृष्टिकर्मा ।।
व्यक्षोदितं दिविचरायन कर्मसाक्षे देशे पुनः प्रचलति क्षितिजप्रभेदात् ।। १८ ।।

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ।।
खेचारामामुदमोस्तौ निरुक्तौ दक्कर्मापिप्रोक्तमुन्तपन्तियुक्तं ।।
इतिश्रीमत्सकलसिद्धांतवाचनाविचारचतुरचिन्त
चमत्कारिणि श्रीसिद्धांतसुंदरेग्रहोदयास्ताधिकारः।।

अथ ग्रहगणिताध्याये नक्षत्रच्छायाधिकारः

प्रस्फुटामयचरज्य कादिभि र्भानुः भावदिह खेट भादिभा ।।
तत्र यातघटिकाः खगोदयादस्त तस्तदवशेषनाडिकाः ।। १ ।।

मध्यस्फुटक्रांति भवे चरार्द्धे तदं तरैक्यंसमभिन्नदिक्ते ।।
तत्प्राणतः सायनदृष्टि खेटालग्नं क्रमादुक्रमतः खबाणे ।। २ ।।

याम्योंतरे तद्युचरोदयास्तलग्नं तदकंतिरनाडिकाभिः
मुदेति खेटो दिवसे नीशायां सशद्धसूर्यातरजैः पलैस्तैः ।।
तत्संयुताः खेचरयातनाज्यो रात्रौ दिने चा विगता भवंति ।। ३ ।।

ताराणां ध्रुवक्काः क्रमेण वसवः पूर्णाश्विनौष्टाग्नयः
शुन्याख्यास्त्रिरसाश्च शैलरुतवस्त्र्यंकारसाशालवाः ।।
नागाशानगाभास्करानगदशः पंचेषु
चंद्राविियन्मांतंगक्षितयस्त्रिकुंजरभुवो नंदांक चंद्रोन्मिताः ।। ४ ।।

सूर्याक्षिणि नगाश्विनोष्टनवद्द्गदस्त्रा
प्रतानाश्विनो वेदेष्वक्षमिताः खदशकयमलाः
मातंगतारामिताः व्योम्यांकोन्मितबाहवः
खदशनांगाश्विरामानगस्वर्वासावियदायनांशरहिते काले निरुक्ताध्रुवाः ।। ५ ।।

आशांश्वमुखे त्रिकोणसदशे सूर्याक्षुराभेध्बयः ॥
सार्द्धास्ते शकटोपमेति मृगभेकाक्षाः शिवारुद्रमे ॥ ६ ॥

तर्कांशाविशमे चतुर्भुजनिभे खंयुग्मभे निःप्रभे
सर्पाभिमुनयो वियस्वविषमाश्रे समद्वयोः ॥ ७ ॥

अर्कां रुद्रमिताश्च हस्तसदशेरुद्राः पदोनंद्वयमुक्ता
भेद्रिगुणा प्रवालसर्दशे सत्त्यशभस्तोरणे ॥ ८ ॥

बलिनिभे द्विपद द्वयमर्द्धयुक्त्यमिह त्रिभुजे यमले
गजाः सदलकाशयने त्रिलवेषवो गजरदे विषयाभिजितिहिशद ॥ ९ ॥

शरसमे खगुणाश्रुतिकुंडले रसगुणास्त्रिलवशततारके ॥ १० ॥

शयनवतद्वितयोजिन षद्यमापिमृदंगनिभेखमिष्टोर्लवाः ॥
विधिशतस्त्रितयं करतो द्वयंभुंजगभवरुणोघधिपादि षड् ॥
अपमंडलतःकिल दक्षिणेपरमुदग्गिशि च स्वशराशकैः ॥ ११ ॥

लब्धकभधृवको रसनागारदयाम्यशरोस्पवियद्यग भागाः ।
कुंभभवस्य च शैलमतंगा दक्षिणवाणइहाद्रितुरंगाः ॥ १२ ॥

॥ अथैषांवासनाश्लोकौ ॥

मध्याह्नकाले निजयोगतारास्तमाग्रविन्यस्ततलेन विद्या ॥
पूर्वोक्ततन्तन्नलिकापथैव सूत्रं कुमानीयसएवकर्णः ॥ १३ ॥

स्तंभः सनातद द्विवरेप्रभा सा त्रिज्यागुणा भाश्रवणेन भक्ता ॥
फलस्य चापं स्वनतांशकाः स्युः ग्रहोक्तवद्र ध्रुवकाः शराः स्युः ॥ १४ ॥

हरिहरितिमरिचिद्दग्निरंशैर्वशिष्टः परदिशिनगभागैरंगिरात्रित्रिरस्मात्
वसुभिपुलस्त्यावद्भिः पश्चिमायांपुलहदहदिगंशैरग्निभागैः ऋतुश्च ॥ १५ ॥

क्रतोश्र विष्णुधिज्या युगादौ स्थिताउत्तराः स्युः शरांशाः मुनीनां क्रमात्यं
च बाणाः कुबाणाः खबाणाश्च प्रयमार्गणाः शैलबाणाः ॥ १६ ॥

नभोंगानि खांगानि तेषांगातिः प्राक्कला अष्टसंख्या इति ब्रंह्मतंत्र्ये ॥
उदायाम्यतः स्वल्पभुक्तिश्च तेषां खर्क्षाणि वर्षाणि तक्रे तलत्वात् ॥ १७ ॥

युगादितः प्राष्कलनं भचक्रे भांशोन्मितं खाभ्रगजेंदुवर्षैः ॥
स्व स्थानयातं किल वक्रगत्या भांशोन्मितं पश्चिमतश्च यातं ॥ १८ ॥

युगांतरैवं परिवर्तनातिघ्नतषंके गतवत्सरैः किं ॥
खखद्विशैलैः शतमष्टयुक्तं किं शेषवर्षैरिति यद्भतष्टं ॥ १९ ॥

शेषेयनंशाः परपूर्वभागे धनर्णसंज्ञा यमादिसिद्धौ ॥
अर्कोदयाग्रापमसाधितार्कस्याष्टार्कयोरंतरतोयनांशः ॥ २० ॥

वृषे द्वाविंशेवियतियति हुतभुक्ब्रह्महृदयौ
शरांशौरष्टाभिर्गगनगुणसंख्यै रुदगतः ॥
प्रजानाथः प्राच्यांशरमितलवैर्ब्रह्महृदयादुदग्बाणः
प्रोक्तो वसुगुणलवास्य मुनिभिः ॥ २१ ॥

चित्रायाः पंचमितैरुत्तरतः स्यादपांवत्सा
आपश्चषडिभरंशैरुत्तरभागेस्ति चित्रायाः ॥ २२ ॥

ध्रुवतिमिमुखतारकोपदेशे यनपदे ध्रुवोन्नतोक्षजांशौ ॥
भ्रमति च परितोस्वमत्सपुच्छसममिवकीलकबद्धवालवत्सं ॥ २३ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथागाराधारभूतेप्रभूतेताराछायाभधृवाघनिरुक्तं ॥
इतिश्रीमन्सकलसिद्धांतवासनाविचारचतुरचिन्तचमत्कारिणि
सिद्धांतसुदरेनक्षत्रछायाघटिसाधनाधिकारःसमाप्तः ॥

अथ ग्रहगणिताध्याये शृङ्गोन्नत्याधिकारः

राजापुष्करमंडले दिनकरस्तीव्रप्रतापान्वितो मंत्रि
तत्प्रतिबिंबसंभृतकलापूर्णाः सुधामंडलाः
युक्तस्तत्करमुद्रया त्रिभुवने तेजो निजं दर्शयन्
पृष्टे वायुरतः प्रयातितरणेहर्तुं तमोवैरिणं ॥ १ ॥

भानुश्चेत्प्रतिबिंबितो जलमये शीतांशुगोल
दिवानिस्तेजानिशिसुप्रभः कथमथो किं सूर्यबिंबासमः ॥ २ ॥

गालार्धरविसोज्वलं च सकलंनस्यातडागे यथापक्षार्ध
खिलदृश्यतेतिगणकाज्ञानं हयः पृछति ॥ ३ ॥

कमलगोलमयंशशिमंडल कमलिनीसकलै र्विलसत्यकंतदिनसन्मुखमिंदु-
तनोर्दलं रविकरप्रंसरैरिदमुज्वलं ॥ ४ ॥

सुराः सुधामंडलमा पिवंति दिनेषु कृध्मप्रतिपन्मुखेषु ॥
तदेव सत्यं न भवेत्कथं वा पुराणवेदागम शास्त्रमूलं ॥ ५ ॥

नवोनवोयं भवती निजायमनोन्हिकेतुः सदुषोग्रमेत्याभगंहि
देवेषुददातिचंद्रः सुदीर्घमायुस्ततरे तथैव ॥ ६ ॥

वेदे सुराः सूर्यकराः प्रसिद्धा स्तरावयछंतिकलाः क्रमेण ॥
सिते सिते ते क्रमशो हरति तदेकवाक्यत्वमिदंमत्तं वा ॥ ७ ॥

अपमयोर्विवरं समदिक्कयोरविनिशाकरयोर्युतिरन्यथा ॥ ८॥

भवति यत्र दिवाकरतः शाशिदिगथ संस्कृतिजातभुज्यका ॥
घुदलजे दुजभाश्रुतिसंगुणारविगुणाक्षगुणात्परिशोधिता ॥
इह युतायदि दक्षिणादिकदृता तदनुलंबगुणेनभवेद्भुजः ॥ ९ ॥

रवि मितात्रहि कोटिरतः श्रुतिर्भुनिवरैरुदितासु द्वये ॥
नयनहीनशशांककलाद्वतानवशतैः सितमत्रकलादिकं ॥ १० ॥

तदिंदुबिंबांगुलसंख्यायाघ्नं सूर्योद्धतं स्यात्परिलेखयोग्यं ॥
समावनौ सूर्यसमाख्यबिंदुविधा यतस्माद्भुजमात्मदिकं ॥ ११ ॥

कोटिदिगंतादपरायतां च दत्वा तदग्रा छ्रवणंभुजांतं ॥
विलेख्य तात्कालिकचंद्रबिंबोद्यग्रतस्तत्रदिशः प्रकल्प्य ॥ १२ ॥

कर्णानुसारापरपूर्वरेखा तद्बिंबयोगात्सितमंगुलाद्यं ॥
कर्णांतरानीययमोन्तराशीतरेणमस्त्यद्वितयंविलेख्यं ॥ १३ ॥

तदास्यपुछोयगसूत्रयुग्मसयोगतो वृत्तमथो विधाय ॥
बिदुत्रयः स्पृग्विधुबिंबमेतछन्नंयथास्याछशशिटंगमुच्चं ॥ १४ ॥

कक्षेन्यथाशंभुजमेव दत्वा तथारवि सहयुतंशशांकात् ॥
अन्यत्र्काशितं पूर्वबदेवसाध्यं शृंगोत्रतित्वंपरि दर्शनीयं ॥ १५ ॥

यतसिद्धांतसिरोमणौ समुदितं कोटेरभावेछृंगोर्धा
धरतेति दर्शहीन सेचंद्राकयोगेकुजे ॥
तस्मिन्दर्शनमेव नास्ति शशिनः शृंगोन्नतत्वं कथं यंत्रोर्ध्वा
घरताकुजोपरिविधौ कोटेरभावः कुतः ॥ १६ ॥

यद्याम्योन्तरमतरं हिमकराहर्नाथयोस्तद्भुजस्तन्मुले
तरणिर्भुजाग्नसहिता कोटिस्तदुर्द्धस्थिता ॥
तत्राग्रे शशिमंडलं कथमिति प्रोक्तं तदौव्यं रवेश्चंद्रो विश्व
गुणं ततोत्रनतयोर्याम्योन्तरत्वादिकं ॥ १७ ॥

सूत्रंसूर्यमुछितंशशितनौयस्मिन्विलग्तं ततो य
द्वन्तभवती कंदुकदलांरतलेशीतगोः ॥

तथावन्मितमिक्षितक्षितिगतैस्तावत स्थितं
साध्यते दोः कोटिश्रुति पाप्तंदिगंशस्बितं ॥ १८ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
धागाराधआरभूतेप्रभूतेशृगोन्नत्यध्यायेवंनिरुक्तं ॥
इति श्रीसकलसिद्धांतवासनाविचारचतुर
चिन्तचमत्कारिणिसिद्धांतसुंदरेशृगोन्नतिः ॥

अथ ग्रहगणिताध्याये ग्रहयुत्याधिकारः

इष्टदिष्टजपरिस्फुटखेटो छायनंनयनकार्मविघा या ॥
अंतरेत्र कलिकानिजगत्योरंतरेण विहवाः खगयोगः ॥ १ ॥

राकरावयदि वक्रगः खगस्तज्जवैक्यपरिलध्बवासरै ॥
वक्रगेप्यगतिकेथ वाल्यगे सागताथवा परितराष्यका ॥ २ ॥

चक्रगावुभयस्वेधरौ यदा व्यस्तमास्तदिवसैः प्रचालितौ ॥
संगमौ स्त इह स्वेटमार्गणौ साध्यचंद्रविशिषोनतिः स्फुटः ॥ ३ ॥

रार्कभिन्नककुभोः स्वबाणयोः स्वस्वसायकहरि
स्थिरवॉयोरंतरं स्फुटनारोयदाल्पकः ॥ ४ ॥

बिंबयोगदलतस्तदा नयो र्भेदयोग इनपर्वतवभ्दवेत् ॥
खखेषु षट्योजनसंरव्यमैनं स्याद्विबसिदोस्तुस्वनागवेदा
बाणवारणवारणगजेंदु यो मंडलं वितंतमेवमंगले ॥ ५ ॥

सौम्यमंडलमिति वेनेविंडा पक्षपूर्णरसभूमिया गुरोः ॥
भानुभूमिकुमिताः सितबिंबषडयुगांगनवबाहवाःशनेः ॥ ६ ॥

व्यासार्धकर्णविवरेण हृताविभक्तास्वात्यज्यया त्रिगुणं साफलहीनयुत्का ॥
कर्णेघिके त्रिभगुणादथ हीनरावं स्पष्टाभवंति तनुविस्तत यो ग्रहाणां ॥ ७ ॥

लिप्तामयान्यथकुजादिकमंडलानि पंचांगंनौलनव सायकसम्मितानि ॥
प्राग्वत्स्फुटानि च विघाय गुणैर्हतानितानि स्युरंगुलमयानि च दूरगत्वात्त् ॥ ८ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथागाराघरथूते प्रभूते सधोगोपंसाधितःस्वेतःस्वेचरां ॥ ॥

इति श्रीसकलसिद्धांतवासनाविचारसारचतुरचित्तचमत्कारिणि-
सिद्धांनसुंदरेग्रहयोगाध्यायः ॥

अथ ग्रहगणिताध्याये पाताधिकारः

चंद्रार्कयोगाजनिते विषुवेति पुण्ये तुल्यांतरे विषुवतो यदि चंद्रसूर्यो ॥
स्यातांतदासमकरोत्ययनं सपातः सूर्यग्रहो पमइति प्रवदंति पूर्वं ॥ १ ॥

ब्रह्म ध्रूवासन्नदिनेर्क चंद्रयोगे भचक्रेमदलेक्रमेण ॥
सवैधृताख्यो व्यतिपातसंज्ञः पातस्तहनाधिकपालिप्ताः ॥ २ ॥

लवैक्यभक्ताः फलमेष्य यातदिनानितैः सूर्यशशांकपातः ॥
तस्तगम्यस्तात्कालिकार्कदुशशांकपातः ॥ ३ ॥

शुशुशून्ये च भार्द्धेचभक्रकालेस्यात्कांतिरप्रभूते ॥
पदेयदेंदुर्विषमेसमेस्याद्द्वियातचंद्रान समभिन्नगोले ॥ ४ ॥

कार्यारवेः क्रांतिरथेंदुबाणस्ततः प्रयोज्या खलु बीजयुक्तिः ॥
यावत्तावन्मितमिह विधोर्मध्यमक्रांतिमानं तस्य
कार्यानिजशरकलाभिस्फुटा क्रांतिरिंदोः ॥
सूर्यकांत्या भवतिहिसमाचेति पक्षौसमानौकृत्वा
लब्धं भवति हिमगोर्मध्यमक्रांतिमानं ॥ ५ ॥

क्रीतेः काष्टैर्धनुरपिततः कारयेद्भूजांशास्त
त्पूर्वेंदुप्रभवभुजयोरंतरं युक्तियुक्तं ॥

प्राग्वल्लब्धै फलमितदिनैर्यातमेष्यैर्विधेयाक्रांतिः
खंडैः खखचरमितैः सिद्धकोष्टेषु संख्यैः ॥
यातैष्याहाः पुनरपितदर्धेन पातेंदुसूर्यैः प्राग्कुर्या
न्मुहुरिति भवेत्क्रांतिसाम्यं सुरम्यम् ॥ ६ ॥

क्रांतिर्विधो स्यादुपचीयमाना सूर्यापमादप्यधिकायतः
सा न्युनाथ वा स्या दपचीयमाना तदापि पातो वीपरित एष्य ॥ ७ ॥

त्रिलिप्ताधिकाः सिंधवः सिंधुराशाविवपादार्ककासां कलिप्तादिनांसाः ॥
सषंगागनागेंदव साद्रिरामानखाड्यश्विभागैर्युताःपिंडलिप्ताः ॥ ८ ॥

सशैलत्रिलिप्तास्त्रिदस्त्राश्च सिद्धा दशांशांतरेपक्तमांशाः प्रदिष्टाः ॥
दिगंशैः कलाशैलवेदाद्विनंदाः शरत्रिंदवस्त्र्यद्रिभूषणखाश्च ॥ ९ ॥

युगाग्न्यश्विस्त्र्यक्षदस्त्राः क्रमेण रसांगाश्विनः पूर्णताराः शरस्य ॥
ग्रहात्सायनांशा न्निजांशापमज्या ज्यकायाश्च बाणो नवत्यंशकोष्टौ ॥ १० ॥

क्रांति साम्यसमयासरपूर्वक्रांतिसाम्यंमपरं तु तदा स्यात् ॥
वृद्दिगः क्षयग इंद्रपमोयं हीनयुग्यदि शरेण तत्समः ॥ ११ ॥

पातमध्यसमयोर्कचंद्रयोर्बिंबकेंद्रं जनितापमौ समौ ॥
बिंबयोगदलतोल्पमंतरं यावदेकविषये पमैक्यता ॥ १२ ॥

मानैक्यखंडकलिकोनितचंद्रमध्यक्रांतेर्विधुः निजचंद्रविवर्जितः सन् ॥
लिप्ताचयांशगतिसंशजित स्थितिस्यान्नाघ्रादिकं ग्रहणावसरपूर्वभागे ॥ १३ ॥

मंदाक्रांति र्निजभुजलवे यत्रभानाः स्फुटेंदोस्तद्विश्लेषः
खरसनिहतश्चंद्र भुक्त्या विभक्तः ॥
एषातीतैः फलमितदिनैश्चालितार्केंदुपातैः क्रांत्योः
साम्यं मुहुरिति भवत्संमतीनां सुगम्यं ॥ १४ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथागाराधारभूते प्रभूते पाताध्यायो युक्तियुक्तोनिरुक्तः ॥ ॥

इति वासनाविचारसारचतुरचिन्तचमत्कारिणि-
सिद्धांतसुंदरेपाताध्यायः ॥

अथ गोलाध्याये भुवनकोषाधिकारः

भाले यस्य कलानिधिर्मधुमिलद्भृङ्गावली गंडयोः
कण्ठेहिर्विलसत्यलं पदयुगे गीर्वाणचेतोगणाः।
व्रह्मापि त्रिजगत्सिसृक्षुरभजन्निर्विघ्नसंसिद्धये
श्रीमन्मङ्गलमूर्तिमाद्यमलयं तंनौमि भक्तप्रियं ॥ १ ॥

यन्नामाक्षररश्मिभिस्तनुगतैः किंचित्कलावान्भवेद्भक्तः
स्वान्तनिशाकरो हततमास्तत्रोच्चरद्भिः क्रमात् ॥
नत्वा तां भुवनेश्वरीमपि गुरून्सिद्धान्तसुदरं
सुज्ञानन्दकरं करोमि चतुरं ज्ञानाधिराजः स्फुटम् ॥ २ ॥

यन्नारदाय गदितं चतुराननेन ज्ञानं
ग्रहर्क्षगतिसंस्थितिरूपमन्यं ॥
शाकल्यसंज्ञमुनिना निखिलं निबद्धं
पद्यैस्तदेव विवृणोमि सवासनं स्वैः ॥ ३ ॥

ब्रह्मार्केन्दुवसिष्ठरोमकपुलस्त्याचार्यगर्गादिभि
स्तंत्राण्यष्टकृतानि तेषू गहनः खेचारिकर्म्मक्रमः ॥
तद्रत्नाकरवासनाम्बुतरणे सिद्धांतपोताः कृताः
श्रीमद्भोजवराह जिष्णुजचतुर्विदार्यसद्भास्करै ॥ ४ ॥

यज्ञादिकर्मार्थमियं प्रवृत्ता वेदत्रयी दिक्समयाश्रितं यत् ॥
तत्साधनायाघमुनिप्रणीतं शास्तंद्दिजैरध्ययनीयमेतत् ॥ ५ ॥

निषिद्धानध्यायाद्यखिलसमये यस्य हि
भवेद्व्रतारंभो नायं द्विज इति जगुः पूर्वमुनयः॥
तथा नाडोकत्वे परिणितवधुः सैव भगिनी
दिशा मूढं कर्मा फलमिति च तिथ्यादिषु विधिं ॥ ६ ॥

वेदाकारसुरेश्वरो विजयते त्रातुं जगत्तस्य
यद्वक्त्रं व्याकरणं निरूक्तमुदितं श्रोत्रं तथा नासिका ॥
शिक्षाज्योतिषमीक्षणं करयुगं कल्पोंघ्रिपद्मद्वयं
छंदश्चेति षडंगवेदपुरूषो ज्ञेयोर्थतः पाठतः ॥ ७ ॥

ज्योतिःशास्त्रं गणितजननप्रक्रियासंहिताभिस्त्रिस्कंधं
तत्खचरगणितं तत्रमुख्यं निरूक्तं ॥

सिद्धांतोसौ ग्रहभवसुधासंस्थितिर्यत्र चाराः
कल्पे मानान्यपि च गणितं प्रोच्यते सोपपत्तिम् ॥
प्रकृतिपुरूषयोगाद्बुद्धितत्वं त्रिसृष्टौ प्रथममभवदेतद्गर्भतोहंकृतिश्च ॥
समभवदथ तस्याः शब्दतन्मात्रमस्माद्गनमथ ततोभूत्स्पर्शतन्मात्रगर्भम् ॥ ९ ॥

वायुर्वायो रूपतन्मात्रमस्मात्तैजस स्तन्मात्रंरस्यात् एव ॥
तोयं तोयाद्गंध तन्मात्रमस्मात्पृथ्वी चैषां संहतेर्जातमेतत् ॥ १० ॥

ब्रह्मांडं तटुदरवर्ति विश्बकर्तु भूर्भुव इति नाभितोस्य लोकः ॥
शीर्ष्णो द्यौर्वदनत इंद्रवह्निसंज्ञौ प्राणोत्थः श्वसन इतीरितं च वेदे ॥ ११ ॥

इंदुरस्य हृदयस्थितोभवद्भास्करो नयनदेशनिवासी ॥
श्रीत्रतोखिलदिशश्च समुत्था सृष्टिमार्ग इति संप्रतिकल्पे ॥ १२ ॥

लीनाः प्राक्यलये पुराणपुरूषे ये वायवः सप्त ते
मध्यप्राणविबोधितास्तु पुरूषान्सप्तासृजंताथ तैः ॥

भूत्वैकत्र महत्प्रमाणपुरूषः सृष्टः सपद्मोद्भवस्तेनेदं
सकलं यथा विरचितं तत्प्रक्रियाथोच्यते ॥ १३ ॥

ब्रह्मादावसृजज्जलं निजगिरस्त्रय्या
सहात्राविशत्श्वांशेनांडमभूदतोग्निरिहयज्जातंकपालद्दयं ॥
तत्संक्लिश्य जले नियोज्य पृथिवी सृष्टाश्रितस्तां
पुनर्वह्न्यंशेन समन्वितोंडमभवद्वायुश्च तद्गर्भतः ॥ १४ ॥

अत्रैवांडकपालतः समभव द्व्योमाथतत्राश्रितः
स्वांशं योज्यसवायुनांडमकरोत्सूर्यो यमस्मादभूत् ॥
द्यौरत्रांडकपालतोथ शकले लिप्ताद्रसाद्रश्मयस्तामाश्रित्य
दिवाकरांशसहितः स्वांशेन चांडं ब्रभौ ॥ १५ ॥

तदंडस्यगर्भात्समभूद्धिमांशुरिहांबु यत्संक्षरितं ततोभूत् ॥
तारागणस्तन्धच्छकलाद्दिशस्तु तल्लिप्तसत्वाद्विदिशस्ततोपि ॥ १६ ॥

सृष्ट्वा लोकान्वाङ्मनोयोगतस्तु मासैरष्टावष्टसंरव्यैर्वसुंश्च ॥
एवं रूद्रान्द्वादशार्कानपीत्थं विश्वेदेवान्विश्वकर्तासृजत्सः ॥ १७ ॥

अदधादनलं वसुश्च भूमौ मरूतं रूद्रगणं नभस्यथोर्कात् ॥
दिवि सूर्यसमन्वितान्विधाता शशिनं देवयुतं दधार दिक्षु ॥ १८ ॥

इति शतपथवेदे षष्टकांडाद्यपाठे पठित इह विशिष्टः सृष्टिमार्गः प्रदिष्टः ॥
उभयविभवयोः स्यादैक्यमीड्यैर्विचारैः
क्वचिदपि यदि भेदः कल्पभेदेन वेद्यः ॥ १९ ॥

कल्पादितो युगमहीधरवेदवर्षैर्दिव्यैः शतेनगुणितैः सुचितं क्रमेण
भूमंडलार्णवमहीधरखेचराद्यं न्यस्तास्ततो भवलये निखिला ग्रहेंद्राः ॥ २० ॥

भूगोलः किल वरतुलो जलधयस्तन्मेखलावस्थिता
यस्मिन्देवनरासुराद्रितरवस्तिर्यक्च पृष्टे तले ॥

यद्वत्केसरधृक्कदंबकुसुमग्रंथिस्तथायं दधत्खे
तिष्टत्यचलोवतारपुरूषैरात्तातिभारः परः ॥ २१ ॥

लंकापुरो परिगतः खचरः सुमेरोर्याम्ये
कुजेथ यमकोटिगतस्य पश्चात् ।
प्राग्रोमके च वाडवानलतस्तु सौम्ये
यस्मात्ततो भवति भूः खलु गोलरूपा ॥ २२ ॥

इति यमवनिकंदुकाकृतित्वे समुदितवान्हिपृथूदकः सुहेतुं ॥
न भवति स यतः प्रमाणसिद्धः खलमतयस्तमतो न मानंयंति ॥ २३ ॥

भूदूरवर्त्यचलकोन्नमना समानतुल्योपलब्धिजनिका प्रतियोजनं भूः ॥
यातुः क्रमेण कथिता ध्रुवसंमुखस्य तिर्यड्मुखस्य च कपित्थनिभातएव ॥ २४ ॥

उत्तानपादतनयाभिमुखं प्रयातुः
स्वार्धान्नतं भवति दक्षिणतो भचक्रम् ॥
सौम्यध्रुवोन्नमनमेकलवाधिकं
स्यादस्येंद्र योजनगतस्य निजप्रदेशात् ॥ २५ ॥

सूर्ये पूर्वकुजाश्रितेतिगतिमान्नांतुं प्रवृत्तः
पुमान्पुर्वाशां करसंगृहीतसिकतायन्त्रोभ्रभू योजनैः ॥
सेष्वंशाद्रि पलाधिकं तु समयं ज्ञात्वा स्वकियोदयाज्ञाता
तेन मही हि कंदुकनिभायाः पंचसाहस्रिका ॥ २६ ॥

सद्भूगोलपदं पुराणपठितं दृष्ट्वा तथा सर्वतो
मेरूः सौम्यदिशीति चाग्रहरता जल्पंति ये मानवाः ॥
भूरादर्शतलोपमेति सकला तेर्थं पुराणोदितं
नो जानंति च सूपपत्तिविदितां सत्कंदुकाकारतां ॥ २७ ॥

मुकुरतलनिभत्वं यत्पुराणप्रदिष्टं
तदवनिशतभागस्यैव नो भूमिगोले ॥
परिधिशतविभागो दंडवद्दृश्यतेतः सम इव मनुजानां भाति गोलो धरित्र्याः ॥ २८ ॥

मूर्ते कुधर्तरिभवेदनवस्थिकातः स्वाभाविको गुण इति स्थिरतास्थिरायां ॥
औष्णयं यथानलगुणो द्रवतोदकस्येत्युक्तं हि भास्करकृतौ तद्वतो न युक्तं ॥ २९ ॥

गोत्राचारधराः पुराणपठिताः शेषादयः संतु तैः
को दोषः खचरोडुपंचरगतौ वेदोदितास्ते यतः ॥
भूमौ चेदचलत्वलक्षणगुणः किं नो तदंशेपुन
स्तोयांशे द्रवता यथानललवे दाहत्वमित्पादिवत् ॥ ३० ॥

धृतवक्रसरीसृपोपि गृध्रः प्रहरं तिष्ठति खेल्पवीर्य एवं ॥
गगने न कथं स कूर्मरूपः प्रतिकल्पं धृतभूरचिंत्यशक्तिः ॥ ३१ ॥

आकृष्टशक्तिश्च महीति न स्याद्यतो घनं शीघ्रमुपैति भूमिम् ॥
आकर्षकं यातिलघुद्रुतं हि मही स्थिराधारमृते कथं स्यात् ॥ ३२ ॥

भूगोलार्धं क्षारसिंधुपरीष्टं मेरूर्देवा यत्र तिष्ठंति नित्यं ॥
नूनं तस्यैवोर्ध्वता यत्र दैत्यास्तस्मिन्प्रोक्ताधः स्थितिः सत्पुराणे ॥ ३३ ॥

इति चेन्न पतंत्यधः स्थिताःकिं गिरयः सिंधुसरिन्नराः ख राते ॥
अधृतं गुरूवस्त्वचेतनं यत्तदधः संपततीति दृश्यतेतः ॥ ३४ ॥

नाशंकनीयमिति वस्तुनि देभेभेदात्सामर्थ्यलक्षणगुणाः कतिचिद्विभिन्नाः ॥
यद्वत्सुशीतलकराश्मशिला द्रवंति सूर्याश्मनिर्मलशिलास्वनलप्रवृत्तिः ॥ ३५ ॥

वज्राणि वारिषु तरंति हि चुंबकाश्मालोहं
समानयति चात्मविदूरवर्ति ॥
उच्चैस्तरं भवति पर्वतवत्समुद्रे नीरं यतो बत वितिचित्रगुणाः प्रदेशाः ॥ ३६ ॥

भाषाकाराचारसामर्थ्यभेदो ह्यत्रैवार्धे देशभेदेन दृष्टः ॥
नृणामेवं किं पुनर्नान्यभागे तस्मात्स्थैर्यं नाम शक्तिश्च तेषां ॥ ३७ ॥

किं नोमुना बहुतरेण मुधोदितेन
गुर्वी स्थिरा वियति येन धृतेयमुर्वी ॥
सर्वं धराधरचरं धरतीति भाति देवोधरायणनिवारणतोवतीर्णः ॥ ३८ ॥

क्षारपयोनिधितः परतोस्ति क्षीरनिधिर्दधि तो धृतसिन्धुः ॥
इक्षुरसार्णवमद्यमयाब्धी तत्परतः सुजलो जलराशिः ॥ ३९ ॥

सुजलजलधीमध्ये वाडवोग्निः स्थितोस्मात्सलिलभरतिमग्नादुत्थिता धूममाला ॥
वियतिपवननीताः सर्वतस्ता द्रवंति द्युमणिकिरणतप्ता विद्युतस्तत्स्फुलिंगाः ॥ ४० ॥

जंबुद्वीपं मेखलावस्थितस्य क्षाराम्भोधेरुत्तरं यतूभुवोर्ध्वं ॥
एवं याम्यार्धे समुद्र द्वयांतः सर्वत्र स्याद्वीपषट्कस्य संस्था ॥ ४१ ॥

शाकं तस्माच्छाल्मलं कौशम स्थात् क्रौंचं गोमेदं तथा पुष्कराख्यं ॥
जंबुद्वीपे मध्यसंस्था प्रदेशा वर्षाख्याः स्युस्तेन वात्र प्रदिष्टाः ॥ ४२ ॥

खवह्निभू योजनविस्तृतेब्धौ लंकापुरं प्राग्यमकोटिरस्मात् ॥
भूतुर्यभागेस्ति ततस्तु सिद्धपुरं ततो रोमकपत्तनं च ॥ ४३ ॥

याम्येन तेभ्यः खलु वाडवाग्निः
सौम्येन मेरुस्त्विव षट्प्रदेशाः
लंकापुरादुत्तरतो हिमाद्रिः स्याद्हेमकूटो निषधस्ततोपि ॥ ४४ ॥

सिद्धाभिधात्पत्तनतस्तथैव सच्छृंगवान् शुक्लगिरिः सुनीलः ॥
दैर्ध्येणपूर्वापरसिंधुलग्नास्तदंतरे वर्षनिवेश एवं ॥ ४५ ॥

लंकाहिमाद्यंतरदेशवरर्त्ति स्याद्भारतं किंनरवर्षमस्मात् ॥
आहेमकुटं निषधावधीत्थं बुधैः प्रदिष्टं हरिवर्षसंज्ञं ॥ ४६ ॥

सिद्धपुराच्चरतोपि तथैव स्तः कुरूवर्षहिरण्मयवर्षे ॥
रम्यकवर्षमतश्च षडेवं त्रीण्यपराण्यथा तानि च वक्ष्ये ॥ ४७ ॥

माल्यवन्नग उदग्यमकोटे र्गंधमादनगिरिस्तुरोमकात् ॥
नीलसन्निषधशैलसंगतावंतरं गिरिचतुष्टयस्ययत् ॥ ४८ ॥

इलावृतं वर्षमितीरितं तत्सद्रत्नचामीकरचारूभूमि ॥
मध्येस्य मेरूः कमलानुकारो विष्कंभशैलैः परितोवृतोस्ति ॥ ४९ ॥

रत्नकांचनमयासुरालयो भिन्नभूमिरुभयत्र निर्गतः ॥
मस्तके दिवि षदोस्य रमंते तत्तलेसुरकुलं निराकुलं ॥ ५० ॥

चंचत्सुवर्णमणिपूर्णमनेकवर्णं सानुत्रयं सुरगिरौ त्रिपुरं च तेषु ॥
नित्यं रमेशपरमेशसुवर्णगर्भास्तेषामधोष्टसुरदिक्पतिपन्तनानि ॥ ५१ ॥

यन्माल्यगिर्य्यवधिसद्यमकोटिपुर्या भद्राश्ववर्षमिति रोमकपत्तनाच्च ॥
आगंधमादननगं किल केतुमालं वर्षं नवेति कथितानी पुराणविद्भि ॥ ५२ ॥

मंदराचलसुगंधयर्वतौ पूर्वदक्षिणविभागयोः स्थितौ ॥
यौ सुपार्श्वविपुलाचलौ तु तावुत्तरापरदिशोः सुरालयात् ॥ ५३ ॥

सत्केतवो गिरिशिरस्सु कदंबवृक्षो जंबुसुपिप्पलवटौ च यथाक्रमेण ॥
वैभ्राजकं धृतिवनं त्वथ नदनं च वेद्यानिचैत्ररथमुत्क्रमतो वनानि ॥ ५४ ॥

गिरिवनेषु सरांस्यरूणाभिधं तदनुमानसनाममहाह्रदं ॥
सितजलाह्वयमंबुजमंगलं सजलकेलिमरालकुलाचलां ॥ ५५ ॥

चलदलिकुलवन्सुनीलनेत्राः सुकनकपंकजकांन्तवृत्तव क्त्राः ॥
मदनसदनकाननेषु रामाः सरसि वसंत्यमरैः सहातिरम्याः ॥ ५६ ॥

तज्जंबुफलविगलज्जलप्रवाहाजंबूनद्यभवदियं मृदायुता सा ॥
स्याज्जंबु नदमिति यत्सुवर्णसंज्ञं द्वीपोयं निगदितवृक्षरम्यनामा ॥ ५७ ॥

खंडान्यथैद्रं च कशेरूताम्रपर्णे गभस्त्याख्यकुमारिकाख्ये ॥
सौम्यं च नागाभिधवारूणे च गान्धर्वसंज्ञं त्विति भारतांतः ॥ ५८ ॥

माहेंद्राह्वायशुक्तिसंज्ञमलयास्ते भारते पर्वताः
प्रोक्ता ऋक्षकपारियात्रकगिरी सह्यश्च विंध्यस्ततः ॥
उद्दिष्टं क्षितिपृष्टनिष्ठमखिलं खंड प्रचंडाचलग्रामारामसरः पुरस्सरमतः पातालतः कथ्यते ॥ ५९ ॥

मंदाकिनी गगनतः पतिता सुमेरौ विष्कंभशैलशिखरस्थसरः समेता ॥
भद्राश्वकेतुकुरूभारतवर्षयाता कैवल्यदा कलियुगेपि निमज्जतां सा ॥ ६० ॥

भूसंपुदे सप्त पुटानि गर्भे तानिह पातालसमा ह्वयानि ॥
एतेषु नागेंद्रफणामणिनां प्रकाशतः पश्यति नागलोकः ॥ ६१ ॥

अतलं वितलं तलं निपूर्वं तदधोन्यच्च गभस्तिमन्निरूक्तं ॥
अपरेपि महासुपूर्वके ते किल पातालतलं तु सप्तमं यत् ॥ ६२ ॥

पातालेश्वसितारूणनिभा पीताधरा शर्करा
शैलाभा कनकोत्तमाधरतले पृथ्वीधरोयं फणी ॥ ॥
पादांक्रांतमहीतले हि कमठेतिष्टंकदाचिद्धरा
भारानम्रशिरास्तदा कुचलनं स्यात्संहितासंमतं ॥ ६३ ॥

भूमेद्वादशयोजनेषु वसते भूवायुरत्रांबुदास्तस्मादावह
संज्ञकः प्रवह इत्यस्मात्स पश्चाद्गतिः ॥
तस्मादुद्वहसंवहौपरिपरापूर्वावहौतत्परावेतेषु
प्रवहानिलेनपवतेतारागणःसग्रहः ॥ ६४ ॥

वियतिमेरूशिरस्तलयोध्रुवौ भवलयं भ्रमंतिध्रुवमध्यगं ॥
खगतचुंबकनामदृषद्वयांतरगतायसवन्न पतत्यधः ॥ ६५ ॥

भूगर्भतो रसरसेषु महीषु संख्यौः शीतांशुमंडलमलं जलगोलरूपं ॥
दंताभ्रषण्नृपमितैः शाशिजं कविं तु तेजोमयं गजगजांबर सिद्धवेदैः ॥ ६६ ॥

उष्णद्युतिं नगानगानलनंदनागतकैंः कुजंनवकुषट्रसरंध्रसूर्यैः॥
जीवं गजत्रिशरऋत्वगभूमिनागैः मंदं धराद्रिनवतींदुगुणाभ्ननेत्रैः॥ ६७ ॥

वसुशररसनेत्रांगाग्निभूवेदसंख्यैर्वियति सकलदूरेमंडलं तारकाणां ॥
सममुडुभिरदृश्यैरंकितं दस्त्रभाद्यै ध्रुवयुगपरिवद्धं धारयाप्तास वेधाः ॥ ६८ ॥

अत्रभास्करपृथुदकमुख्यै र्वासनानकथिता निजतंत्रे ॥
तांविरोधिमतदुषणदक्षां वच्चिसन्मतिमतामपिरम्यां ॥ ६९ ॥

स्वक्ष्माजेंदु समुद्गमास्तमययोः कालांतरं
यद्भेवेत्तत्स्वीयं दिनमानमंवुघटिका यंत्रेण संसाधितं ॥
यत्त्वत्रैव दिने निशाकरचरात्तिप्रश्नमार्गेण तत
भूगर्भस्थनरद्युमानमनयोर्नाड्यंतरेणैति चेत् ॥ ७० ॥

इंदुद्विसंगुणमहीदलयोजनानि स्वीयद्युरात्रघटिकाभिरयं तदा किं ॥
त्रैराशिकेन विधुयोजनकक्षिकेति वा सूर्यपर्वत इयं परिसाधनीया ॥ ७१ ॥

चेत्स्पष्टगत्या विधुकक्षिकेयं तन्मध्यगत्या किमितीहमघ्या ॥
तच्चंद्रचक्राभिहतिः खकक्षा सा खेटचक्तैर्विहृता स्वकक्षा ॥ ७२ ॥

त्रिज्यागुणा भगणभागकलाविभक्ताः
कक्षाः स्वयोजनमयाः श्रवणाः भवन्ति ॥
व्यासः पदं परिधिवर्गदशहृतेः स्यात्स्थूलः
स्फुटस्त्रिभगुणो द्विगुणो भवृत्ते ॥ ७३ ॥

पूर्णपूर्णखुगांगमंगलाशीतिविंशतिधरागवस्विलाः॥
खेटयोजनगतिर्युगेखिलागोक्षखाक्ष वलया भवेदिला ॥ ७४ ॥

इति सद्वासनाज्ञातयोजनश्रुतयः स्मृताः
घरापरिधिमानं च वासनागमसम्मतं ॥ ७५ ॥

पौराणिकैः समुदिता पृथवीग्रहर्क्षसंस्थानमानगतयः परमार्थतस्ताः ॥
कल्पांतरे तु किल संप्रति कालबोधशास्त्रोदिताः सुमतिभिः परिवेदितव्याः ॥ ७६ ॥

एवं विराटपुरुषस्य वपुः सभेदंयो वेद विश्वमयमाद्यमुनिप्रणितं ॥
सायुज्यतां भगवतो लभते नितांतं श्रीवादरायणमुनेरिति वाक्यतोर्थः ॥ ७७ ॥

यत्पिंडीवलयं स सागरधरा मेरूःशलाका परा
कूर्मो मूलधरांबरालयचराः स्नानाय धाराधराः ॥
पूजापुष्पफलानि मेंदुखचरा नीराजने भास्करो
ज्योतिर्लिंगमनेन पूजितमिति स्वांतेस्तु मे सर्वदा ॥ ७८ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
संथागाराधाकभूतेप्रतेगोलाध्यायेलोकसंस्बनिरूक्ता ॥
इति श्रीमन्सकलसिद्दांतेवासनाविचारचतुरचिन्तचमत्कारिणि सन्तंत्राधारे

सिद्दांतसुंदरेगोलाध्यायेभुवकोषस्थंकथनंनामप्रथमाधिकारः ॥

अथ गोलाध्याये मध्यगतिहेतुः

धात्रा सिद्धपुरस्थितेन मधुमाः शुष्कादिमध्यंदिनेसूर्ये
दलिप्रवहानिले भवलय प्रत्यक्भ्रमे योजितं ॥
मेषादिस्बितखेचरैः सह ततो वर्षादिचाराः समं प्रारब्धा
खगभुक्तयश्चसकलाः कल्पादितो नैव ताः ॥ १ ॥

इंद्रलसातौसमवस्थितस्य नित्यत्रिमूर्तपरमेश्बरस्य ॥
वायौ नियाम्यात्मपूर्वषि कुर्युः प्रदक्षिणाः सूर्यमुखाः सतारः ॥ २ ॥

चेदित्यहो किं क्रियतेन्टपिंडात्तद्राशिगैस्तै रीतिमाविचित्यं ॥
जंतुन्हितायोपदिशंति नित्यं भवत्यवश्यंकृतकर्मपाकः ॥ ३ ॥

छायावद्धनमायया जगदिदं छन्नं यदतस्थितं ज्योर्तिगोल विशालसत्फलतरुं प्रारूह्य मूलध्रुवं ॥
श्रीहंसादिखगाः समीरणचलन्नक्षत्रशाखाचराजंतुनांशाद्सत्फलानि नियतं यछंति तद्भाग्यतः ॥ ४ ॥

खमध्यतः सिद्धपुर स्थि तानांगंतु प्रवृत्ता निजपूर्वगत्या ॥
खगाः स्वतुंगापमवातपातैरानीयमानाप्नितेस्वशक्त्या ॥ ५ ॥

पूर्वपरायानिजशक्तिवातैः पातापमेरून्तरयाम्य भुक्तिः ॥
निचोच्च भुक्ति निजनीचतुगांत्पोटाग्रहाणां दृक्गतिर्निरूक्ता ॥ ६ ॥

कुंभकारवरचक्रनेमिगः किटको भ्रमविलोमगो यथा ।
शीघ्रचक्रगतिवद्विभात्यसौ तद्वदेवखचरोभचक्रगः ॥ ७ ॥

चक्रंकालकुललकस्य किमिदं प्रत्यग्शमेश्यते तज्जाता घटिका भवंति सदसत्पाकप्रदाः प्राणिनां ॥
अक्षोयं ध्रुवरावतत्रपरितः ताराश्च धाराधराः खेटाः कीटकचक्रवत् भ्रमंति परिधौत च्चक्रचक्र भूमाः ॥ ८ ॥

केचित्काचसमाछभूतलचलत्गोलात्समंतादभुवश्चंद्रज्ञास्फुजिदर्कभौमविबुधाचार्यार् किभानांजगुः ॥
तत्पक्षे प्रतिमंडल स्बितिवशान्नीचोच्चपातादिकं योज्यं तत्भ्रमण ध्रुवेणमतं नः कल्पनागौरवात् ॥ ९ ॥

भवलये प्रबहानि लवेगतो भ्रमति स्टक्कचरे परदिडमुखं ॥
द्रुतमपूर्वगतीतमुखाग्रहागुरूतयांतरिताः किल पूर्बतः ॥ १० ॥

इति न चिंत्यमुदग्मदिग्गतिर्द्रुतविलंवितवक्रंगतिर्ग्रहः ॥
भवतिभं विहस्य यतस्ततो व्रजति पूर्वदिशं निजशक्तितः ॥ ११ ॥

तुगंकार्मुकमौर्विकेरितशरोगत्वा निवृत्तो
यथावस्थानादपरत्रवायुयुवशतोगछत्य वेगस्तथा ॥
कक्षावृत्तधनुर्गुणेरिति खगस्तद्दच्चलोच्चंगतोनीचंयाति
यदा तदा परगति र्वक्रीसरावोच्यते ॥ १२ ॥

कक्षापदच्युतखगाइवनीच
संगात्पूर्वात्ममार्गमपहाय चरंति वक्रं ॥
चेदित्यहोरात्रपृथुबिंबविलोकनं किं
सर्वोपि रूपमखिलं विपदस्य पश्येत् ॥ १३ ॥

तनुर्धचरो भूवमडच्चगाः क्षितिसमीपगतः पृथुबिंबकः ॥
रविसमिपसुहृरगतो यथा भबति नीचनिजोच्चसमीरितः ॥ १४ ॥

येनाकृष्टः स्वीयकक्षां विहाय भूमे दुरं याति खेटस्तदुच्चं ॥
तन्नीचं येनैष आकृष्ट एवं भूम्यासन्नो जायते दृश्यरूपं ॥ १५ ॥

कदंभिमुखं येन विक्षिप्तो यातिखेचरः॥
सपातोदृश्यरूपस्तुपश्चाद्गतिरयंसदा ॥ १६ ॥

युगपत्रिमहरिद्तिर्गहः प्रवहणाप्यपरत्र गछति ॥
इति तस्य समुद्गमास्तकौ भव तौ भूमिवशादहर्निशं ॥ १७ ॥

मेरूवशादुदयास्तमयौस्तः खेचरतामिति यत्तुपुराणे ॥
सत्यमिदं च विभानियतोयं मेरूगिरिः क्षितिर्मध्यगतोस्ति ॥ १८ ॥

सुत्रप्रोतामलकवदिला गोलको मेरूमध्ये तिष्टतस्योपरि दिवि खगाः सव्यगत्यासुराणां ॥

गच्छंति मे नियतमुदयास्तौ सुव र्णाद्रिनीतौकुर्वंतीवावनिवलयतो वेति लोकप्रतीतः ॥ १९ ॥

उदयादुदयावधि यत्तु रवेरविसावननामदुनंकुदिनं ॥
इति मोदयतो भदिनं च भवेद्दिनषष्टिलवो घटिका कथिता ॥ २० ॥

खचरराश्युदयाद्गतिसंगुणात्खखगजेंदूहृताप्तामितासुभिः ॥
उडुतदनादधिकग्रहसावनं भवति खेचरपूर्वगतेर्वशात् ॥ २१ ॥

सौरवर्षं भवति सवितुः सर्वराशिप्रभो गो दिव्यं तत्स्याद्युर्निशमतयोरंतरालंतुपित्र्यं ॥
ब्राह्मंकल्पहयमथ खेर्द्दर्शने सत्यहः स्याद्रात्रिस्त्वन्याद्युनिशमतयोमनियोगः प्रदिष्टं ॥ २२ ॥

निरक्षदेशे सममडलं य त्तन्मेरूगणां क्षितिजं निरूक्तं ॥
तदुत्तरेजादिलषड्कगेर्के तेषां दिनंरात्रिरथोपरत्र ॥ २३ ॥

कर्कादिगेर्कंदुद नक्रादिगेर्केसुधियाविचित्यं ॥
मृगादितो हरिष्ययति त्पुराणे तेषां मतेरात्रि दलाद्दिनादि ॥ २४ ॥

भवेत्पितृणां शशिपृष्टगानाममाविरामेद्यदलं निशार्द्द ॥
सात्यौर्निमातेर्कसमुद्रतास्तौ पक्षार्द्दयोः कृष्नसितारव्ययोस्तः ॥ २५ ॥

ब्रह्माबुधो ब्रध्नबिंबादि सर्वमाकल्पांतंवीक्ष निद्रां करोति ॥
तस्मित्सुप्ते लीयते तत्समस्तं तस्मात्कल्पो लघुरात्रप्रदिष्टं ॥ २६ ॥

मासः खरामैर्धुनिशैः स्वकीयैः सौरोर्कसंक्रांतिदिनैः समानः ॥
चांद्रः पितृणां धुनिशं तथैव वर्षे भवे द्वादशमासतुल्यं ॥ २७ ॥

दिनसमाननिशासमये जगल्लयमयत्यखिलं किलवेधसः ॥
दिमगते नगतो गतिसाधनं समुदितं रचितं द्युसदिं बुधैः ॥ २८ ॥

द्युचर पूर्वगतिर्द्विविधा स्फुटा स्फुटतयापि च सा त्रिविधा स्फुटा ॥
द्रुतविलंबितवक्रविभेदतो दिविसदः प्रतिमंडलवासितः ॥ २९ ॥

पतनतुंगसमीरणकर्षणैः स्फुटगतिर्नसमानुदिनं यतः ॥
दिनगणादनुपातविधौ ततो द्युचरमध्यगतिः परिकल्पिता ॥ ३० ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथागारागारभूतेगोलाध्यायेभुक्तिहेतुझसमानः ॥

इति श्रीमत्सकलसिद्दांतवासनाविचारवतुरचितचमत्कारिणिसर्वतंवाधारे सिद्दांतसुंदरेगोलाध्यायेगतिनिरूपणंनामद्वितीयाधिकारः ।
॥ छ ॥

अथ गोलाध्याये छेदकाधिकारः

सुराधाराधाराधरतलधरं धारयति च
भ्रमन्ताराचिकेमरूतिचराश्चरयति यः ॥
स्वलीलासंजाताखिलजनहितार्थं स भगवान्
हरिर्विश्वाधारो वरमभिमतं पूरयतु वः ॥ १ ॥

कक्षावृत्तं क्रांतिवृत्तानुकारं पृथ्वीगर्भाघो जनारव्य श्रवोयं॥
यस्मिन्वृत्ते पर्ययान्पुरयंति कल्पोक्तान्खेचरा मध्यगत्या ॥ २ ॥

कक्षाया उपरिस्बितं परफलोज्यायोजनैः
सर्वतस्तु गभिधमंडलंतु तदस्तै रेव नीचाभिधं ॥
मांदैर्मंदमथाश्रुभिश्चलथो मध्यग्रहान्मंदजैस्तैर्वृत्तं
परितस्तदेवमुदितं मंदोच्चनीचाह्वयं ॥ ३ ॥

त्रिज्यया खचरो जनकर्णाः किंतदापरफलज्ययेति यत् ॥
लभ्यते परफलो च मौर्विकायोजनानिमदृशीप्रभेदतः ॥ ४ ॥

मंदस्फष्टो मंदनीचादधस्बादुच्चैः स्वोच्चन्नैवगच्छेत्कदापि ।।
एवं स्पष्टशीघ्रनीचोच्चतोयं मध्यकक्षामंडलं नो जहाति ।। ५ ।।

निजपरफलमॊवीयोजनोनैः स्वकर्णौ
ग्रहमृदुचलनीचे तैर्युतैःरव्योच्चवृ त्ते ।।
खगमृदुचलनीचोच्चनिजात्मीयवृते
निजमृदुचलगत्या पूर्वतोयां नित्यं ।। ६ ।।

उच्चोन्मुखैरंत्फलज्यकोथैर्यद्योजनैस्तिष्टतिभूमिमध्यात ।।
केंद्रंततोयोजनकर्णज्यातं कक्षानुकारं प्रतिमंडलं तत् ।। ७ ।।

मंदोच्चमंद प्रतिवृत्तयोगात्मंदोच्चभागैःप्रतिमंडलेपि ।।
वामं क्रियादिर्भवतीति तस्मात्मध्यग्रहांशैरनुलोमगत्या ।। ८ ।।

मंदस्फुटस्तक्षितिगर्भमध्यसूत्रं समंदश्रवणोथ तेन सूत्रेण
कक्षाकिल यत्र मुक्ता तत्रापि मंदस्फट खेटचिह्नं ।। ९ ।।

तन्मध्ययोरंतरमेवमांदंफलं भवेतद्गुणितेन साध्यं ।।
मदोच्चमध्यांतरमत्रकेंद्रंमध्यो हि नीचोच्चगवृत्तकेंद्रं ।। १० ।।

अथोच्चचिह्नं प्रतिभूमिगर्भात् सूत्रं गतं तत्खलुतुंगसूत्रं ।।
तथैव कक्षाप्रतिवृत्तकेंद्रस्यृकसूत्रयुग्मंपरिकल्पतिर्यक् ।। ११ ।।

सर्वत्रतत्सूत्रयुगांतराले तुल्या यथैवांत्यफल स्यजीवाः ।।
खगोग्च्च सूत्रांतरगाभुजगा भुजज्याकोटिज्यकावा प्रतिवृत्तसूत्रं ।। १२ ।।

उपर्यधस्थातफलज्यकायाः कोटिज्यका स्यान्मृगक्वकीकेंद्रे ।।
अतस्तदेव्यांतरमत्र कोर्दोज्याभुजोतः श्रवणः फलंच ।। १३ ।।

मंदोच्चात्पुरतः प्रयाति खचरः स्वीयाशुभुक्या यतो
मंदोच्चेन विवर्जितो निगदितं केंद्रं ग्रहोच्चांतरं ।। १४ ।।

कक्षास्यमंदफलसिद्धखगान्समताद्ययोजनैः परमशीघ्रफलज्यकोत्थै ॥
शीघ्रश्च तीचवलयं मृदुवत्प्रकल्यं चक्रांशलांकितमिहावनिदूरदेशे ॥ १५ ॥

उच्चं ततो भदलभागमितांतरेण नीचं च तिर्यगिहमध्यगतंसूत्रं ॥
वामक्रियादिरपि तुंगलवैस्तदुच्चान्मेषादितो दिविचरः क्रमतोत्र कल्प्यः ॥ १६ ॥

केंद्रे नक्त्राद्ये त्रिभज्यो षरिष्टं कीटाद्येधः कोटिसंज्ञंफलंस्यात् ॥
तस्मात्द्योगातरं कोटिसंज्ञं बाहुस्तस्मिन्दोफलं शीघ्रकर्णः ॥ १७ ॥

कर्णाग्रे यदि दोःफलं भुजमितिस्तत्रिज्यकाग्रे
धनुस्तदाशुजफलं कर्णातु मंदस्फुटे ॥
अग्रे पृष्टगते मृदुस्फुटखगान्सत्यष्टग्रहे केंद्रतस्तज्ञेयं
गतिवासनामथ वदामिनादिखेचारिणां ॥ १८ ॥

यः श्वरत नाद्यतन खेचरयो र्विशेषः
सैवोदिता ग्रहगतिर्मृदुशीघ्रभिन्ना ॥
तत्साध्यनाय खगेंद्रगतिः स्फुटाद्यै
स्त्रैराशिकै रिह कृता गतिहारगुण्यैः ॥
कक्षावृत्ते यत्र चंद्रोरविर्वा भौमादिनां शीघ्रनीचोच्चामध्यं ॥
तत्सेनायंज्यांतरेणानुपातो यद्येप्तत्स्यातत्वदग्निः कलाभिः ॥ २० ॥

तत्किलभ्यंकेंद्रगत्याथ चैतद्भांशैस्तक्तिंमंदनीचोच्चवृत्ते ॥
सम्यग्मंदफलस्फुटं चलयुगलंयत्स्याध्यते तत्स्फुटं
न ज्ञेयः प्रथमं मृदुस्फुट तनोमध्यग्रहात्केवलात् ॥
तस्मादाशुफलार्द्दमंडजफलाभ्यां
सच्छतान्मध्यमात्कार्यमंदफलं तदेवसकलं दत्वा चलंसाधवेत् ॥
इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथागारागारभूतेगोलाध्यायेछेदकसमानः ॥

इति श्रीसुंदरसिद्दांतेछेदकाधिकारस्तृतीयः ॥

अथ गोलाध्याये मंडलवर्णनम्

पूर्वापरंनिजशिरः परिगं समारव्यंयाम्योन्तराह्ययमदिग्गतंच ॥
तद्योगतोनवतिभागमितांतरेणमध्ये कुजाहयमितोदरसंस्थितानां ॥ १ ॥

निजकुजंतएव समंततः कुदलयोजनमानसमुन्नतं ॥
अरूर्णवर्णदिवाकरमंडलं जलसमे वलयेत्र विलोक्यते ॥ २ ॥

अक्षांशकेदक्षिणतः खमध्यात्पातालतश्चोत्तरागतंच ॥
पूर्वापरस्वस्तिकयोर्निबद्धं तन्नाडिकामंडलसंज्ञकं स्यात ॥ ३ ॥

प्रा क्पश्चिमस्वस्तिकलग्ननेमिध्रुवद्वयस्पृग्वलयंभवेघत् ॥
लंकापुरे क्षितिजं निरूक्तमन्यत्र चोन्मंडलमेव तत्स्यात् ॥ ४ ॥

राशीमंडलवृत्ते खलु तेन संस्थितिर्निजपुरे दिवि येन ॥
दृश्यभानि सकलानि पथेन एष लंघयति पूर्वजवेन ॥ ५ ॥

नाडीवृत्तात्सौम्यतः सिद्द भागैः कर्क्यादिस्तैर्याम्यतो नक्रभादि ॥
क्रांतोपातेनाधुनाहीनएवंतत्संलग्नौ मीनकन्या विरामौ ॥ ६ ॥

अन्येतस्मिन् राशयः स्वापमांशै र्नाडीवृत्ता धाम्यसौम्या क्रमेण ॥
गछंतस्ते वायुना सापवृत्ता स्वीयां सीमां सर्वदानत्यजंति ॥ ७ ॥

पाते पाताद्राशिषट्के विलग्ने तारावृत्ते खेटविक्षेपवृत्ते॥
संपाताभ्यां भत्रये वृत्तनेश्योरंतर्वती स्वांतबांणः सदैव ॥ ८ ॥

पातस्बिते दिविचरे नशरः स्वपाताद्राशित्रयांतरागते परमः परः स्यात् ॥
मध्येनुपात इति पातविहीनखेटबाहुज्ययैव शरसाधनमुक्तमाद्यैः ॥ ९ ॥

क्रांतिमंडलगतं ग्रहचिन्हं यैर्लवैर्बिषुवतोक्षसन्मुखैः ॥
ते भवंत्यपरभागकाः शरस्त तरं द्युचरबिंबचिह्नयः ॥ १० ॥

ध्रुवयोरूदिते महर्षिभिर्विषुवन्मंडलदक्षिणोत्तरे ॥
अपमंडलंदक्षिणोत्तरे ध्कवतः सिद्धलवांतरस्थिते ॥ ११ ॥

उहुमंडलचंचलत्वतश्चलति यं ध्रुवतः समंततः ॥
इयमेव कदंबसंज्ञकावलयनंत त्क्षितिजांतरेयनं ॥ १२ ॥

ध्रुवज्यावृत्तं स्वस्फुटापक्रमांशैनाडीवृत्तान्सौम्ययाम्येसमंतात् ॥
ज्ञेयं स्वाहोरात्रवृत्तं तदेव व्यासार्थध्रुवज्यकायाः प्रमाणं ॥ १३ ॥

दिग्मंडलं द्युचरमंडल लग्ने नेमिद्रष्टुः शिरःपरिगतं क्षितिगर्भगर्भं ॥
दृक्षेप वृत्त मिदमेव यदि त्रिभोनलग्ने विलग्नमिति नत्यवलंबनार्थं ॥ १४ ॥

क्रांतिमंडलविमडले चले दृष्टिमंडलमपि चंचलं ॥
यत्कदंवयुगलस्थ कीलकप्रोतमेति खगवेधमंडलं ॥ १५ ॥

निश्चलं हि सममंडलद्वयं सोम्ययाम्यवलयं कुजत्रयं ॥
ध्रुवज्यकावलयमेव चंचलं गोलयंत्र मितिवृत्त निर्मितं ॥ १६ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथगाराधारभुतेप्रभूतेगोलाध्ययेवर्णनंमंडलानां ॥
इति श्रीत्सकलसिद्दांतेवासनाविचारचतुरचिन्तचम्त्कारिणिसन्तंत्राधारे
सिद्दांतसुंदरेगोलाध्यायेमन्डलवर्णनम्॥

अथ गोलाध्याये यन्त्रमाला

भामद्वयजनसंनिर्भं चतुरचक्रयंतं परस्वनेमि
नलिकानिवद्दमजिनादिभिः साधयेत् ॥
सरंध्रनलिकांतरेण तपने समालोकिते
स्वकेंद्रगतलंबतोनतलवैर्द्युपातादिदिकं ॥ १ ॥

यत्रंतत्रैः स्याच्चमत्कार सारंयस्मातत स्मादत्र यंत्राणिवक्ष्ये ॥
चक्रं तुर्य संभ्रमगोलयंत्रंस्तभौमापुरं घटीसैर्कताख्यं ॥ २ ॥

कार्यतुर्यं चक्रतुयंशिरूपं धार्य तस्मिन्कर्णयुग्मं सरंध्नं ॥
केंद्रं रंध्रे तत्रपटिसलंबानेम्यां रम्याः खांकभागानियम्या ॥ ३ ॥

कर्णाधस्तादालवालंबमानास्त्रिंश ज्जीवास्तत्रतुल्यांतरालाः ॥
षडभागैं र्नाडीकैः कांलनीयापट्टी चेयंज्यांतरालांगुलांका ॥ ४ ॥

केंद्राधस्तादंबरं कल्पनीयं तस्मान्तिर्यक व्यासखंडेन भुजं ॥
पृष्टयंत्रस्योदयाराशिभागलिप्ताः प्रत्यंशपलाद्यंकनीयं ॥ ५ ॥

सिद्धांशज्यापट्टिकायां प्रदेया
केंद्रात्यदिदोर्लवाग्नेनिधेया अर्हज्जीवास्तज्ज्यकाग्रे
तदीया क्रांत्यंशः स्यु र्दोर्लवास्ते यदीया ॥ ६ ॥

सपातेदुदोरंशगायां तु पदद्यां विवस्वंसत्साद्धांगुलेकेंद्रतोक्ते ॥
तदग्रज्यकाग्रेशरांशनखघ्नानवेंदूनकाश्चेदाचंद्रपर्व ॥ ७ ॥

अमांते अर्कमध्यान्हलग्नांतरांशस्थिता पट्टिकाक्रांतिचिफेनसंक्ता ॥
तदग्रज्यकाग्रेघटिलंबनंस्यात्नतांशाः स्वलग्ने नतिस्तज्यकार्धं ॥ ८ ॥

मध्यांन्हेपमनतभागसंस्कृतिर्या व्यस्तासापललवसंमितिस्तदग्रे ॥
पट्टीस्पृग्वसुराशिसंमितिज्यकायाआमुलं निजविषये पलप्रभा स्यात् ॥ ९ ॥

अक्षाभानिजनिजखरसांशयुक्प्रदेया प्राकयद्यां रविभुजभागसंगतायां ॥
तचिह्नस्थितरिजुमौर्विकाग्रतः स्पादाकाशाबधिचरनाडिकाप्रमाणं ॥ १० ॥

ज्ञेया सा चरदलमौर्विकोक्तपद्यामाकाशादयमलवाग्र संस्थितायां ॥
तत्स्पृग्ज्यावनिविवरेवनिज्यका स्यात्केंद्रात्स्चापमगणनाज्यकाद्युजीवा ॥ ११ ॥

केंद्रोर्द्वकर्णविवरे तरणिर्यथास्याद्व्यासार्धकर्णविवरेनिजदृष्टिरेवं ॥
धृत्वा विलोक्य तपनं द्युचरं च तारां लंवाग्रोक्तपरिधौकुजतोनतांशाः ॥ १२ ॥

मध्यान्नतांशगतपट्टिकयानतज्यास्पष्टा तदंकमितमौर्विकया धनुर्यत् ॥
खांकच्युतं रसहतं घटिका भवंति लंकापुरे निजपुरे द्युदलानुपातात् ॥ १३ ॥

केंद्रोर्धकर्णपरिकल्पशंकुनस्य प्रभा कर्णयुगांतरेस्यात् ॥
सप्तांगुलस्यार्कमितांगुलस्य लंबेबरस्थे रविसन्मुखस्य ॥ १४ ॥

द्विघ्नाः स्वोदयनाडिकाप्रतिलंबराशौपलाद्यं ततो लग्नं
सायतभान्वभीष्टघटिकामध्यभवेत्सायनं ॥
अह्नोर्धगतनाडिकानतमघोरा अर्धनश्चोन्नता ये
लंकोदयतो नतोन्नतघटिलग्ने खपातालयोः ॥ १५ ॥

वृक्षाग्र वेधे धृतिसंमिता ज्यालंबेनयत्रांगुलचिह्नशक्ता ॥
भुयो विरूपांगुलचिन्हयुक्ता तत्पूर्वंभूम्यंतरमर्कनिघ्नं ॥ १६ ॥

दृगौच्ययुक्तं किल वृक्षमानं भवेत्तथावृत्तगजांश संस्थे ॥
लंबेस्ववृक्षांतरभूप्रमाणं दृगौच्ययुक्तं च तदौच्यमुक्तं ॥ १७ ॥

खगमृदुचलकेंद्रमत्रदत्वानिगदितपुष्करतस्तदग्रपद्यां ॥
चलमृदुपरिधिद्विचंद्रभागं स्पृशातिगुणः फलमेतदग्रतः स्यात् ॥ १८ ॥

चक्रंतुर्ययंत्रं ॥

चक्रं चक्रलवांकितं च परिधौ सछंखलाधार
कंरेखातिर्यगधोर्ध्वगात्र च युतौकीलेशलाकां न्यसेत् ॥
तुर्याशेन विधाय तुर्यरचनां सूर्योन्मुखेस्मिन्धृते
छायाकीलभवा प्रयाति परिधिंतत्रोन्नतांशाः क्रमात् ॥ १९ ॥

तज्ज्यापूर्णगुणाहता दिनदलादित्योन्नतांशज्यका
भक्तातद्धनुषा हतं दिनदलं खांकोद्दतं नाडिकाः ॥
चक्रं नेमिनलं भ्रमध्यजनवक्त्रेंद्रावलंबान्वितं
कृत्वार्कनलतोविलोक्यसमयं पूर्वोक्तवत्साधयेत् ॥ २० ॥

दिक्साधनार्थं समभूमिभागे निधाय यंत्रं निजकीलभाग्रात् ॥
विलोमतो बाहुरतश्चकोटिर्नमूलगा सा परपूर्वरेखा ॥ २१ ॥

याम्योदक् परपूर्वसूत्र ज युतौ शंकुंनि
धायात्र या छायाग्रापरपूर्वसूत्रविवरंबाहुः श्रुतिः सैव भा ॥
तत्कोटिः परपूर्वगार्थखचरा याम्योन्तरं मंडलं यैरंशैः
सममंडलं च भवतस्तज्यत्रदो कोटिवत् ॥ २२ ॥

छायाकर्णगुणा स्वलंबगुणहृक्रांतिज्यका
गोलयोर्याम्योदक्किल सौम्ययापलभवासंस्कारिता स्यात्भुजः
छायादोः कृतयो वर्गयोश्चविवरान्मुलं हि कोटिर्भवेद्विदोः
प्रागपरस्थिते दिविचरे प्रत्यङ्मुखी पूर्वगे ॥ २३ ॥

कोट्यग्रादपि दोः प्रभाग्रमिलितो यस्मिंस्ततो भुतलाद्वि
दुस्थापितशंकुमौलिमिलितं सूत्रं नयेत्कर्णवत् ॥
तत्सूत्रे नलकनिधाय सरलं वंशद्वयाधारकं तद्रंध्रेण
नभश्चरंस्वसमये भूपायसं दर्शयेत् ॥ २४ ॥

इति नलिकबंधयंत्रं ॥

घटदलघटिता घटिनिरुक्ता तलसुखिरापलषष्टितर्क पूर्णा ॥
मुरजसममथाछाका च यंत्रंतलसुखिरं क्षरदलशर्कराद्यं ॥ २५ ॥

इति शुभघटिकादियंत्रवर्यै र्निजदिनमानदले रविं विधुंच ॥
कथित वदिहसाध्ययंत्रतुर्यैयस्थितिभयुत्तीः परीकल्पयेत्स्वयुतया ॥ २६ ॥

खगमृदुचलशंकुसूचितः सूचिकाग्रः समपृथुतरपृथ्वीमध्यभागे सध्यार्त्रः ॥
दिनकरविहतौ ध्यांवौगुलंतत्रकल्प्यं भवति हीततलमध्यान्तत्प्रभा भाग्रदेशं ॥ २७ ॥

अथपूर्वानितस्यभूजस्यवासना ॥
दिनकरगतलंबस्यान्नर शंकु मूला निजतलमनुयातादाज्यकादोः प्रभावत् ॥
त्रिभगुण इहकर्णश्चेति जात्यांतरस्थं श्रुतिरविनरभोत्थं दृष्टिवृत्ते विचिन्त्यं ॥ २८ ॥

सममंडलखेचरांतर ज्याभूविदोः स्यान्भूतलेमहानरा यत् ॥
उदयास्तमयाख्यसूत्रमध्येनृतलाग्रापरि संस्कृतिर्भुजोयं ॥ २१ ॥

सौम्याग्राग्राछंकुमूलंयमाशं याम्यग्राग्राछंकुमूलंयमाशं ॥
रात्रौ तस्याधोमुखं चोत्तराशंशंकोर्भूलं संस्कृतं स्वाग्रयादोः ॥ ३० ॥

उन्मंडल स्थितरवेरवलंबकोयमुधृत्य शंकुरयमुत्तरगोलदृश्यं ॥
याम्योन्तराच्च सममंडल गाद्दिनेशाघोलम्वकः शशमंडलशंकुरूक्तः ॥ ३१ ॥

अथ स्वयंवहयंत्राणि ॥

नृपतिचित्तचमत्कृतिकारकंनवतरामलयंत्रचयंब्रुवे
जलतलानलिकांकुशभामुखोद्गतसमीरवशेन सदावहा ॥ ३२ ॥

समतलमुखमध्यं धातुजं वर्तुलं वातपनपरिमितस्त्रं धारयेन्स्तंभयत्रं ॥
अणुतरलरंध्रं वारिणा पूरितेस्मिन्मुखतरदुद्रुपाग्राद्बद्दलंबोबहिः स्यात् ॥ ३३ ॥

स्पृशतितलमधस्थ सूर्यबिंबोदयेयं क्षरति सुषिरनिरेयात्पुपर्येव लंबः ॥
परिधितलगनाडीचिह्नतो लंबयोगाद्दति समयमानं ज्ञानराजोक्तयंत्रं ॥ ३४ ॥

अपिच परिधीनाडि चिह्नकीलेषु धार्यास्तनु समधनद्योलंबयोगच्युतास्ता ॥
तलगतशिखिचंचुमार्गतो गोलपाताद्दिनसमयमानं ज्ञानजोक्तयंत्रं ॥ ३५ ॥

अथसुसरलवंश स्वर्णताम्रादिवृत्तैर्विरचितसमभागै र्गोलयंत्रं विधाय ॥
ध्रुवयुगगतंपष्टीगोलमध्य स्थितायां समुदितजलपूर्णस्तंभसूत्रेणवेष्टा ॥ ३६ ॥

क्षरतिसुखिरनीरे गोलयंत्रसखेटंभ्रमति समय साम्येनैवतद्धेयं ॥
समुदितमखिलं वा शर्करापारदाघैः स्वयमिह वहतीदं ज्ञानराजोक्तयंत्रं ॥ ३७ ॥

ताम्रस्तंभे मध्यरंध्रं विधाय स्तंभे कुभं मूलरंध्रं निधाय ॥
तोयंदेयं स्तंभकुंभोदंराभ्यां तिर्यग्धारास्तंभतो निर्गतास्यात् ॥ ३८ ॥

स्बुलेगोलेयष्टिकांते निबकांते निबद्दं वक्रनेम्या षष्टिघद्यादियुक्तं
तिर्यग्धारानीरसंपुरिताभिर्न्नाडीभि स्तमये गोलयंत्रं ॥ ३9 ॥

अथप्रकारांतरं ॥

पीडे चतुश्चरणतुंगतरे सरंध्रे कुंभं निधाय तलरंध्रयुतं सत्तोयं ॥
तत्पादयुग्मगत कीलकमध्यबद्धं चक्रं विधाय शिथिलं तललंबयुक्तं ॥ ४० ॥

तच्चक्रमस्तकधृताघाटिका स्थिरेयंकुंभच्युतोदककणैः परिपूरिता स्यात् ॥
चक्रभ्रमात्यज्यति तद्युगपन्समस्तनीरं तथासमयसाम्यतया विधेयं ॥ ४१ ॥

तच्चक्रंनेमिध्रुवसूत्रनिबद्दहस्तो वाद्यंप्रवादयतिनालिकादारूरूपं ॥
कुंभोथवासिकतया परिपूरितोयं नाड्यंतरेण धटिकां भ्रमयत्यवश्यं ॥ ४२ ॥

मेषद्वयं सुलघुदारूकृतं त्रिकोणयंत्रस्थसूत्रकलितं घटिकांतरेण ॥
युद्धं करोतिकृतचक्रगलंबपृष्टं चैबबुधैरुतं रचयेदतोपि ॥ ४३ ॥

उक्तं धटं घटगतं प्रविधाय तोयं यावन्मितंक्षरति तावदधस्तुलाग्रं ॥
यत्पुन्नातं तदयरं शनकैस्तलस्बंहंसो मुखेन घटिकामश्नतेत्र ॥ ४४ ॥

इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ॥
ग्रंथागाराधारभूतेप्रभूतेगोलाध्ययेयंत्रमालानिरूक्ता ॥
इति सकलसिद्धांतवासनाविचारचतुरचिन्तचमत्कारिणि
सिद्धांतसुंदरेयंत्रमालाचतुर्थोधिकार ॥

अथ गोलाध्याये ऋतुवर्णनम्

घनघने गमने शिशिरादिभिः तरणिरशिपदं परिकल्पयेत् ॥
इति पुरातन गोलविदांमतंतदथ माधववर्णनमुच्यते ॥ १ ॥

अयति मंगलमाधवमाधवे जयति काननसमनिमाधवः ॥
जनितमारूतपुरितवंशज ध्वनित नंदितनिंदितसज्जने ॥ २ ॥

कुसुमपीतसदंबरशोभिते द्यमणिना हृदयेपरिभुषिते ॥
वकुल पाटल चंपक मल्लिका कुसुम पुजित शोभन मस्तके ॥ ३ ॥

धरति मित्रवरो महतीप्रभां तदवलोकनतोकरोघ्रिनिं ॥
निजमनोरथसिद्धवशादयं समुपयाति सुरालयसन्मुखं ॥ ४ ॥

द्विज सुमंगलगायनपूर्वकं मधुवनं भवनं विशति स्वकं ॥
शुकमुरवा वलिपल्लवतोरणं सुमकरंदजमेकसुंभांगणं ॥ ५ ॥

ऋतुपतिं नमतीव महीतलं स्पृशति सत्फलपल्लवपाणिना ॥
इति रसाललतापरितोषिता परिमलैर्विपुलैश्चसदंबरैः ॥ ६ ॥

सरलचंचल पल्लवसार्ध्वजं फलितच्युतवितानमुपाजनू ॥
मदनरूपधरो रतिसुंदरीं समवलोक्यपदे परिमस्तकां ॥ ७ ॥

वदति तामद्रि कथं नयति वत्सरवासरसंचर्यं ॥
गरलगोदरचंद्रमरिचयः किमिति ते चरणस्मरणावने ॥ ८ ॥

वक्तेदोमृगनेत्रलांछनगुणः कंदर्पसंजीवनं
पीयुषं द्युधरे स्वमिन्नविरहे दृष्टःकलानां क्षयः ॥
त योगेनकलाभिवृद्धिरमुनाधिक्येन तघः शशीकांताया
विरहे विधुं विदरुतिक्षीणस्ततो दृश्यते ॥ ९ ॥

ता सुक्षचापधरौकटाक्षविशेषौ मेत्रे हि कृष्णार्जुनो जेतुं
कर्णमुपागता विवततो विद्दस्ते पातितः ॥
गोनागेंद्रयुतं चलद्भ्रमतिकायुष्यान्वितं सेवते
कर्णरन्तालवनं तव प्रियतमे चंद्रादिभीतिः कथं ॥ १० ॥

प्राणाधीश तवैव लोचनयुगं ताचेवकृष्णार्जुनौताविमौमनेत्रे
च प्रतिबिंबितौ तु विमुखे प्राणेकुतरता विह ॥
इत्याकर्णविचारचतुरंप्राणाप्रीया लिंगिता भामा
माधव यो बभूव परमानंदः स किं वर्ण्यते ॥ ११ ॥

युष्यन्मौलि सुनिल निर्मल नभोमुक्तालितारावलीमूलेयं
द्युमणिः कलापिशिनस्तस्याधरे तद्दशात् ॥
रात्रौ वा हि समुल्लसंति कुमुदांभो ज्जानिसंजीवने
स्मृत्वैवममामानसे न सहितो हंसः प्रयातःप्रीयेः ॥ १२ ॥

कालिंदीद एवमूर्द्धजचयो यस्मिन्सुपे
नावलीमुक्तालीतुसूवर्णहंसयुगलंकर्णोत्पलेचोत्पले ॥
तद्वेणीफणिनंकरेण कलयन्मग्नंमनः कंदुकं
पश्यनसत्पुरूषोन्तमःप्रियनदीमालिंगयत क्रीडति ॥ १३ ॥

भीष्येर्ग्रष्मेचोक्षरश्मिप्रतापग्रस्तात्रस्ताः पापिनः स्युः ॥
स्नानै दानैः पुजनैःसप्रसन्नो येषां तेषां भोगलक्ष्मीमहेशः ॥ १४ ॥

अभ्रेजसंघघरत्रदायात्करींद्रो यत्रादत्ते नीरमुग्रैः कराग्रैः ॥
तोयंपेयंयत्रवायोश्चभूमेःसोयंयातोभूतसंतापकालः ॥ १५ ॥

दग्धां मुग्धां वीक्ष्य भूमिनिदाघै र्मेघश्यामश्चंचलापांतवासाः ॥
आरादारादागतोयं धरायां पारावारादुत्थितस्तापहंता ॥ १६ ॥

तारातारा धीशसूर्यादिकानां स्तेजः स्तेजः संभितछादयित्वा ॥
रम्यं रेणुवायुना वादयन्सन गर्जनदेवो वर्षतीहानृतेन ॥ १७ ॥

भीष्मग्रीष्मेणेवसपीडितस्यप्राणत्रायेव मित्रस्य सूतः ॥
देवो विद्युच्चक्रधाराधरः सनजित्वा धर्मं वर्द्धयामास धर्मं ॥ १८ ॥

उष्णस्त्वामयमेति गोपिसघनः पीताबरंतस्याकिबालेसा
चपलागलफिममलामालातर्दिद्रायुधं ॥
वेणुवादयतेकथपवनतः पिछानकिंकेनांमेघोगर्जति
भूघरस्यसिखरेबर्हावलीराजते ॥ १९ ॥

सूर्यं छादयते कथं यदि हरिः कोटीनकांतिर्य
पृथिवीतरेपितुं खपक्षिवचनै रत्नाकरादागतः ॥
संख्येवं प्रतिबोथितापि शिरसा धृत्वांबरं शंकया
खं गेहं प्रविवेश तांसचतुरांप्रीतो हरिः सं ययौ ॥ २० ॥

शरदिविशेरमायांशस्यसंपछुमायां गमनविजयमय्यां शारदायां ।
परिकलितसमुद्रस्ताणां महेंद्रकरतलधृतरूद्रो राजते रामचंद्र ॥ २१ ॥

गगनभृषतोषइत्यादिगगनमृगतोषः सज्जकोदंडवेशस्ति
मिरचरसराषोभरिसेनानिवेशः ॥
उपगतनिजमित्रो नीलसुग्रीवमित्रः
सरसिजः शुभनेत्रो नंदितानेकपात्रः ॥ २२ ॥

निजपतिसहितानांमानसंमोदयेद्यः ॥
स्वदयितवियुतानामात्मरूपेन सद्यः ॥
दहति तदपियुक्तं तत्सतित्वावनाय
चरितमतिसतीनांमात्मवसावनाय ॥ २३ ॥

तरणशरणयाते भीषणे भीमकेतौकथयति रिपुवान्तर्राजयन्त्याश्चवृर्ति ॥
वदति नृपतिरेनमित्रवान्तर्ंतवास्तीत्यपिचरिपुपदंतेयमस्तीतिसत्यं ॥ २४ ॥

तदनुनृपविवव्यादंगदःस्वमयूषोरिपुवरमनुयातःसंधयेतेनपृष्टः ॥
वदति नत नृपेंद्रप्रस्फुरद्रत्नमौलि स्थलगतकरराजन्रामचंद्रस्य युतः ॥ २५ ॥

रुद्रोयं शिरसानमत्यनुदिनं सूर्योपि संसेवते
नंतो यस्य पदांबुजेलनिधौ रौद्रं धनं यत्करे ॥
सुग्रीवाय मृगायलुब्धनुकरिपोस्तापददौत
प्रतियांभुक्षित्वेन परोक्षतो यदि हतानां देहि देवंभजे ॥ २६ ॥

यन्मित्रस्य करप्रतापनिहताश्चुर्णं नतोराशयो
नश्यंक्रतवोंतरायसहिताः सिद्धांतितंद्दर्शने ॥
यस्यैवाभ्युदयो गुरूज्ञकवयो द्दीव्यंति सहर्षितास्तं
देवं शरणं प्रयाहि परमंनोवेद्यम यास्यसि ॥ २७ ॥

या सिंही पयसा पराक्रमतनुः पीयुषपानामरः
पश्चादीसवरैः सुरासुरजयी नावास्तनुतामसः ॥
तंजेतुंवनवासितिपसकृशः खघोतसैन्यः
कथं शक्नोसीति च द्रुततंवदमृषामृत्योः पयास्यति ॥ २८ ॥

इत्युक्ता शिखिनकैः परिवृत्तजातो बहिरावणस्तत्राभूत्समरोमहानिहपरो भूते स्वसैन्यै सुरः ॥
सुग्रीवं मृगमिछतशरहतं द्दष्टा थ राजास्वयंबाणेनारिशिरो
जघानवीजयी श्रीरामवंद्रोभबत् ॥ २९ ॥

अथनिपुराज्येभीषणंतनिधायगगनगति विमानारोहिणीयुकसहजसहज ॥
गेयस्वोच्चराज्यंसमेत्यगुरुबुधकविभक्तःपालयामासलोकान् ॥ ३० ॥

हेमंतोहिमनगनगयाचितैःसुशीमैशस्यंतछिशुमिवेयोषयतयवश्यं ॥
संयातेशरदिनितप ॥
थिवीतरेपितुंस्वयक्षिवचनैरत्नाकरादागतः ॥
संरव्यैचप्रतिबोधितापिशिरसाधृत्वांबरंशंकयास्वगेह
प्रतिवेशतासचतुरांप्रीतोहरीःसनययौः ॥ ३१ ॥

शरविशेरमायांशस्यसंपछु मायागमनविजयमथ्याशारदायां ॥
परिकलितसमुद्रस्तारकाणांमहेंद्रकरतलधृतरुद्रोराजतेरामचंद्र ॥ ३२ ॥

गगनमृगतोषःसज्जकोदडवेषस्तिमिरचरसराषोभूरिसेनानिवेशः ॥
उपगतनिजमित्रोनीलसुग्रीवमत्रःसरसिजःशुभनेत्रोनंदिनेपात्रः ॥ ३३ ॥

निजपतिसहितानांमानसंमोदयेद्यः॥
सःवदयातवियुतानामात्मारूपेणसः ॥
दहतितदपियुक्तंतत्सतित्वावनाघचरिमतिमतानांमात्मचत्यावनाय ॥ ३४ ॥

चरणशरणयातेभीषणेभीमकेनौकथतिरिपुवान्तोराजपन्तपाश्चवृन्ति ॥
वदतिनृपतिरैनमित्रवान्तातवास्तीत्यपिचरिपुपदंतेदेयमस्तीतिसत्यं ॥ ३५ ॥

तदननृपविवाक्यादंगदःसःवमयूषोरिपुवरमनुयातःसधयेतेनपृष्टः ॥
वदतिनतनृपेंद्रप्रस्फुरद्रत्नमौलिस्बागतकरराजद्रामचंद्रस्यहृतः ॥ ३६ ॥

यंशिसानमत्यनुदिनंसूर्योपिसंसेवतेनंतोयस्यपदा
जलनिजाग्रजेविदशंतत्स्नेहादिवविनिवार्यसूर्यधर्म ॥ ३७ ॥

चंद्रोवानिजपरमित्रवालकानिसिचतहन्नमृतमयैर्मयुषैः ॥
पृथ्वीवासरसतयात्मसंभवानिपीयुषंफणिरतितःसमानयित्वा ॥ ३८ ॥

उप्तासौयमसदनोभ्युकेतिह्रेरेआयातःशिशिरममागमेनशीतः ॥
प्रालेयाचलसबलानिलप्रयुक्तंकिजेतुंधृतजलराशिवाडबारी ॥ ३९ ॥

सोमोयंसफलवनौषधिप्रयोगैःक्षुद्रोण । नमृतकरोडनेषुहंति ।।
स्वाधारस्वितजनजीवनायपृथ्वीतत्कालेफन्तजलधआन्यसंपदाद्या ।। ४० ।।

तीक्ष्णांशौशिशिराचलस्पनिकटेहूरेतडेत्फलता
भूछायोपरिचारिमिःखरकरैग्रीष्मेपिकोक्षानिशा ।।
उघ्मंतिक्ष्मकरज्जलंजलनिधेः शीतंतुशीताचलाद्भुमियातियुतैः
स्वकीयकरणैःकालेविशेषांनिजे ।।
इत्थं श्रीमन्नागनाथात्मजेन प्रोक्तो तंत्रे ज्ञानराजेन रम्ये ।।
ग्रंथागाराधारभूतेप्रभूतेगोलाध्यायेवर्णनंऋतुनां ।।
इति सकलसिद्धांतवासनाविचारचतुरचिन्तिचमत्कारिणिसतंन्नाधारे

सिद्धांतसुंदरेरुतुवर्णनंनामपंचमोध्यायः ।।

Notes of the Text

Siddhāntasundara: General Notes

Section 1: Grahaganitadhyaya.

Chapter 1: Madhyamadhikara (on mean places)

Jnanaraja, son of Naganatha, praising Lord Ganesha is trying to explain time measurement of different units as the Indian tradition of astronomy. This astronomical treatise starts with *kalamanadhyaya* where different units of time are explained. This tradition starts from Vedanga Jotiṣa of 14th century BC.

Jnanaraja describes the beauty of the supreme deity with his passion. As the other Indian astronomical treatises here the author presents the time concept first. It follows the time unit of Brahamasiddhanta in Sakalyasamhita. In the Brahmasiddhanta in Sakalyasaṁhita, time is divided in small as well as larger parts. In Siddhantasundara verse 2 – 5 define and explain the astronomical period like manu, yuga etc. and relate among these units. A manu is measured by 71 mahayugas.

1 manu = 71 mahayuga

14 manu = 1 day of Brahman = 1 night of Brahman

The duration of manu, known as manvantara has a sandhya-kala on either side equal to one kreta.

A kalpa is a day of the creator, Brahman consists of 1000 mahayugas or 4320,000 saura years. A saura year is the time that it takes for the sun to return to its same position with respect to the fixed stars when viewed from the earth. The beginning of a saura year occurs when the sun enters the sign Aries. A mahayuga is

divided into four smaller groups: kṛtayuga of 1728000 saura years, treatayuga of 1296000 saura years, dvaparayuga of 864000 saura years and kaliyuga of 432000 saura years.

Jnanaraja in his verses (4 – 5) proceeds to explain how much of the present kalpa elapsed. At the commencement of śaka era. The author tells the regions of 6 manus, 27 mahayugas, a kretayuga, a tretayuga, a dvaparayuga, and 3179 saura years.

(To calculate the exact result with is indicated in the verse, 1955, 883, 179 at the commencement of the saka, the procedure is as follows.

$$6 \text{ manus} = 6 \times 71 \times 4{,}320{,}000 + 7 \times 1{,}728{,}000 = 1{,}852{,}316{,}000$$

"27 mahayugas, a kretayuga, a tretayuga and a dvaparayuga that have elapsed during the reign of the seventh manu until the beginning of our present kaliyuga spanned a period of

$$27 \times 5{,}320.000 + \frac{9}{10} \times 4{,}320{,}000 = 120{,}528{,}000 \text{ saura year.}$$

Finally, 3179 saura years

Therefore total saura years = 1,852,416,000 + 120,528,000 + 3179 = 1,972,947,179 saura years.

This result indicates that, the beginning of the Kalpa to the commencement of the saka era, since, Jnanraja follows saurapaksa, a period of 47,400 divine years, passed from the beginning of the Kalpa until the commencement of planetary motion. 'A divine year is a year of the gods. According to the Indian tradition, such a year equal to 360 saura year. So the 47,400 divine year equals 360 × 47,400 = 17,064,000 saura years.

When the period is subtracted from the above result, we get saura years that have elapsed between the commencement of planetary motion and the commencement of the saka era', i.e.

1,972,947,179 − 17,064,000 = 1,955,883,179 which is indicated in the verse.)

Planetary positions at the commencement of motion is nicely presented by Jnanraja. He says, the position of each planet, each apogee, and each node was Aries 0° i.e. at the beginning of Aries.

The idea of intercalary month is clearly given by the author. In the verses 12-17, he clearly explains astronomical units. A lunar month is defined as the time between one conjunction of the Sun and the Moon and the next. There are 30 tithis in a lumar month. The 'pratipad' is calculated when the Moon has gained 12° over the sun in longitude and so on. Since the variation of the Velocities of the Sun and the Moon are taken. The duration of a tithi is not constant. The duration of a tithi varies between 22 hours to 26 hour. There are 12 saura months in a saura year and 30 saura days make a saura month. Jnanaraja has taken the ardharatrika' system for his calculation. So a civil day is the time between two consecutive midnights.

According to verse 18, the sun and the Moon make 4320,000 and 57,753,336 revolutions during a mahayuga.

Therefore, $57{,}753{,}336 - 4{,}320{,}000 = 53{,}433{,}336$ lunar months in a mahayuga and $30 \times 12 \times 4{,}320{,}000 = 1{,}555{,}200{,}000$ saura days in a mahayuga.

Since there are 53,433,336 lunar months in a mahayuga, so there are

$$30 \times 53{,}433{,}336 = 1{,}603{,}000{,}080 \text{ tithis in a mahayuga.}$$

The number of civil days is found as the revolutions of the stars in a mahayuga diminished by the revolutions of the Sun in a mahayuga.

So, the omitted tithis are, $1{,}603{,}000{,}080 - 1{,}577{,}917{,}828 = 25{,}082{,}252$ civil days are determined by the Suns progress around the earth.

The verses 18-24 give the revolution of planets, its apogees and the nodes. Nicely the author explains through verse, for example, the revolutions of Marcury's sighra are 17,937,060 in a mahayuga. Again, the revolutions of the Sun's manda apogee in a kalpa are 387. The data collected from previous texts may be available but the

author probably satisfies these results applying theories. The number of revolutions given here are the revolutions of the mean planets.

Verse 29 is very important in this chapter. This verse explains the formula to determine Sun's tropical longitude i.e. the longitude of the Sun measured with respect to the vernal equinox, with is the intersection between the ecliptic and the celestial equator at which the Sun crosses from the southern to the northern hemisphere.

It is the tropical longitude of the Sun. and δ is the declination of the Sun. Then

$$\sin(\lambda)\frac{RX\sin(\delta)}{\sin\varepsilon}$$

The obliquity of the ecliptic is the angle between the ecliptic and the celestial equator taken as 24 degree but generally it is denoted as ε.

Then

$$\sin(\lambda)\frac{RX\sin(\delta)}{\sin\varepsilon}$$

This is the general formula for 'method of declination'.

Verse (31-32) simply try to explain the mean motion, the man longitude and the equations. The mean motion of the Sun is equal to the half of the Sum of the smallest and the greatest true motion.

If V_1 and V_2 are the minimum and maximum velocities of the Sun, if V is the mean velocity of the Sun, then

$$V = \frac{V_1 + V_2}{2}$$

V_1 is the velocity when the Sun is at the apogee and V_2 is the velocity when the Sun is at the perigee. Jnanaraja specifies only perigee indirectly and the sun's mean longitude is equal to its true longitude.

To find the mean planet from day count, we can apply a formula, $360 \times r \times \frac{d}{c}$ to measure the number of degrees travelled by the planet r is the number of revolutions of a given planet in a mahayuga, if d is the day count starting from the commencement of planetary motion. Here the saurapaksa employs a midnight system rather than a sunrise system.

According to Jnanaraja the multiplier of a planet is to be found as the revolutions of the planet in a kalpa divided by the Saura years in a Kalpa, the revolution and Saura Years in a mahayuga.

If Rp is the number of revolutions of the planet in a mahayuga, it moves a total of $360 \times Rp$ degrees in a mahayuga.

Therefore, the number of degrees that the planet moves during a saura year is $\frac{360 \times Rp}{y}$ (this calculation is taken from the research paper of Kundsen)

It is also observed that mean longitude of the Moon from the day count, is

$$Y - \frac{x}{60^2}$$

If λ is the mean longitude of the Moon and x be the number of revolutions of the moon in a mahayuga.

Let λ_m be the mean longitude of the Moon and R_M be the number of the revolutions of the Moon in a Mahayuga. The mean longitude of the Moon is λ_m

$$= 360 \times \left(13 + 13x \frac{10}{737} - \frac{1}{8 \times 60^2}\right)$$

$$= a \times \frac{27967063}{21225600}$$

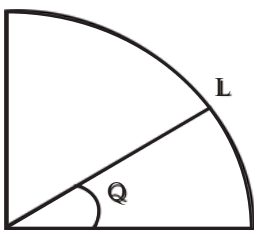
The important contribution of Jnanaraja is to measure mean longitude of Mars, Mercury, Venus, Saturn in a simple way which gives more accurate result than the past. From day count he gives formula (verse 72-73) for determining longitude of the lunar node.

Insertion of intercalary month is another contribution of the author but it is same as school of Suryasiddhanta.

The duration of a saura year is measured by 12 lunar months, 11 tithis, 3 ghatikas and 53 palas. A month from a conjunction of the Sun and the Moon and ends at the next conjunction. Verse 88 explain the corrected circumference of the Earth.

Let C be the circumference of the Earth and C' the corrected Circumference corresponding to the latitude Q, then

$$C' = C \times \frac{\sin(Q)}{R}$$



Spastadhikara deals with the method of computing the true positions of the planets from their mean positions. Jnanaraja, the author of sidhantasundara explained the method to determine true positions of plants. The author of Siddhantasundara follows the calculation of Brahmasiddhanta belongs to the school of Suryasiddhanta. In ganita part of astronomy, astronomers used sine as the radii of a circle. The value used by Jnanaraja is 3438 as Aryabhat and the author of Suryasiddhanta.

Let R be considered as radius of a circle, the circumference is $2\pi R$.

If there are 21600 minutes of arc in a circle, the number of minutes of are per unit of the circumference is $\frac{21600}{2\pi R}$; if $R = 3438$, Then $\frac{21600}{2\times3.14\times3438} \simeq 1$ then, $\sin(\alpha) = \alpha$

So, $R = 3438$ can therefore be compared to modern use of radius in minutes instead of degrees. In Indian tradition Jya means sine. The verses give a table of the sine of each of the 24 multiples of $3°45' = 225'$.

Then, the table gives the sine of each 24 multiples of 225′ between O′ and (90 × 60).

Sine – table given in the Siddhantasundara is like this:

Sine number	Angle	Sine	Modern value
1	3°45′	225	224.85
2	7°30′	449	448.74
3	11°15′	671	670.72
4	15°0′	890	889.81
5	18°45′	1105	1105.10
6	22°30′	1315	1315.66
7	26°15′	1520	1520.58
80	30°0′	1719	1719.00
9	33°45′	1910	1910.05
10	37°30′	2093	2092.92
11	41°15′	2267	2266.83
12	45°0′	2431	2431.03
13	48°45′	2585	2584.82
14	52°30′	2728	2727.54
15	56°15′	2859	2858.59
16	60°0′	2978	2977.39
17	63°45′	3084	3083.44
18	67°30′	3177	3176.29
19	71°15′	3256	3255.54
20	75°0′	3321	3320.82
21	78°45′	3372	3371.93
22	82°30′	3409	3408.58
23	86°15′	3431	3430.63
24	90°0’	3438	3438.00

Jnanaraja gives a method to compute sine values given in the table. Let draw a circle, the circumference of the circle is divided into 96 equal parts (Verse 6). Two points are on the east-west points joined and get an east-west line through the centre of the circle. This is the horizontal line. If the remaining points are connected in pair, one get 49 lines but two of them are merely points, north and south points. So, this gives 48 chords.

In verse 11, the author beautifully explains the method of finding the sine of a given angle. This procedure is applied to compute then sine and the cosine of any given angle between 0° and 90°. The method used is simple linear interpolation. Let α be an angle measured in minutes of arc and satisfying $0 < \alpha < 5400' = 900$ [sin (0°) and sin (90°) are known] Let $\beta = 5400' - \alpha$

$\sin \beta = \sin (90° - \alpha) = \cos \alpha$, Let q and r be the quotient and remainder, respectively, of the division of α by 225, then $\alpha = 225 \times q + r$ where $0 \leq r < 225$

i.e. $\sin q < \sin \alpha < \sin q + 1$

$$\sin \alpha = \sin q + \frac{r}{225} \times (\sin(q+1) - \sin q)$$

In verse 13 & 14, we get a table of differences of small sines. These values are almost near the modern values. The successive differences of the small sines (laghujya) are 25, 24, 23, 21, 19, 16, 13, 10, 6 and 3. The degrees in the angle are divided by 9.

The author here gives another sine table. Here R = 160 and a division of the interval between 0° and 90° into 10 equal parts of 9° each.

Sl No.	Angle	$\Delta \sin n$	sin n	Modern value	Modern difference
1	90	25	25	25.029	25.029
2	180	24	49	49.442	24.413
3	270	23	72	72.638	23.195
4	360	21	93	94.045	21.407

5	450	19	112	113.137	19.092
6	540	16	128	129.442	16.305
7	630	13	141	142.561	13.118
8	720	10	151	152.169	9.607
9	810	6	157	158.030	5.861
10	900	3	160	160.000	1.969

$$\Delta \sin n = \sin n - \sin n - 1 \text{ for } 1 < n < 10$$

In the spastadhikara, Jnanaraja explains planetary theory based or previous knowledge and also contemporary findings. The author explains a planet's true velocity in verses 26 – 28. According to Indian tradition in explaining astronomical terms Jnanaraja determines the true velocity of a planet in terms of velocity of the sighra apogee and retrograde motion.

If $v =$ true velocity

$u =$ retrograde motion

$x_a =$ velocity of the sighra apogee

Then $v = x_a - u$ if $x_a > u$

Or $v = u - x_a$ if $u > x_a$

Just the next verses are devoted to explain the conditions of retrograde motion. He explains how to measure Sun's declination. He deduces a formula.

$$\sin(\delta) = 4 \times \frac{\sin\lambda + \frac{1}{61}\sin\lambda}{10}$$

$$= \frac{124}{305}\lambda$$

where $\delta =$ declination of the Sun

and $\lambda =$ tropical longitude of the Sun.

The unique feature of spastadhikara of Siddhantasundara is to find karana. This treatment is absent in previous astronomical texts. Verse 37 explains how to find current karana. The 60 karnas of a lunar month are numbered starting from 1. We get four fixed karanas

sakuni, catuspada, kimstuguna. Mathematically it can be explained if we suppose K is the number of current karana. That $1 < K < 58$, let r be the remainder from the division of $K - 1$ by 7.

If $r = 1$, the current karana is Bava, it $r = 2$, Balava and so on. If K is 1, 58, 59 and 60, the current karana is one of the four fixed karanas. It is expressed in the table indicating karana name and number.

Karana number								Name
1								Kimstughuna
2	9	16	23	30	37	44	51	Bava
3	10	17	24	31	38	45	52	Balava
4	11	18	25	32	39	46	53	Kanlava
5	12	19	26	33	40	47	54	Taitila
6	13	20	27	34	41	48	55	Gaza
7	14	21	28	35	42	49	56	Vanij
8	15	22	29	36	43	50	57	Visti
							58	Sakuni
							59	Catuspada
							60	Naga

(Number and Names of Karana)

Rising of the signs are described in the verses 39 and 40. Very nicely the method for determining missing times of the signs is explained by the author. For a given location, the rising (times) are diminished or increased by the ascension differences corresponding to one. Two and three signs in the right order and put down inversely. The table shows the rising times of the signs.

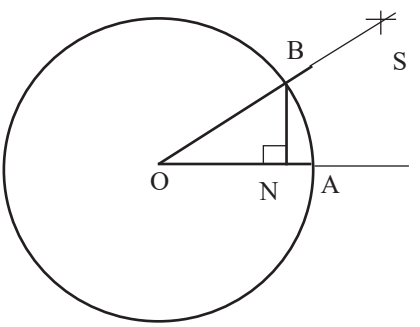
Singh	Rising time on the equator	Rising time elsewhere
Aries	T_1	$T_1 - W_1$
Taurus	T_2	$T_2 - W_2$
Gemini	T_3	$T_3 - W_3$

Cancer	T_3	$T_3 + W_3$
Leo	T_2	$T_2 + W_2$
Virgo	T_1	$T_1 + W_1$
Libra	T_1	$T_1 + W_1$
Scorpius	T_2	$T_2 + W_2$
Sagittarius	T_3	$T_3 + W_3$
Capricorny	T_3	$T_3 - W_3$
Aquarius	T_2	$T_2 - W_2$
Pisces	T_1	$T_1 - W_1$

W_1, W_2 and W_3 be the ascentional differences at the given location corresponding to the Sun having the declinations 30°, 60° and 90°. This chapter spastadhikara ends with the verse to find the amount of precession. A day measured by 30 ghatikas is to be observed. A day whose daylight period is 30 ghatikas is an equinoctial day.

Triprasnadhikara chapter deals with three problems dik, desa and kala i.e. direction, position is space and time, with respect to a celestial body. This chapter involves spherical trigonometry.

Verse 3 explains the method for determining direction east.



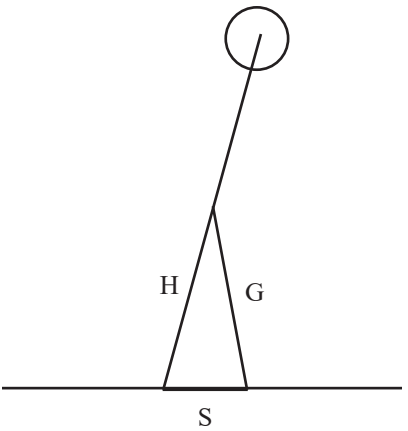
In the figure, S is the Sun, the bold line OB indicates a rod which is oriented towards the position of the rising Sun.

Unless it is the equinoctial day, the Sun will not rise exactly due east.

The angle between due east and rising point of the Sun in called the rising amplitude or simply amplitude.

If amplitude is known, one can find due east on the circle.

On equinoctial day the shadow of the (gnomon) at noon is called equinoctial shadow. When the Sun is situated at the end of virgo or at the end of pisces, the shadow is formed. The hypotenuse which is called equinoctial hypotenuse can be measured from the right angled triangle.



Shadow by a gnomon at noon on an equinoctial day.

G = Gnomon

H = hypotenuse

S = equinoctial shadow

Since the Sun is on the celestial equator on the equinoctial day. The angle between the gnomon and the equinoctial hypotenuse is equal to the local terrestrial latitude. This chapter clearly explains the direction of the Sun and procedure to compute shadow. It deals with the yojanas between two points of a meridian. The uniqueness of this chapter is, it consists a number of problems on direction, positions in space. Many times these are not clear. Jnanaraja composed 46 verses to three problems as Indian astronomical heritage.

There are many references of eclipses in Vedas, epics and later Indian literatures. In the Ramayana of Valmiki a description of the unusual and frightening scene, possibly at the time of Solar eclipse. The demon khara while marching with his army to attack Rama and Laksmana, khara confronts several omens on his way. One of which in Solar Eclipse.

23rd sarga of Aranyakanda tells -

“The Sun was grasped by a glowing enclosure, even like a rotated five-ball, changing it from black until it was red”

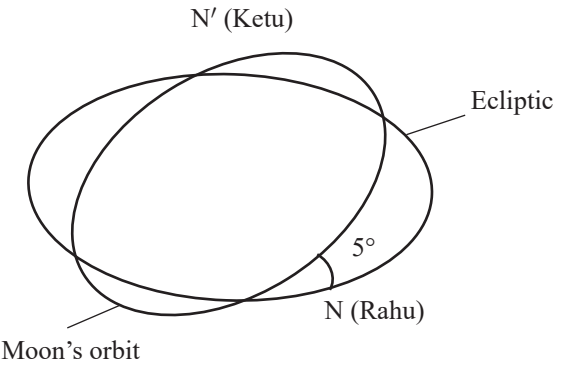
“Flesh-eating animals and birds coming close to Janasthana started howling wickedly”.

Except these instances, solar eclipse took place before the end of the parva like Mahabharata.

When pandavas started for exile, vidura describes an astonishing incident. “In the past there have been instances of amavasya at the end of fourteen, fifteen and (even) sixteen days. But I have not known of are amavasya (at the end) of thirteen days. The Moon and the Sun (in that order) were eclipsed, in the same month in thirteen days”

In every siddhanta, eclipse is explained with importance. In Siddhantasundara, the author adds a separate chapter to explain the possibility of eclipses. Here he deduces formulae to find apparent diameters of the Sun, Moon from the velocities. Here he finds apparent diameters of them. Once diameters are measured duration and obscuration of an eclipse can be determined easily. He defines hour angle but the verse is not clearly understood. The hour-angle is the angular distance between the position of the Sun and the meridian, measured as an arc on the celestial equator.” The hour-angle is used to compute a solar eclipse which is the explanation of Jnanaraja.

As previously stated, lunar eclipses are explained in different Indian literature. The causes of lunar eclipse are explained in different ways as their knowledge base. Lunar eclipse occurs in a full Moon day. On full moon day the Sun and the Moon are on opposite sides of the earth. The Sun’s ray fall on one side of the Earth, facing the Sun, and a shadow will be cast on the other side. When the Moon enters the shadow of the earth a lunar eclipse occurs. This happens when the Sun and the Moon are in opposition. It does not occur on every full moon day. This is because the plane of the Moon’s orbit is inclined at about 5° with the ecliptic. When moon’s orbit becomes align with the plane of ecliptic then lunar eclipse occur. In order that an eclipse of the moon may take place, the Moon must come sufficiently close to the ecliptic. The Moon, on the full moon day, must be close to the one of the nodes of the moon.



In the big orbit of the Moon intersects with the ecliptic at two points N and N′, these points are referred as ascending node and descending mode of the Moon. There are called Rahu and Ketu. The total lunar eclipse occurs when the whole of the Moon passes through the shadow and the eclipse is partial when only a part of the Moon enters the shadow.

In Siddhantasundara, eclipse is explained in several ways. Verses 3 & 4 explains that the cause of lunar eclipse is 'Rahu'. Jnanaraja compared with a part of Ramayana. Ravana was killed by the arrow of Rama. The cause for killing Ravana not the arrow but was Rama, who fired the arrow. Similarly Rahu is the main cause of eclipse. The author identifies Rahu as the lunar ascending node. In the previous chapter diameter of solar disc is determined. In the verse 7, it is measured as the solar disc has 6500 yojanas and the disc of the Moon has 480 yojanas. If the mean diameter of the Sun is d, u the Sun's mean velocity and v the true velocity, then the apparent diameter of the Moon can be computed in a simple way

$$d = d \times \frac{u}{v}$$

To calculate the time of lunar eclipse, it is necessary to calculate the diameter of the shadow of the earth at the distance at which the Moon passes through it.

If d_s is the diameter of the shadow, d_e, d_{su}, d_m be the diameters of the Earth, Sun and Moon respectively in yojanas, than

$$d_s = d_e - (d_{su} - d_e) \times \frac{d_m}{d_{su}}$$

If d_e is considered as 1600 yojanas, we find the diameter of the shadow.

$$\begin{aligned} d_s &= 1600 - (6500 - 1600) \times \frac{480}{6500} \\ &= 1600 - 4900 \times \frac{480}{6500} \\ &= 1238\tfrac{2}{3} \text{ yojanas} \end{aligned}$$

that is $2\frac{1}{2}$ times more than d_m.

It can be measured geometrically. Verse 14 gives the method to find the lunar latitude. The inclined orbit of the Moon intersects the ecliptic in two points 1800 from each other. The angle between the position of the Moon and the ecliptic is called lunar latitude. The angle between the circle of the ecliptic and the circle of the inclined orbit of the moons 4°30′ = 270′. This means that the greatest lunar latitude, which is attained when the Moon is 90° from one of its nodes is 270′. We can compute the lunar latitude.

$$\beta = \sin(\lambda_M - \lambda_E) \times \frac{270}{R}$$

Half-duration of the eclipse is computed using lunar latitude applying the formula noticed in the verses 15 & 16.

$$\text{Half duration of the eclipse} = \frac{60 \times \sqrt{(r_c + r_m)^2 - \beta^2}}{v_m - v_{su}}$$

where r_e is the radius of the shadow of the Earth, r_m is the radius of the Moon; v_m to v_{su} are the velocities of the Moon and the Sun.

Similarly, half-duration of the totality

$$= \frac{60 \times \sqrt{(r_c - r_m)^2} - \beta^2}{v_m - v_{su}}$$

Jnanaraja very nicely explain the point of contact and point of the end of the eclipse line. The amount of abstraction at a given time is also determined by the author.

Another special feature of Siddhantasundasa is the topic "valana is included this candragrahana chapter. In other Indian astronomical texts valana is treated in separate chapter. Ayanavalana and aksavalana are computed. The formula given for the ayanavalana is

$$\sin(\lambda + 90) \times \frac{\sin(24^\circ)}{R}$$

$\lambda =$ processional longitude of the planet.

Jnanraja wrote 'At mid-eclipse, the valana, which is the distance, is corrected by me". The sine of the longitude of a planet increased by three signs is multiplied by the sine of 24 degrees and divided by the radius, the arc corresponding to that result is the ayanavalana.

To compute aksavalana another formula is given by the author.

$$\sin(d) \times \frac{so}{ho}$$

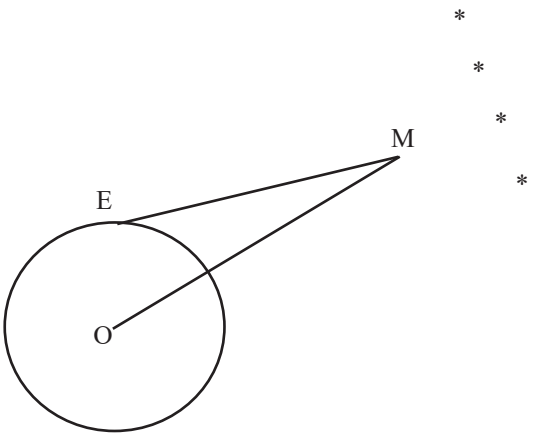
where d is the hour-angles so the equinoctial shadow and ho the equinoctial hypotenuse.

On a new moon day, the Sun and the Moon are on the same side of the Earth. The ray of the Sun are obstacle by the Moon to reach the Earth. A shadow-cone is produced by the Moon and solar eclipse occurs. The conditions of solar eclipse are

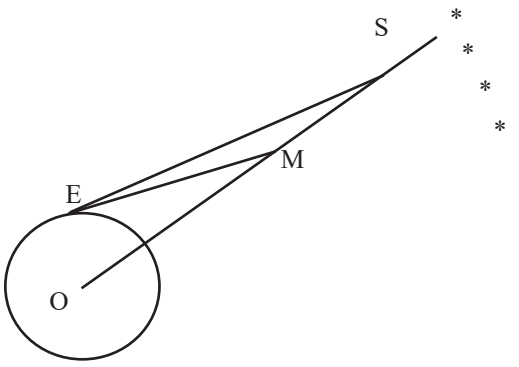
(i) the day must be a new moon day (amabasya)
(ii) the new-moon must be close to one of the nodes.

On new moon day, the Moon is sufficiently close to the ecliptic and so, solar eclipse is possible. Since the diameter of the Moon is smaller than the Earth, solar eclipse is visible only from a limited portion of the Earth's surface.

In this text, the author described parallax. ‘Parallax is the phenomenon that a heavily body when viewed from the center of the Earth, is not seen at the same position with respect to the fixed stars as when it is viewed from a position on the surface of the Earth. The parallax of a planet is the angle between two lines formed by connecting the planet with the centre of the Earth and a given location on the surface of the Earth.



The parallax of the Moon is EMO. For lunar eclipse parallax is not taken into account. The reason is that effect of parallax is the same for the Moon and the shadow of the Earth. The role of parallax for solar eclipse is prominent. Combined parallax is parallax on the Sun and the Moon is considered.



Combined parallax

$$\angle \mathrm{MES} = 180^\circ - \angle \mathrm{EMS} - \angle \mathrm{ESO}$$

Considering ΔEMS

$$\angle \mathrm{MES} = 180^\circ - \angle \mathrm{EMO}$$
$$\angle \mathrm{MES} = 180^\circ - (180^\circ - \angle \mathrm{EMO}) - \angle \mathrm{ESO} = \angle \mathrm{EMO} - \angle \mathrm{ESO}$$

So, the combined parallax of the Sun and the Moon is the parallax of the Moon diminished by the parallax of the Sun. Verse 2 defines longitudinal and lattiitudinal parallax as the previous texts. Parallax is categorized into two by the Indian astronomers; one component, lambana, longitudinal parallax and two, nati, the latitudinal parallax. Nati is measured on a perpendicular to the ecliptic. This chapter is devoted to compute parallax and also a solar eclipse. The author shows the method to derive the formula for the longitudinal parallax from the proportions. When the sine of the difference of the longitudes of the meridian ecliptic point and the Sun is *R*, then.

$$\frac{\sin(\lambda_m - \lambda_{su})}{R} = \frac{\pi}{4} \text{ (π is the value of sine)}$$

If the value of the longitudinal parallax when the sine of the altitude of the nonagesimal is *R*, π^2

$$\text{Then } \frac{\sin(\alpha v)}{R} = \frac{\pi}{\pi_1}$$

These two equations give a formula for longitudinal parallax. This treatment is same as found is Shisyavddhidatantra.

When a planet or a star comes into proximity of the Sun it becomes invisible. This phenomenon is known as helical setting (astamana). When the interval between the Sun and the planet increases so that the planet becomes visible again it is known as helical rising

(udaya). Three planets viz. Jupiter, Mars and Saturn have slower motions than the Sun. Therefore they set, when the Sun approaches them. The planet, which has a motion slower than that of the Sun. always rises (heliacally) in the east and sets in the west. The planet which has a faster motion rises in the west and sets in the east. Mercury and Venus, when retrograde, do the same, but when they have direct motion, they rise helically in the west and set in the east. As so does the Moon. The proper direction of the planets 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 setting of the Sun. As the Sun's distance from these planets becomes small, these are visible slightly above the western region after the sunset. When the distance further decreases, the planets appear 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 heliacal rising.

Time degrees for heliacal visibility are different in different texts. But the maximum degrees of rising and setting are same.

Planet	Time – degree	according to
	Suryasiddhanta	Siddhantasundara
Mars	17°	17°
Mercury	14°	13°
Mercury (retro)	12°	12°30′
Venus	10°	8°
Venus (retro)	8°	7°30′
Saturn	15°	15°
Jupiter	11°	12°
Moon	12°	12°

It is demonstrated the process to determine interval of time with the help of time degree of the planet, the Sun and the time degrees of the maximum limit of visibility the interval before and after the heliacal rising and setting can be known in terms of time unit. The rising times of the sign on which the planet or the Sun is at the calculated moment should be multiplied by the daily motion of the respective planet and divided by 1800.

The rule is like this:

1800 : rising time of the sign :: daily motion : required rising time

$$\text{: Required time} = \frac{\text{rising time of the sign} \times \text{daily motion}}{1800}$$

The difference of the daily motions should be found. By this result, the difference of time-degrees should be divided. The result will be the interval in days past in the heliacal rising or selling.

To find the required days we get a formula:

Difference in time-motions : one day : : Difference in Kalamsas : required days.

$$\text{required days} = \frac{1 \times \text{difference in Kalamsas}}{\text{Difference in time motions}}$$
$$= \frac{\text{Difference in Kalamsas}}{\text{difference in time motions}}$$

This formulae are same as the followers of Suryasiddhanta, like Somasiddhanta. Stars are fixed and relatively they are approached by the Sun. They set in the west and rise in the east. The time of rising and setting can be calculated as the planets. There only the relative motion of the Sun has to be taken into account. The Suryasiddhanta has mentioned that the six stars do not become invisible. These are (i) Abhijit (ii) Brahmahridaya (iii) Svati (iv) Srvana (v) Dhanistha and (vi) Uttara bhadrapada.

In the crescent half month 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 krisna paksa the Sun and the Moon are on the same longitude. The Moon rises with the Sun and remains invisible. When the difference between the longitudes of the Sun and the Moon becomes more than 180 degrees, the Moon rises on the eastern horizon after the Sun set. Knowing this difference one can measure how long after the Sun-set the Moon will rise on any day of the krisnapaksa. According to Siddhantasiromani the problem is to find the time that has elapsed after the rise of the planet not on the horizon but elsewhere. The corresponding prak-drk-graha could be found exactly and at this position of the prak-drk-graha is a point of ecliptic. The heliacal time of rising and setting of a planet can be computed early. Having found the approximate position of the drk-graha when the planet is likely to rise or set heliacally, and let the time in between the rising of the drk-graha and that of the Sun.

If x and y be the differences of the longitudes of the planet and those of the drk-grahas respectively. Then

$$\tan x = \frac{\tan \beta}{\tan \theta} \quad \text{and} \quad \tan y = \frac{\tan \beta}{\tan \varphi}$$

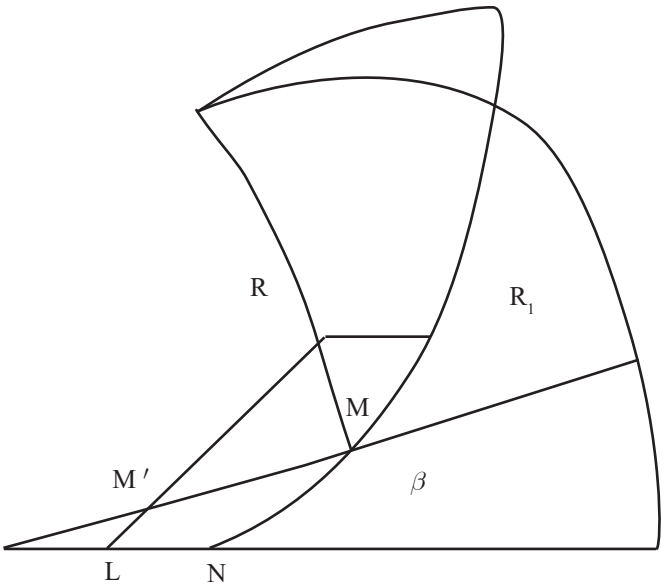
where β is the latitude of a planet and θ and φ the angles which the ecliptic makes with horizon at the planet's rising and setting respectively.

In Siddhantasundara, Nakṣatrachayadhikara chapter consists of 23 verses describing 'mandasphuta graha', 'sighrakarna', 'ayanavalana 'grahasthana etc. to determine longitude of the setting planet is asta-lagna and others. The Venus is to be studied carefully to explain the nature of yasthi.

$\sqrt{R^2 - H^2 \sin^2 \gamma}$ is could yasthi were γ is the ayanvalana. In the previous astronomical texts the chapters are devoted on grahachayadhikara but the title of this chapter in siddhantasundara is nakṣatra chayadhikara. Comparing Bhaskara's Siddhantasiromani

'मन्दस्फुटो ग्रह स्वशीघ्रप्रतिमण्डले भ्रमति तत्र च तस्य पातोऽपि' the node is situated in the ecliptic but in Siddhantasundara, the treatment is something different but the concept is traditional.

The latitude β of the planet multiplied by yasthi and divided by R gives the corrected value of latitude which could be added to the declination of the foot of the latitude, we get modern declination of the planet.



R be a celestial body whose latitude is β and declination RL

Let M is the foot of the latitude circle, RL is called sphutakranti and RM is viksepa and R_1M be sphuta-viksepa, then corrected value of latitude

$$= \frac{Yasthi \times \beta}{R}$$

Ayana drk-karma correction measured in minutes is obtained by multiplying ayanavalana by the celestial latitude and divided by H cos δ (H cos δ = R) and then multiplied by 1800. The result is divided by the rising time of the rasi on which the planet belongs.

Grahasthanaim, the important subject to relate the grahachaya on the ecliptic. Siddhanatasiromoni noticed that -

नक्षत्रानां स्फुटा एव स्थिरत्वात पठिताः शराः /
दृक्कर्मना ऽयनेनैषां संस्कृताश्च तया ध्रुवा //

i.e. "in the case of stars with are fixed, the sphuta-saras or polar latitudes are given and longitudes rectified for ayana drk- karma are given. Bhaskaracharya made this as an approximate statement"

In terms of conjunctions, Suryasiddhanta has described five types of conjunction depending on the way the planets come into contact. These are:

Ullekkha – when there is only the contact of the planets, it is known as ullekkha.

Bheda: When a planet covers some part of another planet but both appear as distinctly apart, the phenomenon is known as bheda

Amsuvimarda : when the discs of the planets remain apart but their rays mingle, the phenomena is known as amsuvimarda (encounter)

Apasavya = If the interval between the planets is less than one degree and if one planet is faint, it is known as apasavya encounter.

Samagama: If the interval is more than one degree' the phenomenon is known as samagama. To determine the particular movement, one particular point has to be marked. So, in each asterism a particular star when comes 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. In case of junction-star the latitude is measured on the dhruvaprotavrtta as it is deflected away from the polar longitude. The junction-star is considered as a fixed star and moves around the pole of the heavens and its longitude is reversed to that point of the ecliptic where its dhravaprotavrtta meets the ecliptic.

Srngonnatyadhikara is that chapter where diurnal rising and setting of the Moon, Moon's shadow, elevation of lunar hors, diagram of lunar horn etc. are discussed. The Siddhantasundara is the exceptional.

As the Suryasiddhanta and its follower Siddhantasundara explains srngonnati as usual.

Moons Sphutakranti, declination of the Moons centre is found from the sun or difference of the Moons mandyakranti (madhyamakranti) and its latitude according to the directions. From this true declination the Moon's ascensional difference can be calculated. In the first quarter of a lunation, on the day when the elevation of the cusps of the crescent Moon is to be determined. Then at the moment of Moon-rise or set, the R sine of the altitude of the moon is to be computed by noting the time from the moment of Moon-rise. When the phase of the Moon according to the definition of phase in modern term is less than half, the Moon will be crescent. Generally, on the back ground of the horizon, one of the cusps is more elevation than the other, this elevation is termed by Indian astronomer as srnngonati. In this text, author dedicates 18 verses to explain srngonati. The rule adopted by Lalla, Sripati and many others is almost same.

To find the cusps of the Moon, one must first find the true longitudes of the Sun and Moon on the second day of the light half of the lunar month, at sunset. According to mallikarjuna, the Nalakayantra is used to observe the star or the planet. It is the first observation. The second observation relate to the Moon. If the then longitude of the Moon is not known, the longitude of the midnight Moon should be found and then the two visibility corrections applied. From the Moon's longitude corrected by the two visibility correction, its Rsine altitude, Rsine amplitude and base are calculated, so the bhuja (bahu). The sum or difference of the Sun's and Moon's bhujas accordingly as they are in the opposite or in the same direction, is the north-south difference of the two bodies. The method to determine sphutabaha or correted bhuja is almost same in all texts from where Jnanaraja took the idea. The bhuja of the moon is in a direction different from the sun, find their sum. If their directions are the same then take their difference. The result in each case is called the corrected bhuja or sphutabaha. This method is given clearly in the Brahmasiddhanta is

Sakalyasamhita. A simple method to get the light half of the Moon is stated here. The difference in the true longitudes of the Sun and moon in degrees, multiplied by the radius of the Moon and divided by 90, gives the illuminated portion. When the difference (mentioned above) is diminished by 1800 and the remainder is multiplied by the radius of the Moon and divided by 90, the result is the dark portion of the dark half. Multiplying the reversed sine of the difference in the longitudes of the Sun and the Moon by the Moon's radius and divide by the radius, the result is the breadth of the illuminated portion of the Moon. This may be converted into angulas. The lower cusp of the Moon is on that side on which lies the base measured in angulas, and the other is the higher cusp. The Moon's higher cusp rises first and sets later. The cusp of the Moon, when its crescent is very narrow, becomes beautiful.

Conjunction of planets is explained in every astronomical text composed by ancient astronomers. A method to find the distance of the earth and the planet is found applying the formula.

R : manda hypotenuse :: sighra hypotenuse : ?

This formula was developed by Mallikarjuna. Aryabhata gives this method in his masterpiece Aryabhatiya. This gives the diameters of the planets in yojanas. If the diameter of the Moon measured in yojanas is divided by 5, 10, 15, 20 and 25, the results are, respectively, the diameters of Venus, Jupiter, Mercury, Saturn and Mars.

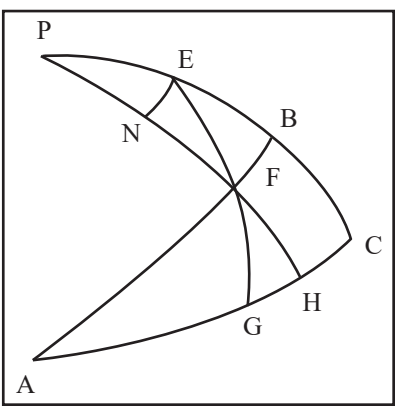
The latitudes of Mars, Mercury, Jupiter, Venus and Saturn are respectively, 9, 12, 6, 12 and 12, minutes, each multiplied by 10. The nodes of Mars, Jupiter and Saturn become more accurate when corrected by adding to their longitudes or subtracting from them. The respective sigraphalas of the planets according to these are additive or subtractive. If the two planets are moving in the same direction, Then to find the days elapsed since the conjunction, divide the difference of their true longitudes in minutes by the difference of the true daily motion. If the slower planet is ahead, the conjunction

will take place after so many days. If one planet is direct and the other retrograde, divide the difference of their true longitudes and expressed in minutes, by the sum of their true daily motions. If retrograde planet has the greater longitude, the conjunction will take place after the days in the quotient. Very interestingly it can be said that astronomical observations and mathematical treatment were too sophisticated in ancient Indian astronomy.

The true latitude of the planet can be determined by Rsine of the remainder of each case multiplying by the greatest mean latitude of the planet and divide by its distance from the centre of the earth.

Jnanaraja excellently represented the duration of conjunction of planets and asterism. When the latitudes of two planets are of different denominations, each planet is said to be in the same direction of the ecliptic as its latitude. But when they are of the same denomination, the planet having the shorter latitude is said to be in a direction opposite to that of its latitude with reference to the centre of the other planet. He determined the direction of planetary conjunctions. He calculated udaylagna (rising ecliptic points) and the astalagna (setting ecliptic points)

If the true longitude of a planet is greater than the polar longitude of a nakṣatra, their conjunction has taken place; if less, it will take place. It is a good observation. As for example, the polar longitude of Agastya is 2^s 27°. When the true longitude of a planet is the same as this value, there is conjunction of the planet and Agastya. The Moon, when is the middle of the asterism of Rohini, it its southern latitude is 2°40′ and occults the principal star, Rohini, when its southern latitude is 4°30′. Again the moon occults the middle star of the asterism. Magha when it has a north latitude of 4°30′.



To calculate the rising ecliptic point or setting or ecliptic point, the method which can easily be applied, is given below. (Figure)

Let AB be the ecliptic, AC the equator, P the north-pole, N the nakṣatra and PN FH meeting the ecliptic and equator in F and H respectively. Let NE be the diurnal circle of N meeting EFG, the horizon in E.

Then AF is the polar longitude or dhruvaka of N, FH its mean declination, NF its latitude and NE the visibility correction due to local latitude or aksadrkkarmasu.

Then, NH = true declination of sphutakranti

= NF + FH

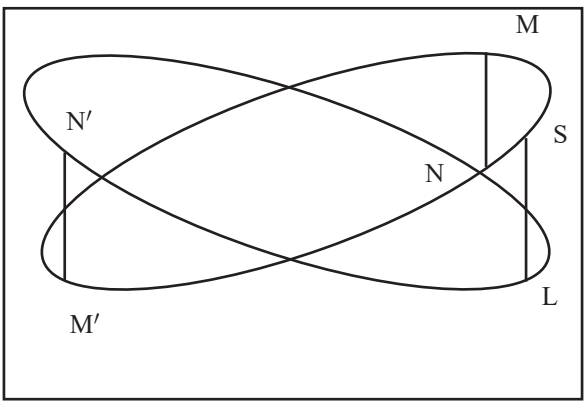
= latitude + mean declination

If N and F lie on opposite sides of AC, the true declination would be the difference between the latitude and the mean declination.

It is a convention in Indian astronomy that rising and setting of the stars are due to motion of whirl wind. Before Siddhantasundara old Indian astronomical manuscripts notices this concept. The lagnas calculated by the method given here are called udayarka and astamayarka. Let, the Sun is on the eastern horizon, a nakṣatra will rise helically with the Sun, if its udayalagna is above the horizon at a distance of 14° kalamsa from the sun. To find the true longitude of the Sun in this position, the Sun is at that point of the ecliptic which following the udaylagna is at a distance 14° kalamsa from the Sun. In this chapter time or helical visibility of the stars, helical invisibility of the stars, helical invisibility of the stars, helical visibility of stars at any place etc. are vividly discussed. The difference between the udayarka and astamayarka of a nakṣatra, expressed in minutes, when divided by the true daily motion of the Sun, gives the days for which nakṣatra is visible or invisible.

Patadhyaya contains only 15 verses in Sidhantasundara. Pata is understood in uyatipata and vaidhrti. Vyatipata is defined as occurring at that moment when the sun and the Moon have equal declinations, being situated in opposite ayanas but in the same sphere. The second pata vaidhrti occurs when the Sun and the Moon have equal

declinations, they being situated in the same ayana but opposite spheres. In Indian astronomical texts this chapter is composed in the last. Here the author described closely the uttaragola, daksinagola, uttarayana, dakainayana etc. Geometrically, Vyatipata is explained through poetic manner.



In this figure, Vyatipata occurs when SL = MN, where S and M represents the Sun and the Moon situated respectively in Uttasayana and daksinayana respectively but in the same uttaragola. If the positions of S and M are interchanged, then also vyatipata occurs. The vaihrti occurs when SL = MN, here both the Sun and the Moon are in the same ayana but in opposite golas.

Time of vyatipata and vaidhpti is calculated mathematically in this chapter which is called patimaddhyakala. When the Sun of the true longitudes of the Sun and the Moon is 6 or 12 signs, the time is known as patadhruvakakala. Finding the longitudes of the Sun, Moon and its nodes at that time, the declination and latitude of the Moon and hence its true declination ore determined.

The prathama (first difference) is the difference between true declination and sun's declination and a para is the difference between sun's declination and the Moon's declination. Now, the difference between the prathama and the apara is the increase or decrease in the difference of the Sun's declination and the Moon's true declination. The mathematical explanation is adopted by the scholars at modern

time. Which helps to determine patamadhyakala, patadhruvakakala and patasparsakala.

Vyatipata and vaidhrti are important from the point of view of pancanga or calendar. The verses committed to explain the method to find the time taken by the Moon to leave the end of a yoga, tithi and karana.

This general note according to the verses of Siddhantasundara is expected to understand the main principle of astronomy of ancient and classical age. There is small difference in concept of theoretical astronomy of different decades. Aryabhata started this journey accumulating previous knowledge and initiating mathematical discussion. Bhaskara supported this school but in early age Brahmagupta become a great critic of Aryabhata. In khandakhyadaka, he agreed with Aryabhata, Bharkayacharya supported Brahmagupta and composed a large volume containing four chapters. Jnanaraja composed this text which is important for its addition of yantramala, rtuvarnanam.

Section: Goladhyaya

I praise the god, Ganesha on whose forehead the moon rests, on whose temples a line or black bees congregated in search of nector who is the god of success, at whose feet the heart of the gods, and whom even Brahman, desiring to create three worlds, served for the sake of unhindered success, I, Jnanraja, am composing Siddhantasundara, which is correct. I am bowing down to my teachers as well to Bhuvenshwari, whose blessing has destroyed darkness who was worshipped through a yantra, respecting that deity I am starting to compile Siddhantasundara. According to the knowledge given by Brahma, which is present in Bramasiddhanta in Sakalyasamhita the previous knowledge of motion of planets. In the slokas I am presenting that knowledge precisely, with demonstration. Brahma compiled eight Siddhantas, Surya, Soma, Vasistha, Romaka, Pulastya, Brhaspati and Garga. The methods planetary motion are given

in three books. To cross over the difficulties by demonstrations of siddhantas were made by Bhojraja, Varahamihira Son of Jishnu, caturveda, Aryabhata and Bhaskara.

The three Vedas came forth for the sake of rites such as sacrifices and so on. Time and direction in these sastras, which is to be studied by Brahmana, was taught by ancient sages.

Jnanaraja, son of Naganatha, compiled Siddhantasundara praising Ganesha. According to Indian tradition the bees are attracted by the forehead. The author says that even Brahma, desiring the three worlds, served for the sake of unhindered success.

Jnanraja noticed Tantrism, which means systems. He invokes Bhuvaneswari, the deity of tantra. This tantra is the text of astronomy. The source of Siddhantasundara is Brahmasiddhanta in Sakalyasamhita. Brahonasiddhanta in sakalyasmhita was narrated by Brahma to sage Narada. Brahmasiddhanta followed Suryasiddhanta, So, Siddhantasundara also followed Suryasiddhanta. In India, four Brahmasiddhantas were found one, Paitamahasiddhanta, two, Brahmasiddhanta in Sakalyasamhita, three, Brahmasphutasiddhanta of Brahmagupta and four, in Vishnudharmottora Purana. The Brahmasiddhanta mentions eight questions where this siddhanta belongs to second ‘prasna’. Jnanaraja also mentions eight treatises, Brahman, surya, soma (Candra), Varahamihira, romaka, Pulastya, Brhaspati and Garga. Dhavale edited Brammasiddhanta in Sakalyasamhita consulting nine manuscripts collected from different repositories, Somenath Chatterjee also studied this text and his published book contains translation and notes. Chatterjee translated those verses which are related to astrnomy. The third chapter consists verses describing rituals, astrological contents etc. Chatterjee avoids these verses in his book. The eight ‘prasnas’ are: first, Surya, second, Brahman; third Pulisa, fourth, Soma; fifth, Romasa, sixth, Garga Seventh Brhaspati; eighth, Vasistha.

Jnanaraja compiled this text when western astronomy started to induce Indian astronomy directly. In Medieval period, Arabic astronomy also took a crucial part in Indian astronomy. After

Bhaskaracharya's Siddhantasiromoni, not many elementary works were done in India Siddhantasundara is exceptional and compiled in crucial period.

The author called siddhantas as 'tantras'. Most probably, author respects 'eight' as his ancestor. He noticed eight tantras as eight limbs in the system of yoga, eight limbs in the system of ayurveda and eight astakas of the Rgveda. In the three Vedas, rites, correct timing for sacrifices depend on astronomical calculation.

It is said that ancient sages who begin their religious rituals during any forbidden time, such as during the intermission of study, is not 'dwija' twice born.

The statement of Veda conquers for the earth. The mouth of the lord is vyakarana; nirukta is said to be his ear; likewise, his nose is siksa; Jyotisa is his eye; his pair of hands is Kalpa and his pair of lotus like feet is chanda. In this way six limbs are identified for measuring and recognition.

Specifically Jotihsastra has three divisions; astronomy, astrology and hora. The computation of planetary motion is the part of astronomy, the siddhanta texts with the help of mathematics gives the measure of a Kalpa and Computations is with demonstration.

The principle of creation of this words is the combination of prakriti and Purusa'. The basic elements of creation are sound, sky, wind, light, water, from water the another basic element of smell arose, earth arose and jointly this world arose.

Astronomically ascendant means a point on the horizon where the ecliptic is rising. The forbidden time means a woman has the same ghatika as a given man has the same ascendant , So, that woman is a sister, not marriageable. An action about direction is fruitless, so tithis are explained. The science of astronomy is explained through such metaphor which is the tradition of India. The Vedangas, limbs of the veda, are sir auxiliary disciplines through which Vedas are properly understood. These disciplines are considered as the different parts of a body i.e. mouth as vyakaran, nose as siksa, jyotisa as eye, hands as Kalpa, feet as chandas, Kalpa is considered as the age of

creator – god brahma, 432000000 years. The Indian astronomical knowledge in divided into three divisions, astronomy, science to explain motion of planets, time, direction, space; astrology, tries to explain the fate of fellows assuming the application of planets and stars; hora is nothing but table of a fellow indicating his 'chak'

Very interesting, the author includes the cosmology according to Indian philosophy. Sankhya is one of the classic schools of Indian philosophy. The principle of this school of philosophy regards that this world as being composed of two elements prakriti and purusa. Jnanaraja tried to explain the creation in detail according to Sankhya school of Indian philosophy. Here purusa is considered as the universal consciousness, prakriti is choiceful consciousness. Both of them are eternal, timeless and immeasurable. According to samkhya philosophy, prakriti or nature in responsible for all manifestation and diversity.

The universe rests in the belly of the creator of all. From his two feet, the earth; from his naval, the atmosphere; from his head, the heaven; from his mouth, Indra and Agni; from his breath, wind. This explanation is found in the Veda. In the heart, moon rests; the Sun rests in the eyes. From his car, all the directions arose. This is the path of creation in the present kalpa.

The seven vital airs merged into the primeval persons during the previous destruction; created seven persons. By them, one creature was formed. He appeared from a lotus. This is fashioned by (Brahma) creator and it is called his creation. At first, Brahman created water from his own speech. He entered along with triple by means of a portion of himself. As a result an egg arose. From that portion, Agni arose. After pressing the pair of shells together and put them in the water, the earth was born. Then he joined with (earth) possessing a portion of Agni. An egg arose, and air was created.

At that place, atmosphere came from the shell of the egg. Joining with sky, having joined his own portion with air, he made an egg, the sun arose. In that place. The heaven arose from the shell of that egg and the sun beams arose from the juice sticking to the half-shell;

joining with sky by means of his own portion along with a portion of the sun an egg appeared. Referring Satpathabrahmana the creation of the universe is explained in this text. Here the author is trying to make a particular path of creation.

The term Kalpabheda is often used by the interpreters of the puranas. Kalpaveda means different kalpa (veda means different). Kalpa refers to the 4,320,000,000 years. A period of 47400 divine years during which the Earth, planets and so on are created, occurs at the beginning of the Kalpa is a basic idea of saurapaksa.

A divine year is considered as 360 of our years, so the period is 360 x 47400 = 17,064,00 years. This period is called sristikala. After the creation of the Moon, Sun and five great elements (Mahabhuta) Brahma created other planets and stars. According to Suryasiddhanta from fire was born the Mars; from Eath, the Mercury; from ether, the Jupiter; from water, the Venus and from wind, the Saturn.

There is a thought process explaining the sphericity of the Earth. In Indian thought Lanka, Romakapura, Siddhapura and Yamakot are four imaginary cities on the terrestial equator, each being 90° from its neighbors. In Indian philosophy pramanas (proof) are ways for acquiring knowledge. These pramanas come from different ways; direct observation, logical inference and now obsolete in science supernatural authority. Jnanaraja presented pramana by experience. Yojana, the unit of distance in Indian tradition, varies from 2½ miles to 9 miles differs in various contents. Here in consideration is if one travels from east to west, no change in altitude above the horizon is perceptible but a change in altitude is seen when traveling from north to south. Verse 25, says when travelling 14 yojanas north, the polestar is elevated 1°. If C be the circumference of the Earth in Yojanas, and since C corresponds to 360°, then

$$\frac{1}{14} = \frac{360}{C}$$
$$C = 14 \times 360$$
$$= 5040$$

So, the circumference of the earth is 5040 Yojana. Jnanaraja describes the geography of the northern hemisphere is almost similar described in Siddhantasiromani. Motion of the celestial sphere is explained in Siddhantasundara nicely. The seven winds surrounding the Eath are Avaha, Pravaha, Vdvaha, Samvaha, Subaha Parivaha and Paravaha. The celestial sphere at the earth's equator is constantly carried towards the west by the Pravaha wind. According to mythology, to the gods it appears to move to the right and to the demons, to the left.

The Sun moves from the first point of Aries to the last point of Gemini in three months. Again from the first point of Libra to the last point of Sagittarius in three month. The greatest altitude of the Sun is 24° from the horizon during the day of the gods or demons. The Zenith is 90° from the horizon. This is equivalent to 14 ghatikas along the equator. So, when the Sun has its greatest declination of 24° and reaches its great latitude. The gods see the Sun during the first half of the solar year; the demons, see it during the second half.

The bright half of the moon increases periodically and the dark half is that during which the dark portion increases. So, the morning twilight is the eighth day of the Moon in the dark half of the lunar month and the evening twilight is the eighth day of the Moon in the light half of the lunar month. Since on the day of the new moon the Suns disc is just above that of the Moon, to the manes, the Sun appears to be on the zenith. As the Moon recedes from its position below the Sun, the Sun appears to be declined. Then, on the middle of the eighth day, when the Moon is at a distance of 90◦ from the Sun, it appears to be on the horizon.

On the full moon day, the Sun is hidden by the Moon's disc which is at a distance of 6 signs from it. Again on the eighth day, when the Moon approaches the Sun, the latter is visible. Then, gradually, it rises above the horizon.

Sisyadhivrddhida tantra of Lalla describes this chapter in another form. In goladhyaya. Maddhyagativasana is well organized. The creator's day Lalla explained as 'Brahma the creator, stationed at a

greater distance from the Earth, Sees the Sun at all times. So the day is different from that of the gods. When he closes his eyes, it is night for him and vice versa. During the day of Brahma, the Earth increases 1 Yojana and all its sides, during the night this imaginary growth of the earth is destroyed. The whole creation gradually destroyed and created. This is the notion of our traditional knowledge; Jnanaraja did not ignore such myths associated with cosmology, motion of the earth and other planets.

In the chapter of chedaka, we get the concepts of different circles like kaksyavrtta. A planet's own orbit with radius equal to the semi-diameter of the planets orbit and graduate it with the divisions of degree and minutes. Knowledge of the sphere of universe is essential to an astronomer. The astronomers depend on the sphere of the universe for calculations of position of planets, motions of planets etc. the mean motions of the planets are clearly perceptible on the armillary sphere. If the circumference of the Kakasyavrta is divided into 12 signs following the 12 signs of the Zodiac and the earth at the centre of the circle, it can be easily explained. From this circle we can get eccentric circle or kendravrtta. With the upper end of the diameter a centre and radius equal to the radius of the epicycle, if we draw a circle, we get nicocavrta or the planet or epicycle of the planet. When a planet is at a distance of 6 signs from the apogee, it is said to be at the perigee or nica when a planet is at the perigee, it is nearest to the earth. Thus a planet appear small or large accordingly. The formula which Jnanaraya adopted from lalla. For the first correction to the motion of a planet is

$$\frac{Correct\ manda\ epicycle}{80} \times \frac{bhogyakanda}{225} \times motion\ of\ mean\ anomaly$$

And formula for the sighra correction to the motion of a planet is

$$\frac{correct\ sighra\ epicycle}{80} \times \frac{bhogyakanda}{225} \times \frac{R}{hypotenuse} \times motion\ of\ sighra\ anomaly$$

When the anomaly is within 6 signs, beginning with Capricorn, its Rcosine is above the Rsine antyaphala. So, their sum is the correct Rcosine. Again, when the anomaly is within 6 signs beginning with cancer its R cosine is below the Rsine antyaphala. So their difference gives the correct Rcosine.

In Indian system the distance between the centre of the earth and the true position the planet is known as hypotenuse or karna the correction or phalo is determined where the hypotenuse cuts the arc of the concentric intercepted between the point and the position of the mean planet. At the end of a revolution of a planet there is no difference between its mean and true motions. The various phenomena relating to a planet, such as its rising, regressions, etc. arc only apparent.

Further chapters of goladhyaya section are self-explanetary. But in yantramala chapter, all precious astronomical instruments are studied. Not only previous knowledge of instruments, some innovative ideas are found. One instrument is noticed here which is not known before. Jnanaraja did an excellent job in rtuvaranam chapter which is unique in astronomical text.

Concluding Remarks

Siddhāntasundara, an astronomical text was composed in the early sixteenth century (1503 CE). At that very time western science was floursing in and other parts of the world. Two different titles, Siddhāntasundara and Sundarasiddhānta, are used in manuscripts, as well as in secondary sources, though Siddhāntasundara is mostly used.

Jñānarāja explicitly says in the verses of the golādhyāya that what he has put into his own verses and augmented by adding vāsanās is the astronomical knowledge that was spoken by Brahman to the sage Nārada and written by Śākalya, in Brahmasiddhānta in Śakalyasaṁhitā. This is the main source of Siddhāntasundara. The Brahmasiddhānta mentions eight personage as the authorities from whom the since of astronomy originated.

एतच्च मत्तः शीतांशोः पुलस्त्याच्च विवस्वतः
रोमकाच्च वशिष्ठाच्च गर्गादपि वृहस्पतेः
अष्टधा निर्गतः शास्त्रं स्वयं परमदुर्लभम .....

Jñānarāja also names the same eight sages as the originators of eight treatises:

(i) Brahman, (2) Śūnya, (3) Candra, (4) Vaśiṣṭha, (5) Romaka, (6) Pulastya, (7) Bṛhaspati, and (8) Garga. Brahmasiddhānta is considered as second praśna (द्वितीये प्रश्ने). Dhavale edited first the text and he found some details about eight praśnas. Chatterjee also edited examining Dvavale's edition and other four manuscripts where the author indicates eight praśnas. The eight astronomical treatises are

considered old siddhāntas. These siddhāntas are titled according to the spokesman or teacher like Sūryasiddhānta, the siddhānta which is explained by Surya to Maya, similarly Brahmasiddhānta was spoken by Brahma to Nārada. Varāhamihira compiled five astronomical texts Sūryasiddhānta, Pitāmahasiddhānta, Romakasiddhānta, Pauliśasiddhānta and Vaśiṣṭhasiddhanta. This Sūryasiddhānta is old siddhānta. Popular Sūryasiddhānta is considered as modern Sūryasiddhānta

Jñānarāja follows the Indian school of astronomy in spite of then existing western influence and Islamic school of astronomy. When Jñānarāja composed this text then Islamic culture had already penetrated India. Jñānarāja learned Heron's method to find the square root of any given positive number by means of an initial approximation and iteration. Mathematical knowledge of the author is reflected in the text.

A few astronomical terns important to understand this text are explained below:

Epoch: The Indian astronomers are not keen observers but good calculators. They did not record the observation but calculated from observations an epoch the places the planets should occupy. Varāhamihira gives as the working epoch for the Paiāmahasiddhānta, saka 2; 80 CE; for the Romakasiddhānta saka 427, 505 CE etc. The modern Sūryasiddhānta actually works from the beginning of the Kali Yuga or 3102 BCE.

Ahargaṇa: Ahargaṇa means 'sum of days' return to a method of calculating the number of years, intercalary months and omitted tithis in a yuga, the number of civil days (sāvana) that have elapsed from a certain period, when the years, months, days (tithis), in which dates are generally expressed like 15 Feb 2022. Here days, month, and year are expressed. The astronomical texts give the years (Y) in a cycle, the intercalary months (Mi) in a cycle, and the omitted tithis (Do) in a cycle as the essential elements. From these elements other elements can be deduced.

Solar month (Ms) = 12 Y
Synodic month (Me) = 12 7 + Mi
Sidercal month (Msi) = Me + Y
Solar days (Ds) = 30 Ms
Tithis (De) = 30 Me
Civil days D = De − Do

Celestial coordinates: For bodies on or near the ecliptic, ordinary celestial longitude was used. The method was not sophisticated. In the Pañcasiddhāntikā the two stars of Punarvasu, are given the same longitude and latitude.

To express the latitude of a star its distance in angulas from the ecliptic was given, the moon's diameter being divided into 15 angulas. Later the co-ordinates used for defining the position of stars were the ecliptic and the great circle passing through the poles of the equator and ζ Piscium. The longitude is then the part of the ecliptic intercepted between ζ Piscium and the point of intersection of the declination circle passing through the star and the ecliptic. The corresponding latitude (β_1) is the part intercepted on the same declination circle between the star and the ecliptic.

Precession: The rule for calculating the amount of precession is –

In a Yuga (4,320,000 years) the circle of the asterism falls back east-ward six hundred revolutions.

The period of revolution is $\frac{4{,}320{,}000}{600} = 7200$ years the revolutions referred to be those of a point on an epicycle whose centre is at a fixed point on the ecliptic as deferent and the radius of the epicycle is $\frac{3}{10}$ of the radius of the deferent. The angle subtended by the radius of the epicycle at the centre of the different is approximately $17\frac{1}{2}$ degrees. In one revolution epicycle the precession is $4 \times 17\frac{1^{\circ}}{2}$ and as one revolution taken place is 7200 years the amount of precession a year is approximately 35 seconds.

Nakṣatra and its meaning: The nakṣatra, means constellation, occurs quite a number of times in the Ṛgveda and others. In the

Atharvaveda all the 27 nakṣatras or constellations enumerated. Griffith has attached the following notes with these nakṣatras:

Kṛttikā – one of the lunar mansions, Pleiades.

Rohiṇī – a lunar asterism personified as the daughter of Dakṣa and the favorite wife of the Moon. It is called Rohinī, the red, from the colour of the constellations principal Aldebaran.

Mṛgaśirā – a lunar asterism containing λ Orionis.

Ārdrā – the fourth of sixth lunar asterism.

Punarvasu – the fifth or seventh lunar asterism.

Sunṛta – pleasantness, a name of the Uṣā or dawn

Puṣyā – the sixth or eighth lunar asterism

Aśleṣā – the seventh lunar asterism (Āśleṣā)

Maghā – the tenth lunar asterism. Sometimes regarded as the wife of the Moon

Svātī – the star Arcturus, as forming the fifteenth lunar asterism.

Citrā – spica, virginis the twelfth lunar mansion.

Phālgunī – forming part of a double nakṣatra.

Hasta – the thirteenth lunar asterism.

Rādhā – Success

Viśākhā – One of the nakṣatras or lunar mansions.

Anurādhā – the seventeenth lunar mansion.

Jyeṣṭhā – the sixteenth lunar mansion.

Abhijit – the twenty-seventh lunar mansion.

Śravaṇā and Śraviṣṭhā – lunar asterism twenty-eight and one

Śatabhiṣā/Śatabhiṣāk – the twenty-fifth asterism.

Proṣṭhapadā – a double nakṣatra, the third and fourth asterisms.

Revatī – the fifth asterism.

Aśvayujā – two –horse-harnessers; the head of Aries, forming according to one account the first.

Bharaṇī – three stars forming the seventh asterism.

Griffith concludes that these nakṣatras, the asterisms in the Moons path, were twenty seven in number according to the earlier reckoning and twenty-eight in later astronomy. But the number twenty eight in connection with the enumeration of the nakṣatras occur in the Atharvaveda.

अष्टविंशानि शिवानि शग्मानि सह योगं भजन्तु मे

The word 'nakṣatra' has been used in three senses

a) a star in general sense;
b) 27 equal parts of the zodiac;
c) Asterism in the zodiac belt

The first and the third are the most frequent meaning of the word in the vedic saṁhitās. It may be that the zodiacal belt was divided into 27 equal parts called nakṣatras. In earlier literatures star groups like Kṛttikā, Mṛgasirā etc. are referred as nakṣatra.

True positions of planets:

The Sūryasiddhānta states that the circle of asterisms, bound at the two poles, and impelled by provector wind revolves eternally, and attached to this, are the orbits of the planets - Saturn, Jupiter, Mars, Sun, Mercury, Venus and Moon in this order. Ancient astronomers accepted this order. The orbit of planet that is situated 'higher' is larger than the one 'below' it. Thus the Moon makes many revolutions, and Saturn does a much less number of revolutions because the orbit of the moon in very small. The provector wind is believed to impel the planets towards their 'ucca', and being drawn forward and back ward, the planets are regarded as moving with varying

motion. The word 'ucca' refers to both mandocca (apex of the slowest motion) and sighrocca (apex of the swiftest motion). According to Indian astronomers, wind is not related to the acceleration or retardation of the rate of the planet's motion.

A major concern of Indian astronomers was to determine the true positions of the planets, particularly of the Sun and the Moon. They endeavored continuously to adopt refined methods for such determinations and have provided details, such details also throw light on their trigonometrical and associated mathematical skills.

According to modern astronomy, the planets excepting the Moon, revolve in orbit, of which the centre is the Sun. As a result of their distances from the Sun, Mercury and Venus revolve round the Sun in orbits smaller than the Earth's; Mars, Jupiter and Saturn revolve in orbits larger than that of the Earth and the orbits are not circular but elliptical with the Sun at one of its foci. Greek planetary model is a little different from Indian model. Long before Ptolemy, it had been noticed that the motions of the Sun, Moon and the planets Mercury, Venus, Mars, Jupiter and Saturn in the back ground of stars were not regular. Apolonius of Perga (230 BCE) is credited with the epicycle to be accounted for the irregularities. Hipparchus (130 BCE) was able to explain the solar motion successfully, using the epicycle or the eccentric models to be accounted for the equation of centre. It was left to Ptolemy (150 CE) to give a more satisfactory account of Moon's motion. In his Almagest, Ptolemy states that he was the first to establish a theory of planetary motions.

Ptolemy accepts the order of the planets assumed by the ancient astronomers, namely, Moon, Mercury, Venus, Sun, Mars, Jupiter and Saturn. All irregularities in the motion of a planet can be accounted for through combinations of uniform and circular motions. Ptolemy states that there are two apparent anomalies for each of the five planets:

(i) the zodiacal anomaly which depends upon the position of the planet on its ecliptic, and

(ii) the solar anomaly, which varies according to its position, relative to the Sun.

Ptolemy gives the mean periods and the synodic periods. Ptolemy combines the eccentric and epicyclic systems, the former to be accounted for the zodiacal anomaly, and the later for the solar anomaly.

Graceo-Arabic astronomy is geocentric. The Earth, a tiny point comparison with the vast dimensions of the universe at its centre. The universe consists of thirteen concentric spheres, four terrestrial and the remaining nine celestial. Of the latter, each of the seven lower ones is made up of a number of components called eccentric and epicycles. The eccentrics revolve with uniform circular velocity round different centres. Each of the seven planets is studded within an epicycle, which in its turn is fixed is the eccentric. The foundation of Islamic astronomy was laid in the very beginning of Islam but properly started from the reign of second Abbasid caliph al-Mansur (753–774 CE) when the Almajest and the Brāhmasputasiddhānta were translated into Arabic. The tenth century CE was the golden period of Islamic astronomy. The latter half of the tenth and the first half of the eleventh century produced four eminent astronomers. Ibn sina, al-Biruni. Ibn-ul-Haytham and Ibn Yunus. It was in the beginning of eleventh century that al-Biruni was exiled into India and he introduced the study of Graeco-Arabic astronomy in India. In the latter half of eleventh century, the saljuq sultan malik shah built an observatory to determine the true time of vernal equinox as well as to reform the calendar.

In the latter half of the fourteenth century the centre of scientific activities shifted to central Asia. Timur besides being a famous conqueror, was a great patron of science and this tradition also continued in his dynasty. His grandson ulugh Beg was a great scholar of mathematical sciences. He founded the first academy of science in modern times. Ulugh Beg erected an observatory at samarquand (1420 CE) under the directorship of Qadi zadeh and Jamshed kashi.

The findings of the observatory were compiled by Ulugh Beg with the help of Qushji in what was subsequently called Zij-i Ulugh Beg. Zij is a set of a number of astronomical tables proposed directly or indirectly on the basis of the findings of a particular observatory. In Indian literature the term Zij seems to have been explained first by Abul Fadl in his Ain-i-Akabari and later on by Mulla Farid, the court astronomer of Emperor Shahjahan in his astronomical work Siraj ul-Istikhraj and Zij-I shahjahini.

Jñānarāja developed his work in this situation. Theoretical as well as observational data are collected in different parts. Astronomical instruments are explained in Siddhāntasundara nicely and one new concept is there. Like the other early cultures, Vedic culture was also noted for its observations of the luminaries of the sky. The Ṛgveda speaks an instrument, a quadrant, turiya. There is also view that the Aitereya Brāhmaṇa indicates the earliest use of gnomon in India in the context of the summer solstice and the viṣuvat in the middle of a year. There is no tangible evidence in the Vedas to prove beyond doubt the observations of gnomonic shadow for determining the time. However naked eye observations of the movements of the Sun and the Moon, their rising and setting points, their northward and southward motions were made continuously by the Vedic priests as evidence by a statement of the kauṣītaki Brāhmaṇa.

Gnomon: the earliest use of gnomon for the determination of cardinal points can be found in the description given in the kātyāyana Śulbasūtra. This text says, ‘After placing a śaṅku (gnomon) on a level ground, and describing a circle with a cord whose length equal to that of the gnomon, two pins are fixed on each of the two points where the tip of the gnomon- shadow touches the circle in the forenoon and afternoon respectively. The line joining these two points is the east-west line.’

The water instrument or clepsydra has been briefly described in both the Ṛgvedic and Yajurvedic recensions of the Vedāṅga Jyotiṣa, in terms of emptying water in a vessel in a time unit of one nādikā. It may be noted that two nāḍikās constitute one muhūrta. Kauṭilya’s

Arthaśāstra states that, 'a hole in a jar of four māṣaka-s of gold made into four aṅgulas in length with water flowing through it, measures one āḍhaka'. Indian astronomers developed and used basically twelve types of instruments. They were: the gola; bhagana; cakra; dhanus; ghati; śañku; śakaṭa; kartarī, pīṭha; kapāla; śalāka and yaṣṭi.

Lalla says, "No astronomical treatise is complete without a section on the sphere of the universe, just as the night is not lovely without the rays of the Moon, no woman without breasts, and on feast without sweets; the importance of the knowledge of the armillary" sphere was stressed by Lalla; Jñānarāja stressed on water instrument.

Siddhāntasundara is unique for its chapter ṛturvarnanam, where the author follows Kalidasa. This poetic feeling has been saturated, with astronomical concept. In Siddhāntasundara, the astronomical text of late medieval era when the knowledge, is being mixed with islamic and western culture. After a few years, planetary model has been changed; geocentric to heliocentric with Copernicus, started scientific revolution which is considered as the epoch of modern science.

APPENDIX A:
Astronomical Technical Terms

adhikamāsa: A month gained by the lunar reckoning over the solar. An adhikamāsa or intercalary month is a Synodic month; an intercalation takes place when two lunar months begin in the same solar month.

Samkraṁaṇa.- Intercalary month. Kalpādhimāsa × completed solar days – residual adhimāsa = solar days × completed adhimāsa (bījagaṇitaṃ)

adhyaradhāśriccheda: Right-angled triangle

adhva: Distance of a place from the prime meridian

agaṇitacāra: An anonymous work containing a set of astronomical tables for determining without actual calculations the movements of the planets with reference to Mars, Mercury, Jupiter and Venus.

agrajyā: The Hindu sine of the arc of the horizon in between the rising point of the Sun and the east point.

akṣajyā: The term is used for the sine of the latitude

akṣa(or) Pala: Latitude (Terrestrial)

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

akṣakarṇa: The hypotenuse of the gnomonic triangle when it's shadow is equal to what is called *aiṣuvat-chāyā*.

ākṣavalanam: 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.

antyā: The Hindu sine of an arc of the celestial equator corresponding to Hṛti. It is used to signify the point where the Sun rises, as projected on the equatorial arc. It also shows the measure of half-day length at given latitude.

antyakarṇa: to calculate the true place of a planet this term is īused for variable hypotenuse (śīghrakarna).

apakrama: used for the declination of the Sun

Asta: Setting or heliacal setting.

Ayanabindu: Solstice.

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.

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.

Āyanavalanam: The angle at the point of a star, between its declination circle and the secondary to the ecliptic through the star.

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.

Bhāga: A degree.

Cāpa: Arc.

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.

Cāndra-māsa: The time between two consecutive full moons or New moons.

Chāyā or Bhā: Shadow cast by the gnomon.

Chāyābhuja: The projection of the shadow on the east-west line.

Chāyākraṇa or Bhākarṇa: The hypotenuse of the gnomonic triangle whose two sides are the gnomon and its shadow.

Chāyākoti: The perpendicular from the extremity of a shadow on the east-west line.

Dhruva: The star near the celestial pole or the celestial pole itself.

Dhruvaka: The celestial longitude.

Dhruva-protavṛttam: The declination circle.

Digjyā: The Hindu sine of the azimuth measured by the angle between the prime vertical and the vertical of a star or a planet.

Dorjyā or Bhujajyā: Hindu sine of celestial longitude.

Dṛgjyā: The Hindu sine of the Zenith distance.

Dṛg-lambana: Total parallax.

Dvāparayuga: Twice the period of a kaliyuga.

Dyujyā: The Hindu cosine of declination or the radius of the celestial equator to be R equal to 3438 units.

Dyujyā-vṛtta or Ahorātra-vṛtta: The diurnal circle of a star or a planet.

Ghaṭi or Nāḍi: An interval of time equal to 24.' (minutes)

Grahaṇa: Eclipse.

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.

Kadamba: Pole of the ecliptic.

Kadamba-protavṛtta: A secondary to the ecliptic through a star or planet.

Kakṣamaṇḍala: The deferent of a planet or the circle with the earth as centre and radius equal to 3438 units.

Kalā: The Hindu sine in the diurnal circle corresponding to the Sūtra (given bellow).

Kalā or Liptā: A minute of angle.

Kaliyuga: The period consisting of 4,32,000 mean solar years.

Kalpa: Dvāparayuga is twice Kaliyuga; Tretāyuga thrice and Kṛta four times. All these put together constitute a Mahāyuga. 71 Mahā-yugas make one Manvantara. 14 Manvantaras with what are called Sandhi periods on either side equal to a Kṛtayuga or thousand Maha-yugas make a Kalpa.

Kramajyā: Hindu sine of an angle.

Karṇa: Half of the duration of a tithi.

Karṇāgrajyā: The Hindu sine Agrājyā

Ketu: The diametrically opposite point of Rāhu. Rāhu also means the circular section of the earth's shadow at the moon.

Krānti-Vṛttam: Ecliptic.

Kṣitija: The Horizon at a place.

Lagna: The Rāśi which rises at any moment or the rising point of the ecliptic.

Lambana: Parallax in longitude.

Mahāyuga: The Sum of four yugas.

Manvantara: A period equal to 71 Mahāyugas.

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

Nākṣatra-māsa: The time taken by the moon to go from Aśvinī again to Aśvinī.

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.

Prācī: East point.

Prācyaparā: East-west line.

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.

Rāśi: An arc equal to 30 degree (on the ecliptic).

Śanku: Gnomon.

Śankucchāya: The shadow cast by the gnomon.

Saura-māsa: The time when the sun occupies one Rāśi.

Tithi: The time taken by the elongation of the moon to increase by 12 degree starting from zero.

Trijyā: The Hindu sine of three Rāśi's or 90 degree equal to R or 3438 units.

Udaya: Rising or heliacal rising.

Vighaṭī or Vināḍī: One sixtieth of a ghaṭī.

Vikṣepa: Celestial latitude.

Viṣuvatbindu: Equinoctial point.

Vṣuvat-Vṛtta: Celestial equator.

Vṛtta or Maṇḍala: A circle.

Yaṣṭi: R^2 -Āyanavalanaj$ā^2$. 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*.

Yoga: The time which elapses when the sum of the longitudes of the sun and the moon to increase by 13º10′3″ starting from zero.

Yuti: Conjunction.

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Critical Apparatus

Manuscripts used for critical apparatus: B1, B2, B3, B4, B5, B6, B7, A1, A2

B1, B2, B5, B7 start with grahagaṇitādhyāya

B3, B4, B6 start with golādhyāya

A1 & A2 are incomplete

Section - Grahagaṇitādhyāya

madhyamādhikara

Verse 1 गजाननायनम्, ङ, B4 गणेशायनमः
Verse 2 युगै B3, स्तु / तु B4
Verse 3 अयुत / अयुतं B3 / B4
Verse 4 वर्ष / व B7 A2, महदिने / मह दिने B5
Verse 5 युगमथ / युगमय B5
Verse 8 प्राह / माह B5
Verse 9 मूनि / मूनिः B7
Verse 10 दृश्यन् / दृश्च B6, तेतरं / ते B4 B7
Verse 12 त्रि / त्रिक B6
Verse 14 मसो / समो B2 B3 B7
Verse 15 कुघ्रवाणं / कुघगवाण B2 B3 B5
Verse 16 चान्द्र / चंद B2 B3
Verse 17 भगणवर्जित / भगणवर्ज्जत B3 B7
Verse 19 दनादन्ति / दंनिदंत B3 B7
Verse 20 भर्गण / भगण A1 B3 B5, युगमेता / युगेमता B5 B7
Verse 21 पञ्चाङ्ग / पंचागं B3 B5

Verse 22 भुजङ्गामि / भुजंगामि B5 B7
Verse 23 ग्रहाः / ग्रहा B2 B3 B7
Verse 24 कल्पे / कस्पे B2 B3 B5, दिशौ / दिशे B B7
Verse 27 तरू / तरूः B3 B5 B7, कल्पये / काल्पय B5
Verse 30 भूक्ति / भूक्ति B2
Verse 32 प्रतिदिनं / प्रतिदिन B7
Verse 33 साम्यं / याम्य B5
Verse 36 तत्समो / तत्स्ममो B7
Verse 40 wrongly numbered B7
Verse 43 सौरार / सौरारि B5
Verse 45 सूर्यचक्रै / सूर्यचक्रे B3 B7
Verse 49 एवमेव / एव B3, सित B4, / शोधितः / शोधित / शोधिताः B7
Verse 52 मासक / मास B5
Verse 55 तिध्यन्त / तिध्यन्त B5
Verse 56 गणत्फल / गणःफल B5
Verse 58 श्रुतयो / शुतयो B5, मौमे / मैमो B4, वर्गो / वर्गा B5, स्तु / स्तू B5 गुणो / गुणे B2
Verse 61 कुरामा / कुरामाः B7
Verse 62 रस / र B5
Verse 63 जीवे / जीर्वे B5 B3
Verse 64 padas are wrongly numbered B5 A2
Verse 66 विकलिकाशु / विकलिकासु B7
Verse 69 गन / गण / गुण B5
Verse 75 अलब्धो / अलब्धा B3
Verse 77 चान्द्रमासे / मासे चान्द्रे / मासे चांद्रे B7
Verse 78 wrongly numbered वस्तरे / वंस्तरे B5
Verse 82 मय / मिति B3
Verse 84 wrongly numbered B3 / नन्द / नंद B3 /लङ्कातः B3 लङ्कावः B4
Verse 88 wrongly numbered B3, प्रस्फुटो B2 / प्रस्फुटः B5
Verse 89 numbered as 88 मयाति B4 / मयान B3 / मयात्र B5

spaṣṭādhikāra

Verse 1 जनन / जननि B4
Verse 2 नागाः / नागा B4

Verse 3 नगेन्दु / नखेंकु B5 B7
Verse 6 not numbered B4 रुपरिगा / रापरिगा / अपरिगा B3 B5 B7 परयो / पस्यो B3
Verse 8 not numbered B4 दलतः / दलत B4
Verse 11 स्तयोः / स्तयो B5 फलन्मिता / फलन्मित B5 B7
Verse 14 अयाता / अजाता B7 केन्द्रशीघ्रे / शीघ्रो corrected form
Verse 16 वलये शका / वलये शकाः between these two words भागः शराः B5 enclosed
Verse 25 wrongly numbered B4 सम्यङ्नन्द / सम्य
Verse 28 गमे गम स्फुटा स्फुटाः B3 B4 गतिः गति B5 केन्द्र केंद्र B5 B5
Verse 29 numbered as 28, ms is not clear खेचरानाम् / खेचरानां B5
Verse 32 गतिभिः / गतिभि B1; स्फुट / स्फुत B7; गुणं / गुण B1
Verse 34 भवनज्या / भुवनज्या B5 B7
Verse 36 मृताङ्ग / मृतांग B5; तस्ट / तस्टं B5
Verse 40 wrongly numbered B7; सिञ्जिनीकृति / शिंजिनीकृति B5
Verse 41 पादीनार्क / पादीनाद्धु B3 विस्तृते / विस्तृतौ B5
Verse 43 कालः / काल B3, कोलाः B4; यदा / वदा B1; सदा B3 समास्ततो / समस्ततो B4 B5
Verse 46 wrongly numbered B5; त्रिंशद्घाटी / त्रिंशदघटी B7 विषुव / विशुव B1
Verse 47 निगदिता / न गदिता B5 B7 मुनि / भुनि B5
Verse 48 इत्थं / इति B5

tripraśnādhikāra

Verse 1 सद्वासना / यद्वासना B2, मिधास्ये / निदास्ये B5, जनित / जनिता B1
Verse 4 गताथ / गताथं B2 B5
Verse 6 कोटिर्नि / कोटिनि B2
Verse 7 पूर्व / पूर्वं B1, कुज्यका / कुज्यक B5, मण्डल / मण्डलं B5
Verse 10 समनाथ / समना च B2 B3, दोरिति / दोरति B3
Verse 15 उत्रा / उत्क्रा B3, खण्डै / खण्डा B5 B5. In this verse there exists some letters probably which are not known to Pingree
Verse 16 काग्राप्र / काप्र B5, अग्रादि / आग्रादि B3
Verse 18 not numbered
Vese 20 not numbered B5 हतं / हृतं

Verse 21 क्रान्ति क्रान्त B5
Verse 22 अव्यक्ता / अव्यक्षा B3 B5
Verse 23 तुल्य /तुल्या B2 B3 B4, नृपति / नृपती B5, शशि / शशि त
Verse 25 not numbered B3, तन्मुलं / स्तन्मुलं B5 B7
Verse 27 भूगोलं / भूगो B2, परिकल्प / परिकल्प्यं B5
Verse 29 कोटिज्या / कोटिज्यां B2 B5, कोटि ज्या B7
Verse 30 not numbered B3 B4 अपि च / उदाहरणं B3
Verse 32 पदे / मते (not correct)
Verse 35 सूत्रम् / अथ सूत्रम् B2
Verse 37 अथ कालसाधनम् सूत्रम् सोधनम् B3
Verse 38 दले / गुणे B3, स्वपला / स्वप (ला) B1, वशै / दशी B3
Verse 41 not numbered B3 B4, पतितं / पतिता B4 B5
Verse 42 वलय / वल B3, स्मृत / स्मृतिः B5

parvasambhutyādhikāra

Verse 1 रामै / रमै B3, गुणै / गुणौः B5, लभ / लाभः B5
Verse 2 दिनमणिः / दिनमणे B5, नयाति / न्यपाति B3, तमः / स्तमः B3
Verse 4 विम्वं / विंव B3
Verse 6 स्वाह / स्वा B3, मोक्षां / मोक्षा B3, तया / नया B3 (incorrect)
Verse 7 गनाथा / नाथा B1, इति श्रीसिद्धान्तसुन्दरे पर्वभुतिनामाध्याय B5

candragrahaṇādhikāra

Verse 1 ग्रहण / गृहण B1 (incorrect), पुच्छ / पुछ B5
Verse 2 श्रुति / स्मृति B5 A1
Verse 3 wrongly numbered (क)संहतो / संहतो B5
Verse 4 तथापि / तथपि wrongly numbered B3, करणे / करणो B3 B5, रिह / रिति B1
Verse 6 मेवम् / येवम् B3
Verse 8 शशङ्क / शशक B5, विम्वं / विंव B2A1, गतौ / गती B3 B1
Verse 10 मरीचि / मरिचि B4, विधु / विं B5, वुधै / वुधे B1
Verse 12 देशे / दोशे B1 B3 वङ्केन / वंकेन B4
Verse 13 भक्ताः / भक्ता B2 B4 काले / कालः B5
Verse 14 भानुजभुजा जीवा / भानुभुजा जीवा B5 B4, नीनितं / नोनित B1 / नुनितं B3 B5

Verse 16 भवतीह / भवती B1 मध्यमम् / मध्यकं B2, स्फुट निजम् / स्फुट निशि B1 निजं स्फुटं B4 B3
Verse 17 संमीनलनो संमीलनो B1 B2
Verse 18 केन्द्रं केंद्रे B5 तक्षेपवृत्ते तक्षेपवृत्तेः
Verse 19 न्मानै न्मैनै B1 B2 चन्द्रस्य चंद्रस्य
Verse 20 स्पर्शा / पर्शा / स्पर्श B3 निज / निजे B3, स्थिती / स्थिति(भ्यां) B1 B3, व्यर्केन्दु / व्यर्केंदु B3 B5, नाडिका / नाडीका B2, भुक्ति / भक्ते B3 स्थि / थि B3
Verse 22 पूर्वापरा / पूर्वेपरा B1 B3, विम्वे / विंवे B3, वलनानि / वलनादि B5
Verse 23 मयन / मयनं B5
Verse 24 परायापम् परा यापम् B5 परायामप B2 B4
Verse 25 मध्ये ऽन्तरं / मध्ये नारं B4, विमोक्ष / विमुक्ति B5
Verse 26 भादिका B2 B5, खल / खग B2 B4
Verse 27 नतगुणा / नगुणा B4, पल / फल B1 पले B2 correct form
Verse 29 मण्डलं / मं डंल (corrupt)B2, खेटे / खे टे B2, योस्तु योस्च B1 B2, तुल्यान्तरम् / तुल्र्यातरम् B3
Verse 30 ऽनुपाता / (नु)पाता / नुपात्ता B5, साक्षे / सापे B1, दुलनं / दुलना B1
Verse 31 कल्प्या कल्पा B5 A1 मन्डलाभं मन्डलाभ्पां B5
Verse 32 In B1, both halves of the verse are numbered as 32
Verse 33 numbered as 32 in B2, केन्द्राद्य / केन्द्रा B2 B5 केन्द्र / केंद B3
Verse 34 numbered as 33 B2 स्पर्श / स्पर्शा B5 विम्वग / विंवाग्र B2 B4 A2
Verse 35 पर्वान्तः / पर्वातः B5 B3 सूर्येन्दु / सूर्येंदु B3 B5 समगमो / समागमो B2 B5 भवतीति / भवतिति B3
Verse 36 दोज्या / प्रेज्या B1 दन्ता / दंतात्मा B2
Verse 38 पश्चिमतः / पश्चतः B1 B5 वलना / वाणः B3 A2
Verse 39 केन्द्रा –च B4, केन्द्रा-मध्य B4

Colophon इति सिद्धान्तसुन्दरे चंदग्रहणाधकारः इति श्रीसिद्धान्तसुन्दरे चंदग्रणाधिकारः (other manuscript)
Verse 1 समानकाले / स (म) मानकाले B2 चन्द्रावृंत / चन्द्रावृत्तं B2 रविगतं / रविगत B4
Verse 2 wrongly numbered B5 सुमतिभि / सुमति B5 A2
Verse 4 कोटिभास्कर / कोटिभार्कार B2 B5 A2 मय / मये B5
Verse 5 तानाः / ताना B2 B5 घटिकाचतुष्कं / घटिकाचतग्रं B2

Verse 7 संहतो / सेहतो B4 वर्गनत / वर्गा नत B2
Verse 9 not numbered, वेदा / वेद B2
Verse 10 तत्परि / त्परि B1 B3
Verse 11 विलम्वन / विलंवनं B5 B4
Verse 12 मुक्ति / भुक्ति B2 B4 क्रमतः / क्रमश B5 ग्रहे / ग्रही B4 तरणि / तरणि B2
Verse 13 wrongly numbered B4 गदिता / विता B5 B2
Verse 15 wrongly numbered B4 युगे / युते B5
Verse 16 जेन / जन B2 प्रोक्ते / प्रोक्तो B5

sūryagrahaṇādhikāra

Verse 1 अतिगतिरथसूर्यादग्रतः / अतिगतिरथसूर्यादाग्रतः B4
Verse 2 अखंड / आखंड B2 सुमयः / स्तमयः B2 B4
Verse 3 भास्वहते / भास्वऊते B2 B5 परत्र / परत्रा B2 B3
Verse 5 भौमातग्रहा / भौमाद्ग्रहा B2
Verse 6 स्त्क / स्तु B2
Verse 7 लध्बा / लध्ब B4
Verse 8 अक्ष / आक्ष B2 प्रभाह / प्रभाद्व B2
Verse 9 & 10 in B2 representation is different
Verse 11 विघ्ना / निघ्ना B3
Verse not numbered B5 B2, In B3 one folio is not found
चक्र / वक्रे B2 दिवाकर / दिवाटर B3

nakṣatracchāyādhikāra

Verse 2 वेचरा / तेचरा B2 तत्प्रापतः सायनह / तत्प्रा-नद B2 B3
Verse 3 उदंति उदेति B2 B5 निशयां / नीशाया B2
Verse 4 ध्रवक्ता / ध्रवका B3 B2 क्रमेयावलवः / क्रमेणवसव B2 wrongly written B3
Verse 5 not numbered B2 ध्रवाः / ध्रुवा B2
Verse 6 अशा / आशां, अश्वि / अश्व, सदेशे /सदैश B2
Verse 8 अर्कां / अक्र्का B3 पदोनं / पदेन B2 B5
Verse 9 वलिन / वलिनि B2 भेवि / शेहि B2 B3
Verse 10 the second half of the verse is omitted in B2
Verse 11 wrongly numbered

Verse 12 लुब्धक / लब्धक B2 ध्रुवको / ध्रूवको B2 कुंभ / कुभ B5
Verse 13 मध्यान्ह / मध्याह B5
Verse 14 स्तंभ / स्तंश B2
Verse 15 वशिष्ठः / वन्तिष्ट B3 B5
Verse 20 wrongly numbered B2 B3
Verse 21 विपति / वियति B2 B5

śṛṅgonnatyādhikāra

Verse 1 राजापुष्कर / राजापुष्करे B2 त्प्रतिविंवि / त्प्रतिविंव B2
Verse 2 (incorrect) शनु / भानु B2 B5 not numbered
Verse 3 numbered as 2 ज्ञानाद्ययः ज्ञानाहय (incorrect)
Verse 4 कमलव्योल / कमलगोल B3 B2 (कमि) लिनी B2
Verse 7 सारा / स्तण B2 सिते (अ) सिते B5
Verse 8 wrongly numbered B2 योर / त्रिर B2
Verse 10 श्कति श्रुति B2
Verse 18 कोटि शृति / कोटि श्रुति B3 B2
In ms B2 number of verses are wrongly numbered and sequence of verses is not regular manner

pātādhyāya

Verse 1 योजन / योगजनि B2 स्यातांत / स्यात्तात B2 B5
Verse 2 (स) / (त्र) B2 B5
Verse 3 शुन्ये शु B1 B3 B5 omit in B5 Ms
Verse 5 wrongly numbered B2 युक्तिः / युक्ति B3
Verse 6 wrongly numbered B3 त्रीनेः / क्राते B2
Verse 12 यात / पात B3
In different manuscripts number of verse are different.