O. NEUGEBAUER AND D. PINGREE

THE PAÑCASIDDHĀNTIKĀ OF VARĀHAMIHIRA

PART I

Det Kongelige Danske Videnskabernes Selskab
Historisk-Filosofiske Skrifter **6, 1**

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PREFACE

Written in the sixth century A.D., the Pañcasiddhāntikā of Varāhamihira is unquestionably one of the most important sources for the history of Indian astronomy and its relation to its Babylonian and Greek antecedents. The edition of the text with translation and commentary by Thibaut and Dvivedi, first published in 1889, has made the work generally available. But in the past decades not only have new manuscripts come to light, but also much new insight into Indian astronomy and into the astronomy of the Hellenistic period has been gained. It is hoped that the present publication will bear witness to the increase in our understanding of the Pañcasiddhāntikā thus obtained.

We are greatly indebted to the Kgl. Danske Videnskabernes Selskab, to the Institute for Advanced Study in Princeton, and to Brown University for their cooperation, which has made this publication possible.

O.N., D.P.

PART I

TEXT AND TRANSLATION

BY

D. PINGREE

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1. Introduction

A. Varāhamihira and his works

Varāhamihira, the son of Ādityadāsa, was a Maga Brāhmaṇa—that is, a descendent of one of those Persian Zoroastrians who entered India toward the beginning of the Christian era[1]. We learn from the penultimate verse of his Bṛhajjātaka (XXVIII, 9) that he was a native of Avantī or Western Mālwā (see also Pañcasiddhāntikā XVII,61) and resided in a village called Kāpattika. His date is delimited by his use of Lāṭadeva's epoch, A.D. 505, in the Pañcasiddhāntikā (see below p.8) and by the fact that Brahmagupta was familiar with his work when he wrote the Brāhmasphuṭasiddhānta in A.D. 628[2]. It has further been suggested that he was connected with the Aulikara court at Daśapura (modern Mandasor), and in particular with Yaśodharman who is known to have been ruling in Saṃvat 589 = A.D. 532[3], though no definite assertion can be made with regard to this hypothesis.

Varāhamihira was a prolific author in the three traditional skandhas of jyotiḥśāstra[4]. On gaṇita he composed only the Pañcasiddhāntikā; on horā he wrote the Bṛhajjātaka and the Laghujātaka; and on saṃhitā the Bṛhatsaṃhitā and the Samāsasaṃhitā. He also composed three works on military astrology—the Bṛhadyātrā, the Ṭikaṇikāyātrā, and the Yogayātrā—as well as a Vivāhapaṭala on the astrology of marriages. Several other works have been attributed to him, but their authenticity is doubtful.

Of the relative chronology of the works of Varāhamihira some notion may be derived from his cross-references. In Bṛhajjātaka XXVIII,4–6 he seems to indicate that his karaṇa, the Pañcasiddhāntikā, as well as treatises on interrogations[5], on

[1] See, e.g., D. K. Biswas, "The Maga Ancestry of Varāhamihira," *Indian Historical Quarterly* 25, 1949, 175–183. Traces of Persian influence on the Pañcasiddhāntikā are to be noticed in I, 23–25 and XV, 19. On the Maga Brāhmaṇas in general see now H. von Stieteneron, *Indische Sonnenpriester. Samba und die Sākadvīpīya-Brāhmaṇa, Schriftenreihe d. Südasiens-Instituts d. Universität Heidelberg* 3, Wiesbaden 1966.

[2] The date A.D. 505 is certainly not used in the Pañcasiddhāntikā because it is the date of his birth as is sometimes alleged. And there is no compelling reason to accept the tradition that he was one of the Nine Jewels at the court of Vikramāditya, no matter whom that shadowy figure is identified with.

[3] See D. Pingree, "The Empires of Rudradāman and Yaśodharman: Evidence from Two Astrological Geographies," *JAOS* 79, 1959, 267–270.

[4] A complete bibliography will appear in the appropriate volume of D. Pingree, *A Census of the Exact Sciences in Sanskrit*, to be published in the Memoires of the American Philosophical Society.

[5] We have no work on interrogations by Varāhamihira himself, but that of his son Pṛthuyaśas, the Ṣaṭpañcāśikā, does survive.

military astrology, on omens (saṃhitā), and on the time of marriage (the Vivāhapaṭala) had already been written. Moreover, Pañcasiddhāntikā I,22 seems to refer to the fact that he had not yet composed his books on horā, which include the Bṛhajjātaka. The Bṛhajjātaka, then, was written after the Pañcasiddhāntikā.

But Pañcasiddhāntikā XV,10 refers to Bṛhatsaṃhitā V,8–11, while the Bṛhatsaṃitā in several places (I,10; II (p. 22); V,18 (cf. Pañcasiddhāntikā VII–IX); XVII,1; and XXIV,5 (cf. Pañcasiddhāntikā XIV,34)) refers to the Pañcasiddhāntikā. Varāhamihira must have been working simultaneously on both texts. Furthermore, Bṛhatsaṃhitā II (p. 68) lists the subjects to be covered by a work on horoscopy, but this list is not a table of contents to either the Bṛhajjātaka or the Laghujātaka. Later (p. 71) there is a list of subjects for a work on military astrology, but again the list does not correspond to any of his three books on this subject; and, moreover, Varāhamihira only remarks that the subject has been written on by ācāryas when he would certainly have mentioned his own work if any such yet existed. It appears, then, that the Pañcasiddhāntikā and Bṛhatsaṃhitā were composed simultaneously towards the beginning of his writing career, the Bṛhajjātaka towards its end, and at least one work on military astrology and the Vivāhapaṭala in between.

Against this theory it may be objected that Bṛhasaṃhitā I,10 states that Varāhamihira had previously written extensively ("vistaratas") on genethlialogy, military astrology, and marriage. Either one must conclude from this that he wrote all of his major works simultaneously, or assume that I,10 was added to the Bṛhatsaṃhita by Varāhamihira after he had finished the Bṛhajjātaka. The latter seems to us the more probable solution.

B. The epochs of the Pañcasiddhāntikā

Varāhamihira in I,8–10 indicates that the ahargaṇa of the Romaka is counted from sunset at Yavanapura, which begins a Tuesday, at the beginning of the śuklapakṣa of Caitra in Śaka 428. We identify this date with 6 P.M. at Alexandria on Monday, 21 March 505 A.D., when the sunset day Tuesday began. The sunset at Yavanapura is reiterated in XV,18, where it is attributed to Lāṭācārya, the "commentator" of Varāhamihira's Romaka; and the Tuesday is confirmed by the rules for determining the week-days in I,17–21[6]. In VIII,1–5 we are given the Romaka's kṣepas for sunset at Avantī on 21 March 505, from which it is clear that a mean conjunction of the Sun and Moon will indeed occur (by the Romaka's calculations) shortly before sunset in Yavanapura.

In the ārdharātrika system, which is used by Lāṭadeva's (?) Sūryasiddhānta, a sidereal year ends at 0;3,9 days after midnight at Avantī of 20/21 March 505. It is for this time, or rather for the midnight exactly, that the kṣepas of the planets are

[6] The long discussions by Dikshit and others about whether this date is really Caitraśuklapratipad are irrelevant as their computations are based on the elements of the ārdharātrica system, not on those of the Romaka.

given in XVI,1–6. However, it appears that there was an earlier Sūryasiddhānta which employed a noon-epoch; the kṣepas of the Sun, Moon, lunar apogee, and lunar node are given according to it for noon at Avantī of Sunday, 20 March 505. These deviations from the epoch of I,8 are due to the facts that the parameters of the various siddhāntas do not yield identical times for conjunctions and that days are assumed to begin at various epochs.

But Varāhamihira not only does not use a single epoch throughout his work; he also fails to inform his reader accurately of the dates and sometimes even of the existence of the epochs he employs that are different from that given in I,8–10. His karaṇa thus becomes totally useless in many sections. If the reader remains ignorant of the epoch actually employed, he cannot obtain a correct result by following the rules in the text; and if he knows enough to be able to discover what the epoch was, he no longer will benefit (except as an historian) from the Pañcasiddhāntikā.

C. Varāhamihira's sources

In I,3 Varāhamihira states that there are five siddhāntas: the Pauliśa, the Romaka, the Vāsiṣṭha, the Sūrya, and the Paitāmaha, and that of these the first two were commented on by Lāṭadeva. It is precisely these five siddhāntas which he urges an astrologer to study in Bṛhatsaṃhitā II (p. 22). But his sources, as he himself indicates, are more numerous; for he names Arhat (i.e., Jaina tradition) in XIII,8; Āryabhaṭa in XV,20; Pradyumna in XVII,62; the Magas in I,23; the teacher of the Yavanas in XV,19; Lāṭadeva or Lāṭācārya in I,3 itself and in XV,18; himself in XVII,61,62, and 64; his Bṛhatsaṃhitā in XV,10; Vijayanandin in XVII,62; and Siṃhācārya in XV,19. We are not justified, then, in regarding all the material in the Pañcasiddhāntikā as having been derived from one of the five siddhāntas named in I,3. We can only distinguish certain sections as being from one source or another on the basis of Varāhamihira's explicit statements, and then attempt to gather associated material around these nuclei on the basis of their use of identical parameters. The colophons cannot be blindly followed, as is demonstrated by that for chapter III; this attributes the whole chapter to the Pauliśasiddhānta, though III,34–35 are certainly from the Romaka and III,4 and 9 belong with II (Vasiṣṭha).

Aside from the Pañcasiddhāntikā, one of our chief sources for a knowledge of Varāhamihira's sources is the Brāhmasphuṭasiddhānta which Brahmagupta wrote in Bhillamāla in 628. He is mainly concerned there, when he mentions his predecessors, either with praising his main source, the Brahmasiddhānta (i.e., the Paitāmahasiddhānta of the Viṣṇudharmottarapurāṇa)[7], or with attacking Āryabhaṭa[8]; but he also discusses certain aspects of some of the other works. A translation of all the relevant passages will be found in the Appendix (cf. F, p. 22).

[7] Cf., e.g., I,2; II,31; II,33; V,25; X,62; etc.
[8] Cf., e.g., I,12; I,32; I,61–62; II,19; II,33; II,46–47; VI,12; IX,11; X,13–14; XI,4–45; etc.

I. *The Paitāmahasiddhānta*

This work is summarized in chapter XII of the Pañcasiddhāntikā. Its epoch is 11 January 80 A.D. and its elements are derived from the Jyotiṣavedāṅga of Lagadha. Varāhamihira does not refer to the Paitāmahasiddhānta of the Viṣṇudharmottarapurāṇa, though that work is apparently mentioned by Āryabhaṭa (Golapāda 50) and certainly used by Brahmagupta as the basis of his Brāhmasphuṭasiddhānta.

II. *The Vasiṣṭhasiddhānta*

There existed a Vasiṣṭhasiddhānta already in A.D. 269/70 as Sphujidhvaja writes in his Yavanajātaka (LXXIX,3):

"By following the opinion of the sage Vaśiṣṭha some of those concerned with (astronomical) rules (believe that this great lunisolar yuga) is best; for those led by the Yavanas ... (the lunisolar yuga) is 165 years."

Varāhamihira states in II,13 that the shadow-problem in II,12–13 is from the Vasiṣṭhasamāsasiddhānta (presumably an abridgement of a longer original Vasiṣṭhasiddhānta). We are inclined to believe that the rest of II is also from the Vasiṣṭha. If this assumption is true, we have Vasiṣṭha's solar theory (II,1), lunar theory (II,2–6; see also III,4 and 9), theory of nakṣatras and tithis (II,7), rules for computing the length of daylight (II,8), and gnomon-problems (II,9–13). The whole is based on Babylonian techniques filtered through Greek intermediaries. The epoch of the lunar theory is 3 December 499; this is perhaps the date at which the original Vasiṣṭhasiddhānta was turned into the Vasiṣṭhasamāsasiddhānta available to Varāhamihira. A kṣepa (presumably added by Varāhamihira) accounts for the difference between this epoch and 22 March 505.

All manuscripts insert after XVII,5 a note attributing the theory of Venus in XVII,1–5 to the Vāsiṣṭhasiddhānta; but these verses are an integral part of the whole section XVII,1–60 which presents a treatment of the motions of the five star-planets based on Babylonian methods. This also may well be properly assigned to the Vasiṣṭha- (or Vasiṣṭasamāsa-) siddhānta. The kṣepas indicate as epoch 22 March 505; they must have been added by Varāhamihira. An earlier Indian adaptation of Babylonian planetary theory is found in Sphujidhvaja (LXXIX,40–47).

By 628 Brahmagupta knows only of a Vasiṣṭhasiddhānta published by Viṣṇucandra (see Brāhmasphuṭasiddhānta I,62; II,46–47; X,13 and 62; XI,31,46–51, and 55; XVI,36; XXI,37–39 and XXII,2), who apparently combined ārdharātrika (Lāṭa) and audayika (Āryabhaṭīya) elements with some from Vijayanandin. He is constantly linked in the Brāhmasphuṭasiddhānta with Āryabhaṭa and Śrīṣeṇa. It might have been argued that his was the version of the Vasiṣṭhasiddhānta which is summarized in the Pañcasiddhāntikā and which uses as epoch 3 December 499 (the epoch of the Āryabhaṭīya is also 499). But Viṣṇucandra's use of a mahāyuga and of epicycles, which are unknown to Varāhamihira's Vasiṣṭhasiddhānta, precludes this identification. Viṣṇucandra, then, must be dated in the latter half of the sixth century.

Copies of Viṣṇucandra's Vasiṣṭhasiddhānta were still available in the ninth century as Pṛthūdakasvāmin, in his commentary on the Brāhmasphuṭasiddhānta, quotes from it three āryās. The first (on XXI,3; the first two pādas are also quoted on XXI,11a–b) is similar to Pauliśa frag. P 51:

Thus in the Vasiṣṭhasiddhānta[9].

"The earth, consisting of the five mahābhūtas (i.e., earth, fire, water, wind, and space) stands in the middle of the space of the cosmic egg (jagadaṇḍa) for the existence of all creatures; it is round (and) called a sphere."

This verse is also quoted by Utpala on Bṛhatsaṃhitā II (p. 58).

The next fragment is quoted on XXI,4:

Thus in the Vāsiṣṭha siddhānta[10].

"The sphere of the stars, which is covered with planets, nakṣatras, and constellations, constantly revolves from left to right in the sky."

And the third āryā is quoted on XI,54:

The yuga of precession (ayana) (is given) by Viṣṇucandra at the beginning of his chapter on yugas (yugaprakaraṇa)[11]:

"The yuga of the ayana is said to be 189411 (revolutions); this was formerly the opinion of Brahmā, the Sun (i.e., Sūrya), and so on."

Another āryā which is quoted as Vasiṣṭha's by Utpala on Bṛhatsaṃhitā II (p. 27) probably comes from Viṣṇucandra's work:

So the revolutions of the Moon (in a mahāyuga), when multiplied by 27, (become the days of) the nākṣatra measure in the opinion of Vasiṣṭha and others[12]:

"The nākṣatra (days) in a caturyuga are said by the ancientsto be 1559340072."

Two other āryās of astrological content are quoted as Viṣṇucandra's by Utpala. The first is found in his commentary on Bṛhatsaṃhitā XIX,8 and in that on Bṛhajjātaka II,20[13]:

"The conjunction with the Sun of (the five star-planets) beginning with Mars together with the Moon is called their (heliacal) setting, that (of the five star-planets) with each other a (planetary) conflict."

The second occurs in his commentary on Yogayātrā IV,48–53[14]:

[9] jagadaṇḍakhamadhyasthā mahābhūtamayī kṣitiḥ /
bhavāya sarvasattvānāṃ vṛttā gola iti sthitā //

[10] tatrāgre grahanakṣatratārāgaṇasamāvṛtaḥ /
ajasraṃ bhramati vyomni jyotirgolaḥ pradakṣiṇam //

[11] tasya cātra cid rudrakṛtanandāṣṭakendavaḥ /
ayanasya yugaṃ proktaṃ brahmārkādimataṃ purā //

If the precession makes 189 411 revolutions in a Kalpa, the yearly motion is approximately 0;0,57° and the precession amounts to 1° in about 63 years.

[12] pakṣasaptakhaśūnyābdhiguṇagorthaśarendavaḥ /
caturyugārkṣāṇy etāni kathitāni purātanaiḥ //

The Vasiṣṭha's revolutions of the Moon in a mahāyuga, then, are those of the ārdharātrika system: 57 753 336. This is what one expects from Brahmagupta's description of Viṣṇucandra's work.

[13] divasakareṇāstamayaḥ samāgamaḥ śītaraśmisahitānām /
kusutādīnāṃ yuddhaṃ nigadyate 'nyonyayuktānām //

[14] balavatsaumyasamete pāpe kṛcchreṇa kendrage siddhiḥ /
balavatpāpasamete saumye siddhir na yātuḥ syāt //

"If there is a (weak) malefic planet in a cardine with a strong benefic, there is success for one who sets out (on a military campaign), though with difficulty; but if it is a (weak) benefic with a strong malefic, there is no success."

III. *The Romakasiddhānta*

The Romaka (one of the two siddhāntas which Varāhamihira claims to have been commented on by Lāṭa) is evidently, because of its name, of western origin. Sections of the Pañcasiddhāntikā which can unquestionably be ascribed to the Romakasiddhānta in Lāṭa's edition are I,8–10; I,15; III,34–35; and VIII. These passages discuss the computation of the ahargaṇa from the epoch—sunset at Yavanapura (= Alexandria) on 21 March 505; the elements of the Romaka's yuga; some speculation on a "world-year"; and solar eclipses. The use of sunset epoch, the Metonic cycle, the Hipparchan tropical year, and epicycles for the Sun and Moon indicate that the original Romakasiddhānta had an Hellenistic origin. One suspects that it arrived in India during the period of Śaka or Gupta rule in Western India. This Romaka is referred to by Brahmagupta in Brāhmasphuṭasiddhānta I,13.

But another Romakasiddhānta was known to Brahmagupta. This was composed by Śrīṣeṇa on the basis of elements from Lāṭa, Vasiṣṭha, Vijayanandin, and Āryabhaṭa (see Brāhmasphuṭasiddhānta I,62; II,46–47; X,13; XI,31,46–47,48–51, and 55; XVI,36 and 46; XXI,37–39; and XXII,2). Śrīṣeṇa was evidently contemporary with Viṣṇucandra.

IV. *The Pauliśasiddhānta*

To this work we can definitely assign I,11–13, in which Varāhamihira gives the rules for determining the ahargaṇa in the Pauliśasiddhānta as commented on by Lāṭadeva. The same parameter for the length of a year appears in III,1, so that at least in part the colophon of III is correct in ascribing that chapter to Pauliśa (it has been noted above that III,34–35 refer to the Romaka; Lāṭadeva, of course, may have inserted such a reference into his commentary). In this chapter again we find a mixture of Babylonian and Greek methods, though with a strong influence of Indian concepts (e.g., III,18–27). We see no secure way to sort out the material in this chapter which may go back to the original Pauliśa.

The Pauliśasiddhānta was apparently based on an Hellenistic source, and Pauliśa may represent the Greek Παῦλος; but he certainly had nothing to do with the astrologer Paulus Alexandrinus who wrote the Εἰσαγωγή in A.D. 378[15]. The identification depends on al-Bīrūnī's misreading in the India (see fragment P 1 of the later Pauliśasiddhānta) of T.n.y.s.r. in Arabic (for Sthāṇvīśvara, the locality at which the later Pauliśasiddhānta was written) as S.y.n.t.r; the only difference in Arabic script is in the positioning of the dots. Al-Bīrūnī corrects himself in a later Maqāla (see fragment P 41 of the later Pauliśasiddhānta). Moreover, Paulus Alexandrinus the astrologer is

[15] See D. Pingree, "The Later Pauliśasiddhānta", *Centaurus* 14, 1969, 172-241 and also *Isis* 54, 1963, 237 n. 63.

not known to have written on astronomy; and his limits of solar daily motions—1;2° and 0;57° (Εἰσαγωγή XXVIII)—disagree with those found in the table apparently from the Pauliśasiddhānta incorporated in Pañcasiddhāntikā III,17—1;1° and 0;57°.

The colophon of chapter VII, on solar eclipses, attributes it to the Pauliśa; chapter VI, on lunar eclipses, is closely connected with it and probably comes from the same source. This attribution may well be correct. There is more doubt about the colophon of chapter XVII, which ascribes the planetary theory of XVII,65–80 to the Pauliśasiddhānta though Varāhamihira in XVII,61–64 claims it for himself. In favor of the Pauliśa as the source of this section is the Babylonian character of the theory.

In the eighth century another Pauliśasiddhānta was written, which is essentially ārdharātrika. It is this work to which, e.g. Pṛthūdakasvāmin, Utpala, and al-Bīrūnī refer. Its fragments are gathered and discussed in the article mentioned in footnote 15.

V. *The Sūryasiddhānta*

Varāhamihira speaks of Lāṭadeva as a commentator on the Pauliśa and Romaka, but says nothing of the name of any original work of his. We believe that he wrote the Sūryasiddhānta summarized in the Pañcasiddhāntikā. Such a tradition was known to al-Bīrūnī (India, ed. p. 118, trans. vol. 1, p. 153). The parameters of this work belong to the ārdharātrika system which, as Brahmagupta tells us (Kaṇḍakhādyaka I,1), was promulgated by Āryabhaṭa; and Bhāskara, commenting on the Āryabhaṭīya (Kālakriyā 10) in 629, names Pāṇḍuraṅgasvāmin, Lāṭadeva, and Niḥśaṅku as pupils to whom Āryabhaṭa directly expounded astronomy.

On the assumption of Lāṭadeva's authorship of this Sūryasiddhānta, Pañcasiddhāntikā I,8–15 appears as a unit summarizing Lāṭadeva's rules for determining the ahargaṇa for a given calendar date with respect to his chosen epoch; I,14 gives the rules for the Sūryasiddhānta, based on the same parameters as are IX,1–2; IX (on solar eclipses) is attributed to the Sūryasiddhānta in both the first verse and in the colophon. It, however, gives the epoch as noon at Avantī rather than as midnight. Since this is not an error in the text, it is a reflection of an earlier version of the Sūryasiddhānta using noon epoch.

The identity of parameters shows that chapter X (on lunar eclipses) is also from the Sūryasiddhānta. And finally XVI (on the planets) is stated in verse 1 and after verse 11 to be from the Sūryasiddhānta; the statement is confirmed by this chapter's use of ārdharātrika parameters.

The epoch of this ārdharātrika version of the Sūryasiddhānta is midnight of 20/21 March 505 in XVI. But in IX there is evidence of an earlier Sūryasiddhānta using noon epoch and slightly different parameters for the mean motion of the Moon, lunar apogee, and ascending node. The kṣepas in IX,1–5 are computed for noon of 20 March 505. We assume that it was Lāṭadeva who computed these kṣepas, added the corrections in IX,4 and who authored the source of XVI. Another possible reflection of this earlier Sūryasiddhānta is the rule for computing the kakṣās and diameters of

the Sun and Moon given in IX,15–16. The underlying assumptions of the other ārdharātrika texts for the solution of this problem (see, e.g., Mahābhāskarīya VII, 23–24 and fragment P 59 of the later Pauliśasiddhānta) are missing. And the method employs the true hypotenuse, which, according to IX,7–8, is not involved in the present text's computation of the manda equation as one would expect if it is to be used in the later passage.

One Śatānanda wrote a Bhāsvatī whose epoch is Śaka 1021 or A.D. 1099. This work he claims to be based on the Sūryasiddhānta taught by (Varāha)mihira (vs. 6). This work has not been utilized in our discussion of the Pañcasiddhāntikā; but the fact that it contains a section of the projection of eclipses indicates that Śatānanda probably considered Pañcasiddhāntikā XI to be from the Sūryasiddhānta.

VI. *Summary of attributions to the five Siddhāntas*

To the five siddhāntas, then, we can attribute the following chapters of the Pañcasiddhāntikā.

I,8–15	Romaka, Pauliśa, and Sūrya (Lāṭadeva's three)
II	Vasiṣṭha
III (most)	Pauliśa
III,34–35	Romaka
VI	Pauliśa (?)
VII	Pauliśa (?)
VIII	Romaka
IX	Sūrya
X	Sūrya
XI	Sūrya (?)
XII	Paitāmaha
XVI	Sūrya
XVII,1–60	Vasiṣṭha (?)
XVII,65–80	Pauliśa (?)

The other chapters are from various sources which we can only in part identify.

VII. *Varāhamihra's other sources*

a. Āryabhaṭa is referred to in XV,20 as having used as epoch both midnight at Laṅkā (in the ārdharātrika system) and sunrise at Laṅkā (in the Āryabhaṭīya). But he is not subjected to a vicious attack such as that launched against him by Brahmagupta.

b. Āryabhaṭa's pupil Lāṭadeva[16] appears in XV,18, where his epoch is stated to be sunset at Yavanapura (Alexandria); this is the Romaka's epoch (I,18). Within the Pañcasiddhāntikā we can also attribute to him some of the verses in XIII. Thus

[16] He is referred to by Brahmagupta in Brāhmasphuṭasiddhānta XI,46–51.

with XIII,1–2 compare these verses of Lāṭa cited by Pṛthūdakasvāmin on Brāhmasphuṭasiddhānta XI,3:

"The symmetrically round sphere of the earth stands in the heavens, free-standing (?) on all sides, held up by all the good and bad actions of creatures[17]."

"It is covered on all sides with mountains, rivers, and seas, with cities, kingdoms, trees, quadrupeds, and so on, and with kadamba, puṣpa, and granthi flowers[18]."

With XIII,9 compare a verse cited by Pṛthūdakasvāmin on Brāhmasphuṭasiddhānta XXI,6:

"The gods see the Sun proceeding from left to right on the equator, which is the horizon of their vision; the demons, those warriors in battle, see it moving to the left on their (horizon)[19]."

Another pair of āryās quoted from Lāṭa by Pṛthūdakasvāmin on the preceding verse finds no direct parallel in the Pañcasiddhāntikā (but cf. XIII,5):

"As from this region, so in all directions does the circle of the constellations rise up; it leaves a center of fixedness (i.e., the pole). This (axial) line splits the surface of the earth; like a cloud in an extensive plain a star stands above it[20]."

A half-verse of Lāṭa quoted by Pṛthūdakasvāmin on Brāhmasphuṭasiddhānta XXI,8a–b is comparable to Pañcasiddhāntikā XIII,27a–b:

"For a half of a year the Sun, having risen once, is seen by the Gods[21]."

Finally, Śaṅkara in his commentary on Bāṇa's Harṣacarita[22] quotes an āryā defining vyatīpāta as Lāṭa's:

"For when, in the heavens, the Sun and Moon are together in one mārga (i.e., semicircle between equinoxes) and when (the longitude of) the Sun and (that of) the Moon equal half of a revolution (i.e., 180°), then there occurs vyatīpāta[23]."

c. The influence of Varāhamihira's Iranian (Maga) ancestors, which perhaps reached him through his father and teacher Ādityadāsa, is found in I,23–25; the guru of the Yavanas in XV,19 is perhaps a Sasanian astronomer. Siṃha, who is also mentioned in XV,19, is referred to again only by Brahmagupta (Brāhmasphuṭasiddhānta XI,46–47). The same is true of Pradyumna and Vijayanandin whose names appear in XVII,62; for the first see Brāhmasphuṭasiddhānta XI,46–47 and 57–58, for the second XI,48–51 and 57–58. Varāhamihira's only other recognizable source is the Jaina tradition recorded in XIII,8; with this compare Brāhmasphuṭasiddhānta XI,3. To this same Jaina tradition may be due the term trailokya in the colophon of XIII.

[17] kṣitigolaḥ samavṛtto khe kila tiṣṭhati samantāt tv apadeśaḥ /
sāmānyaiḥ sattvānāṃ śubhāśubhaiḥ karmabhir upāttaḥ //

[18] parvatanadīsamudraiḥ purarāṣṭradrumacatuṣpadādyaiḥ /
pracitaḥ kadambapuṣpagranthibhiḥ samantataḥ kusumaiḥ //

[19] dṛgharije sve viṣuvati paśyanty amarāḥ pradakṣiṇagam arkam /
apasavyagatiṃ daityāḥ samare svāsthaṃ yudhā śramiṇaḥ //

[20] tasmāt kṣetroddeśād yathā yathā sarvato diśaṃ tathā /
unnamati bhagaṇacakraṃ dhruvatvamadhyaṃ parityajate //
bhittvā kṣititalam uttiṣṭhatīva meghaḥ prakṛṣṭadeśasthaḥ /
rekhāpy eṣā tiṣṭhaty upari jyotirgaṇo 'py evam //

[21] saṃvatsarārdham amaraiḥ sakṛd udgata eva dṛśyate sūryaḥ /

[22] Ed. A. A. Führer, Bombay 1909, p. 184 (I have emended his text).

[23] gagane hi himakarārkau yugapat syātāṃ yadaikamārgasthau /
bhagaṇārdham arkaś ca yadā śaśī tadā bhaved vyatīpātaḥ //

D. The Pañcasiddhāntikā in later literature

The first author to demonstrate a knowledge of the Pañcasiddhāntikā is Brahmagupta in his Brāhmasphuṭasiddhānta (I,13; XIV,46–49; and XXIV,2–3), which was written at Bhillamāla in A.D. 628. It is from the Brāhmasphuṭasiddhānta and its commentary-tradition that al-Bīrūnī (India, ed. pp. 118–119, trans. vol. 1, p. 153; this is Pauliśa frag. P 1) knows of the five siddhāntas. In Brahmagupta's Khaṇḍakhādyaka, written in A.D. 665, the fractions by which the ahargaṇa is to be multiplied to find the mean longitudes of several of the planets are identical with those in the Sūryasiddhānta of the Pañcasiddhāntikā; but both sets may be independently derived from their common ārdharātrika parameters.

In A.D. 718 an Indian, Chüt'an Hsita, produced a work entitled Chiuchih-li at the T'ang court. The Chiuchih-li, whose epoch is A.D. 714, is said to be based on methods devised by Brahma and inherited by Wut'ung Hsienjên, "the excellent scholar of full understanding of five." This seems to be a reference to the Pañcasiddhāntikā. A number of passages in the Chinese work can be paralleled in our text, though it is clear that Chüt'an Hsita's source was based on other texts besides the Pañcasiddhāntikā; he uses, e.g., $R = 3438$ rather than $R = 120$.

The parallel passages are as follows:

I. The computation of the ahargaṇa (pp. 499–502). The Chiuchih-li uses formulas which are the equivalents, with suitable substitutions for the new epoch, of the formulas in I,9–11 (Romaka).
II. The computation of the mean longitudes of the Sun, lunar apogee, and lunar anomaly (pp. 502–505). The rules in the Chiuchih-li are based on the parameters in IX,11–12 (Sūrya).
III. The computation of the solar and lunar equations (pp. 506–511). This passage is derived from IX,7 (Sūrya).
IV. The computation of the length of daylight (pp. 511–513). The Chiuchih-li depends on III,10 (Pauliśa).
V. The determination of the daily progress of the Moon (p. 514). See III,9 (Pauliśa).
VI. The determination of the daily progress of the Sun (p. 515). See III,17 (Pauliśa).
VII. The computation of the nakṣatra, nakṣatrasaṅkrānti, and tithi (pp. 515–518). See III,16 (Pauliśa).
VIII. The computation of the longitude of the lunar node (pp. 521–522). See III,28 (Pauliśa).
IX. The computation of lunar latitude (pp. 526–527). See IX,6 (Sūrya).
X. The computation of the duration of a lunar eclipse (pp. 528–529). See VI,3 (Pauliśa?).
XI. The computation of the magnitude of a lunar eclipse (pp. 529–530). See VIII,18 (Romaka).
XII. The computation of the duration of totality of a lunar eclipse (pp. 530–531). See VIII,16 (Romaka).

In A.D. 864 Pṛthūdakasvāmin of Sthāṇvīśvara wrote a commentary on Brahmagupta's Khaṇḍakhādyaka in which he refers to his already existing commentary on the Brāhmasphuṭasiddhānta. In this second commentary he quotes several verses from chapter XIII of the Pañcasiddhāntikā[24]. Utpala, apparently a Kāśmīrian, wrote a commentary on Varāhamihira's Bṛhatsaṃhitā in A.D. 966 in which he quotes 117 of the Pañcasiddhāntikā's 443 verses[25]. Al-Bīrūnī, when he composed the India in 1030, knew of the Pañcasiddhāntikā only from his Panjābī paṇḍitas, whose information was evidently derived from Bṛhatsaṃhitā II (p. 22) and from a commentary on the Brāhmasphuṭasiddhānta[26]; he had no manuscript of the text. Śatānanda in 1099, at an unknown locality[27], wrote the Bhāsvatī allegedly based on the parameters and methods of Varāhamihira's Sūryasiddhānta. And a Jaina author, Makkibhaṭṭa, wrote in Western India in the late fourteenth century a commentary on the Siddhāntaśekhara of Śrīpati in which he quotes several verses from the Pañcasiddhāntikā[28]. So far there is no indisputable evidence that the Pañcasiddhāntikā was known outside of an area roughly corresponding to the modern states of Madhya Pradesh, Gujarat, Rajasthan, the Panjab, Kashmir, and West Pakistan.

However, some verses from the text are quoted by fifteenth century Kerala astronomers of the dṛggaṇita school in their commentaries on the Āryabhaṭīya. Thus Parameśvara (c. 1380–1460) cites a verse[29], and Nīlakaṇṭha (b. 1443) several others[30]. It is noteworthy that all four verses that they quote are also found in Utpala's commentary on the Bṛhatsaṃhitā, which was known in Kerala; it is not proved, then, that they had a copy of the Pañcasiddhāntikā.

The manuscript tradition also supports the theory that the Pañcasiddhāntikā was never known outside of Western and Northern India. All known manuscripts are descended from two copies of the text, which in turn are derived from a common, lacunose manuscript. The older of the two was copied in Stambhatīrtha (Cambay) in 1616, while the other was in Sojītrā in Gujarat in the 1870's. Its then owner claimed that it was copied from a manuscript in Benares, where other manuscripts of the text and a commentary were available[31]. No such other manuscripts have ever turned up, however, despite the extensive work in cataloguing private and forming public manuscript collections that has been carried on in Benaras between 1873 and the present. We therefore doubt the story of a Benares provenience, and assume that the Sojītrā manuscript represents a Gujarātī tradition.

[24] They are XIII, 2–3, 5–6, 9,12,27, and 35.

[25] I,1,8–10, and 16–22; II,13; III,1,10,21, and 25; IV,20–23,27–28,30–33,35–36,38,41–44, and 48–49; V,1–10; VI,9–10 and 15; VIII,1 and 9–18; IX,1; XII,1–3; XIII,1–34 and 39–42; XIV,33 and 39–40; XV,15 and 18–29; and XVI,15–16.

[26] See Pauliśa frag. P 1.

[27] In the text he refers only to Avantideśa and Laṅkā; but such references do not help to fix his own place of residence. Some commentators place him at Puruṣottama in Orissa on the basis of his reference to the deity Puruṣottama in the last verse of his work.

[28] They are XIII,36 and XV,17–20.

[29] This is XIII,12.

[30] They are XIII,1 and XV,20 and 29.

[31] See G. Bühler quoted in A. E. Gough, *Papers Relating to the Collection and Preservation of the Records of Ancient Sanskrit Literature in India*, Calcutta 1878, pp. 116 and 132–133.

The first modern scholar to note the existence of the Pañcasiddhāntikā was G. Bühler, who noticed the Sojītrā manuscript in his tour in search of Sanskrit manuscripts undertaken on behalf of the Government of the Presidency of Bombay in 1873/74. The Cambay manuscript was procured in 1879/80, and copies of the two manuscripts (probably our D and E, now in the National Library in Calcutta) were sent to G. Thibaut in Benares, who collaborated with S. Dvivedin in attempting to interpret them.

The first results of their labors on the text were published in 1884[32], in which particular attention was paid to the Sūrya and Romaka siddhāntas. The following verses were edited, translated, and discussed: 1,1–10 and 14–15; III,13; VIII,1,4–5, 7a–b and 8; IX,1–4; XV,19; and XVI,1–11. Also cited are Brāhmasphuṭasiddhānta I,13 and XI,47–50b. From all of this they correctly concluded that none of the five siddhāntas summarized by Varāhamihira is presently extant.

Their main publication with regard to the Pañcasiddhāntikā was an edition of the text with English translation and Sanskrit and English commentaries, which appeared at Benares in 1889[33], The inherent difficulties of a technical text without a commentary and the corruption of the manuscripts, while frequently overcome, at many points obstructed their understanding of the work. It would serve no purpose to discuss here in detail our disagreements with their interpretations.

In the year 1890 S. B. Dikshit[34], using a manuscript copied by Janardan Balaji Modak, Head Master of the Thāṇā High School, from the copy of the Sojītrā manuscript which we have denoted B[35], discusses the chronological implications of I,8 and 14; IX,1–4; XV,18 and 20; and XVI,10–11. Dikshit concludes that the epoch of Varāhamihira is Tuesday 22 March 505, but that, according to the Sūryasiddhānta, the kṣepakas in IX,1–4 are for noon of Sunday 20 March, and the kṣepakas in XVI, 10–11 are for midnight of 20/21 March in the same year.

In the same year Dikshit published a second article[36] devoted to the Romakasiddhānta, in which he discusses I,3 and 15; III,1; and VIII,1–5 and 8. He also discusses the Romakasiddhānta as known from Brāhmasphuṭasiddhānta I,13; XIV,46; and XXIV,2–3, and Śrīṣeṇa (and Viṣṇucandra) in Brāhmasphuṭasiddhānta I,62; II,46–47; X,13; XI,31,46–50, and 55; XVI,36; XXI,38–39; and XXII,2. He concludes that Śrīṣeṇa was not the author of the Romakasiddhānta summarized by Varāhamihira, that the kṣepakas in VIII,1,4–5, and 8 are computed for sunset of 20 March 505, and that this is not the epoch of the original Romakasiddhānta, which he claims was written between the time of Hipparchus and A.D. 150 as it uses the Hipparchan length of year and says nothing of the calculation of the longitudes of the planets,

[32] G. Thibaut, "Notes from Varāha Mihira's Panchasiddhāntikā," *Journal of the Asiatic Society of Bengal*, 53, 1, 1884, 259–293.

[33] Reprinted at Lahore in 1930 and at Varanasi (Benares) in 1968.

[34] S. B. Dikshit, "The Original Sūrya-siddhānta," *Indian Antiquary* 19, 1890, 45–54.

[35] Dikshit explicitly states (fn. 2) that Modak copied the manuscript from one of the two in the (then) Deccan College Collection, which are our A and B. And Modak's copy reads bhauma° in I,8d, ṣadyaneṃdri° in IX,2c and khakhavedavikalikāḥ in XVI,11c, all in agreement with β against α.

[36] "The Romaka Siddhantas," *Indian Antiquary* 19, 1890, 133–142.

which Dikshit believes to indicate that the Romaka was pre-Ptolemaic. Dikshit later in 1890 compared his conclusions with Thibaut and Dvivedin's edition[37].

Commenting on Dikshit's paper on the Romaka, J. Burgess[38] compares the Romaka's luni-solar parameters with those of Ptolemy and contends that Hipparchus had a planetary theory. In the following year he claimed[39] that the table of sines in IV,6–11 is closely related to the Ptolemaic table of chords and may have been derived from it.

In 1895 M. P. Kharegat of Bombay read a lengthy paper dealing with many difficult passages in the Pañcasiddhāntikā[40]: 1,8,10–13,17–20, and 23–25; II,1 and 3–6; III,4,20–21, and 29; IX,5 and 15–16; X,1; XII; and XIV,34–38. He has many valuable comments to make. He came near to explaining the computation of the ahargaṇa according to the Pauliśa in I,11–13; he realized the Persian background of the "lords of the degrees" in I,23–25; he correctly explained the theory of solar motion in II,1; he understood the character of the Vasiṣṭha's lunar theory in II,4–6 and III,4; he noticed the kṣepa of the ascending node in III,29; he correctly emended IX,15–16 on the distances and diameters of the Sun and Moon; he realized that the reading 286 is correct in X,1; and he computed the epoch of the Paitāmahasiddhānta in XII (though we do not understand his reference to the yogatārā of Dhaniṣṭhā).

Serious investigations[41] of the Pañcasiddhāntikā were only resumed in the 1950's. Neugebauer first recognized the Babylonian period relations in II,2[42] and in XVII,66–80[43]. K. S. Shukla corrected and explained IX,15–16 in much the same way as had Kharegat, and emended XVI,23[44]. T. S. Kuppanna Sastri interpreted II,1–6 and III,4 as had Kharegat, and further explained II,7–13[45]. Pingree noted the Babylonian character of XVII,1–60[46] and of III,4 and VIII,5[47].

The present edition of the Pañcasiddhāntikā does not solve all the remaining problems connected with this text. We suspect that much will never be understood unless better manuscript material becomes available. Until that may happen we hope that future historians of Indian astronomy will find this volume a useful tool in their researches.

[37] "The Panchasiddhantika," *Indian Antiquary* 19, 1890, 439–440.

[38] J. Burgess, "The Romaka Siddhantas," *Indian Antiquary* 19, 1890, 284–285.

[39] "The Sines of Arcs in the Pancha-Siddhantika," *Indian Antiquary* 20, 1891, 228.

[40] M. P. Kharegat, "On the Interpretation of certain passages in the Pancha Siddhántiká of Varáhamihira, an old Hindu Astronomical Work," *Journal of the Bombay Branch of the Royal Asiatic Society* 19, 1895/97, 109–141.

[41] We do not discuss here such articles as V. Thiruvenkatacharya, "Ayanamsa and Indian Chronology. The Age of Varahamihira, Kalidasa, Etc.," *Journal of Indian History* 28, 1950, 103–110, which has been satisfactorily refuted by T. S. Kuppanna Sastri and K. V. Sarma, "The Saka Era of Varahamihira—Salivahana Saka," *Journal of Indian History* 36, 1958, 343–367. An attempt to understand some passages was made by P. C. Sengupta in *JDL/UC* 18, 1929, art. 3.

[42] O. Neugebauer, *The Exact Sciences in Antiquity*, Princeton 1952, pp. 158–159, 2nd ed., Providence 1957, pp. 165–166.

[43] *Ibid.*, pp. 165–166; 2nd ed., pp. 172–173.

[44] K. S. Shukla, "On Three Stanzas from the Pañcasiddhāntikā," *Gaṇita* 5, 1954, 129–136.

[45] T. S. Kuppanna Sastri, "The Vāsiṣṭha Sun and Moon in Varāhamihira's Pañcasiddhāntikā," *Journal of Oriental Research, Madras* 25, 1955/56, 19–41.

[46] D. Pingree, "A Greek Linear Planetary Text in India," *Journal of the American Oriental Society* 79, 1959, 282–284.

[47] "Astronomy and Astrology in India and Iran," *Isis* 54, 1963, 229–246 (see 236–237).

E. The manuscript tradition of the Pañcasiddhāntikā

The surviving manuscripts of the Pañcasiddhāntikā fall naturally into 2 classes which I have designated α and β.

Class α

A. BORI 338 of 1879/80. 22 ff. After the colophon is written: saṃvat 1673 varṣa śāke 1538 pravartamāne dvitīyāśvinaśudi 2 budhe adyeha staṃbhatīrthavāstavyaṃ paṃditaśrīpītāṃbara tatsūnuḥ śrīśrīraṅga tatputraḥ paṃditanānā tattanayo paṃditagoviṃdaḥ tasyātmajena śaṃkareṇeyaṃ paṃcasiddhāntikā likhitā / ātmapaṭhanārthaṃ tathā ⟨paro⟩pakṛtaye ca. The copying was finished, then, at Stambhatīrtha (Cambay) on Wednesday 2 October 1616 Julian by Śaṅkara, the son of Govinda, the son of Nānā, the son of Śrīraṅga, the son of Pītāmbara. This manuscript (or D, a copy thereof?) was Thibaut and Dvivedin's main manuscript, which they reproduced in the left-hand column of their edition; we have quoted its readings from that reproduction.

D. NL Calcutta 39. 24 ff. This recent manuscript agrees almost entirely with **A**, of which it is most probably a copy—perhaps the copy utilized by Thibaut and Dvivedin. It now ends at XVII,79d. We have used a microfilm.

G. IO Bühler 268 (Keith 6288). 20 ff. This manuscript is a copy of **A** completed on Sunday Bhādrapada śuklapakṣa 1 of Sam. 1936, Śaka 1802 = 5 August 1879 Julian. We have not used it.

Class β

B. BORI 37 of 1874/75. 49 ff. This is a copy made in 1874/75 of a manuscript belonging to Sadārāma Joshī of Sojītrā, who claimed to have procured it in Benares. Thibaut and Dvivedin quote some of **B**'s readings (or those of **E**, its copy?) in the apparatus to their edition, whence we have taken them. Where they are silent, β in our apparatus does not necessarily include **B**.

C. OI Baroda 7165. 33 ff. After the colophon is written: saṃvat 1928 varṣe śake 1793 pravartamāne māghaśuklā I śukre // jyotirviduttamarāmadurlabharāmeṇa likhitā // amadāvādanivāsinā mubāībaṃdaramadhye idaṃ pustakaṃ likhitaṃ. The copying (from Sadārāma Joshī's manuscript?) was completed on Friday 28 January 1872 Julian by Uttamarāma Durlabharāma, a resident of Amadāvāda (Ahmadabad), at Mubāībandara (Bombay?). We have used a transcript prepared in 1958.

E. NL Calcutta 64. Pp. 7–114. This manuscript seems to be a copy of **B**—perhaps that used by Thibaut and Dvivedin. It now begins at I,22a. We have used a microfilm.

F. Bombay Univ. 288. 32 ff. After the colophon is written: saṃvat 1928 miti bhāda vadi pratipadā paṃcasiddhāntikākhyaṃ pustakaṃ jya likhataṃ nāthurāmapārikabrāhmaṇa. The copying was finished, then, on 17 September (?) 1871 Julian by Nāthurāma Pārika, a brāhmaṇa. This manuscript is a copy of the same manu-

script that **C** was copied from—i.e., perhaps that which belonged to Sadārāma Joshī. We have used a microfilm.

Besides these seven manuscripts there existed in 1890 the manuscript belonging to J. B. Modak of Thāṇā which was copied from **B**, and we know of a manuscript (no. 6674) of the Pañcasiddhāntikā in the Ānandāśrama in Poona. The manuscripts recorded as the property of Sjt. Puspachandra Sarma Daloi of Helach in Assam and of the Arsha Library in Vijayanagara (no. 506) probably contain the Bhāsvatī of Śatānanda, which is sometimes confused with our text.

The archetypes of α and β (henceforth denoted simply α and β) were derived from a common original. This is shown by their sharing not only numerous errors, but also several lacunae (e.g., IV,43c–45b and VI,9). In general α is more correct, but neither gives any evidence that its scribe understood the material he was copying. Aside from their respective readings, each class is distinguished by lacunae peculiar to itself. Thus α omits XIII,3d–4d and β IV,18b–V,9c, XIII,11c–12d, and XVII,6c–7c. Moreover, β transposes XIV,33a–XV,7d (16 verses) so that they follow XV,24a[48].

Utpala had a fuller text than do we; he knew IV,43c–44d and VI,9. There are probably other verses which were in the original text and which were not in the archetype of α and β and were not quoted by Utpala. See, for instance, Brāhmasphuṭasiddhānta XIV,46–49 and note that Varāhamihira in Bṛhatsaṃhitā XVII,1 says that he has dealt with planetary conflicts (transits) according to the Sūryasiddhānta in his karaṇa. Unfortunately, as useful as Utpala's quotations are, they do not contribute now all that they might to our knowledge of the text. This is due to the fact that we do not yet have a critical edition of Utpala's commentary on the Bṛhatsaṃhitā, but only a text prepared by Thibaut's collaborator, Dvivedin. Dvivedin was certainly influenced by the readings adopted in his edition of the Pañcasiddhāntikā; thus, in his edition where Utpala quotes I,8, he prints somadivasādye which is the emendation he and Thibaut suggested for α's saumya° and β's bhaumya°; but Dikshit had a copy of Utpala in which bhauma° was read. In our apparatus, then, Utpala refers to Dvivedin's text and not necessarily to that tenth century scholiast.

[48] These 16 verses must have occupied 1 or 2 folios of β, which have obviously been misplaced. This proves that all β manuscripts go back to a single archetype, probably the Sojītrā manuscript.

F. Appendix. Verses from the Brāhmasphuṭasiddhānta

I,13. Yugas, manvantaras, and kalpas are said in smṛti to be the definers of time; as they do not occur in the Romaka, the Romaka is outside of smṛti.

I,62. Those who know Śrīṣeṇa, Āryabhaṭa, and Viṣṇucandra, when they see one who (really) knows mean motion, do not stand and face him publicly as horses, when they see a lion, do not stand and face him.

II,46–47. At the beginning of a yuga the true longitudes for Āryabhaṭa, Mars and so on (i.e., the star-planets) for Śrīṣeṇa, and all the planets for Viṣṇucandra do not start out from the beginning of Aries. Since the true (longitudes of) Mars and so on have fallen far away (from the truth) in (the treatises) of Śrīṣeṇa, Āryabhaṭa, and Viṣṇucandra, they are not respected by the wise.

X,13. For one observing (heliacal risings and settings) every day at sunrise or sunset and (making the calculations) described by Śrīṣeṇa, Āryabhaṭa, and Viṣṇucandra, there is no unity of observation and computation.

X,62. Even though one knows the tantras (written by) Āryabhaṭa, Viṣṇucandra, and so on, he is not a teacher; but he who knows the Brāhma's operations in the dust (i.e., computations) has attained the status of a teacher.

XI,3. The Jina says that there are 54 nakṣatras, two Suns, and two Moons and that days are caused by the revolution of the dhruvamatsya; this is false.

XI,31. Since Śrīṣeṇa and Viṣṇucandra compute solar eclipses with the five sines (the agrā, the madhyajyā, the raviśaṅku, the dṛggati, and the dṛkkṣepa), they share in the errors with respect to solar eclipses which have been enunciated by Āryabhaṭa.

XI,46–47. Ignorance is doubled every day by the disagreements of Śrīṣeṇa, Viṣṇucandra, Pradyumna, Āryabhaṭa, Lāṭa, and Siṃha regarding eclipses and so on. The mistakes singly pronounced by Āryabhaṭa are properly to be considered the faults of Śrīṣeṇa and the rest; I shall now mention some other faults.

XI,48–51. Śrīṣeṇa took the mean (motions of the) Moon and Sun and the Moon's apogee and node from Lāṭa; the mean (motions of) Mars, Mercury's śīghra, Jupiter, Venus' śīghra, and Saturn (and their) revolutions in the years that have passed of the yuga from the Vāsiṣṭha, (and?) from the chapter (pāda) composed by Vijayanandin; and the apogees, epicycles, computation of true longitudes, and so on from Āryabhaṭa. Thus he made the Romaka, which was a clothes-binding knot (?),

into a patched garment. Viṣṇucandra, taking these same (elements), made the Vāsiṣṭha. In these two (works) there is never any agreement between observation and calculation with regard to eclipses and so on; whatever agreement there is is a happy chance. Therefore, what use are these two inaccurate (siddhāntas)?

XI,52. The center of the circle of perigee and apogee is called the "apogee" by the stranger to the sphere[49]; as the apogee is not there he does not know the apogee.

XI,53. Since (the planets) had various latitudes at the beginning of the Mahāyuga and their true longitudes were (their mean longitudes) increased by the equations due to the various positions of their apogees, therefore the (fixed) nodes and apogees (in some siddhāntas) are not correct.

XI,54. The most and fewest nāḍīs are respectively in daylight and in night-time (when the Sun is) at the end of Gemini (in the tropical zodiac); the ṛtus depend on the motion of the Sun (in the sidereal zodiac). There is no yuga for the ayana due to its (motion); but both ayanas are fixed[50].

XI,55. That which is called a mahāyuga by Śrīṣeṇa, Viṣṇucandra, and others, but which is outside of the (system of) yugas, is stupid because at the beginning of the mahāyuga there are minutes of dṛggati in the case of the planets (i.e., the planets are not at the beginning of Aries).

XI,56. It is said in the smṛtis that the creation of the planets and constellations occurs at the beginning of a day of Brahma, their dissolution at its end. As there are very many (of their mahāyugas) in this mahāyuga, this (system of theirs) is incomplete.

XI,57–58. Because of the daily disagreement (with observation) (of the longitudes) of the planets, tithis, karaṇas, nakṣatras, days, and months in such things as eclipses and planetary conjunctions, who would touch a chapter (pāda) with his foot (pāda)? As the lowest (pāda) karaṇas are those of the stigmatized (aṅkaciti[51]), Vijayanandin, Pradyumna, and so on, their errors will not be written down here.

XIV,46–49. The calculation of the nakṣatras that is described in the Pauliśa, Romaka, Vāsiṣṭha, Saura, and Paitāmaha (siddhāntas)[52] is not mentioned by Āryabhaṭa; therefore it is described (here). Six nakṣatras are one and a half sized, six are half sized, and fifteen are equal sized; there is one bhoga of Abhijit. The (first) six are Keśa (i.e., Śravaṇa) Āditya (i.e., Punarvasu), Viśākhā, Proṣṭhapadā (i.e., Bhādrapadā), Āryamṇa (i.e., Uttaraphalgunī), and Vaiśvadeva (i.e., Uttarāṣāḍhā); the (second) six are Jyeṣṭhā, Bharaṇī, Svāti, Ārdrā, Vāruṇa (i.e., Śatabhiṣaj), and Āśleṣā. The fifteen are not named here, and the one other nakṣatrabhoga is called Abhijit, because this nakṣatra is difficult to learn for the slow-witted.

XVI,36. Since the eclipse falls far off (from the truth) in (the works of) Śrīṣeṇa, Āryabhaṭa, and Viṣṇucandra, because of the disagreement of calculation (with observation), (any) agreement is accidental.

[49] The "stranger to the sphere" is identified as Āryabhaṭa by Pṛthūdakasvāmin.

[50] Pṛthūdakasvāmin here quotes a verse from Viṣṇucandra's Vasiṣṭhasiddhānta regarding precession; see above p. 11.

[51] Literally, "he who has a multitude of stigmata"; Pṛthūdakasvāmin identifies him with Āryabhaṭa.

[52] The passage no longer survives in our Pañcasiddhāntikā.

XVI,46. (This) additional chapter on eclipses is not to be given away, even with curses for the destruction of someone's good fortune; the (original) section on eclipses, since (it follows the treatises of) Āryabhaṭa, Śrīṣeṇa, and so on, is not accurate.

XXI,37–39. "If Rāhu obscures the Moon from the east, why does he not obscure the Sun thus? Why is there not so long a duration of a solar eclipse as there is of a lunar eclipse? How can the Sun pervade (all) objects and Rāhu be something else? Since there is a difference of obscuration in a solar eclipse, solar and lunar eclipses are not caused by Rāhu." (This opinion expressed) by Varāhamihira, Śrīṣeṇa, Āryabhaṭa, Viṣṇucandra, and others is opposed to popular beliefs and is foreign to the Vedas, smṛtis, and saṃhitäs.

XXII,2. Since the sphere was not understood by teachers such as Śrīṣeṇa, Āryabhaṭa, and Viṣṇucandra, the Brāhma's sphere was made accurate.

XXIV,2–3. The beginning of the yuga is simultaneously from sunrise in the south, from midnight in the west, from sunset in the north, and from noon in the east: just this was done by Sūrya, Indu (i.e., Soma), Puliśa, Romaka, Vasiṣṭha, Yavana, and so on. Therefore one siddhānta was written and no other.

SANSKRIT

2. Text

〈श्रीवराहमिहिरविरचिता पंचसिद्धान्तिका प्रारभ्यते /〉

श्रीरामचन्द्रायेय नमः /

दिनकरवसिष्ठपूर्वान् विविधमुनीन्द्रान् प्रणम्य भक्त्याद्यौ /
जनकं गुरुं च शास्त्रे येनास्मिन्नः कृतो बोधः //१//
पूर्वाचार्यमतेभ्यो 〈सद्〉 यच्छ्रेष्ठं लघु स्फुटं बीजम् /
तत्तद्दिहाविकलमहं रहस्यमभ्युद्यतो वक्तुम् //२//
पौलिशरोमकवासिष्ठसौरपैतामहास्तु सिद्धान्ताः /
पंचभ्यो दृग्बाह्यौ व्याख्यातौ लाटदेवेन //३//
पौलिशास्त्वब्द स्फुटो ऽस्मौ तस्यासन्नस्तु रोमकप्रोक्तः /
स्पष्टतरः सावित्रः परिशेषौ दूरविभ्रष्टौ //४//
यत्तत्परं रहस्यं भ्रमति मतिर्यत्र तन्त्रकाराणाम् /
तद्दृमपहाय मत्सरमस्मिन् वक्ष्ये ग्रहं भानोः //५//
दिक्स्थितिविमर्दकर्णप्रमाणवेला ग्रहाग्रहाविन्दोः /
ताराग्रहसंयोगं देशान्तरसाधनं चास्मिन् //६//

1 quoted by Utpala on BS 2,2 (p. 67)
Title: om. aβ Invocation: श्रीगणेशाय नमः β 1b विबुधमुनीन् भावतः प्रणम्याद्यौ Utpala 2b यद् suppl. T.-D. यच्छ्रेष्ठ a, यत् श्रेष्ठ β, com. T.-D. 2c तत्कृदिहाविकल° a, तत्त(त्र C, च F)दि(हि C, हि F)हा(रा C, हालिं F)सिल° β, com. T.-D. 3a° रोमयु° B, °रोमयू° F 3b पंच सिद्धान्ताः aβ 4a पौलिशतिथि a, पौलिशतिथः β 5a यत्तत्परं β 5c मच्चर° B, मत्सर°CF 5d वक्ष्ये a, वदये (ये C) β, com. T.-D. 6a दिक्सं(म CF)स्थिति° β 6d °साधनं a

3. Translation

Chapter I

I,1. Revering in the beginning with devotion the various leaders of the sages, beginning with the Sun and Vasiṣṭha, and my father and teacher by whom I was instructed in this science;

I,2. whatever is the best, easy, accurate correction (bīja) according to the opinions of the former teachers, that secret in its entirety I shall attempt to tell here.

I,3. The siddhāntas are the Pauliśa, the Romaka, the Vāsiṣṭha, the Saura, and the Paitāmaha; of these five the first two were commented on by Lāṭadeva.

I,4. The Pauliśa is accurate; that which was pronounced by Romaka is near it; the Sāvitra (i.e. the Sūryasiddhānta) is more accurate; the remaining two have strayed far away (from the truth).

I,5. Whatever is the highest secret where the minds of the authors of tantras are perplexed, that—the eclipse of the Sun—I will explain in this (work), putting aside envy.

I,6. In it (in this work) are (the rules for computing) the direction, duration, totality, hypotenuse, magnitudes, and times (of solar eclipses), the occurrence or non-occurrence of lunar eclipses, the conjunctions of stars and planets, and the computation of longitudinal differences;

सममण्डलचन्द्रोदयसंस्थानि शाङ्कवच्छाया /
उपकरणान्यच्छज्यावलम्बकापक्रमाध्यानि //७//
सप्ताश्विवेदसंख्यं शककालमपास्य चैत्रशुक्लादौ /
अर्धास्तमिते भानौ यवनपुरे सौमदिवसाद्ये //८//
मासीकृते समासे द्विघ्ने सप्ताहते ऽष्टयमनिघ्नैः /
लब्धैर्युतो ऽधिमासैस्त्रिंशद्घ्नस्तिथियुतो द्विघ्नः //९//
रुद्रघ्नः समनुशरो लब्धोनो गुणखसप्तभिर्भुगणः /
रोमकसिद्धान्ते ऽयं नातिधिरे पौलिशे ऽप्येवम् //१०//
द्विघ्नाः साष्टनवरसाः <सौरे>दिवसाः कृतुसप्तनवघ्नकाः /
पौलिशमते ऽधिमासास्त्रिषड्दिनाद्यवमसंक्षेपः //११//
तिथिदशांशमध्य दस्राद्धिमासार्धं स्वराम्बरैकाब्धैः /
अवमार्धं पंचतनुद्विद्विमितैस्तिथिशिवांशैश्च //१२//
अधिमासकेषु भूयो ऽप्येक ऋतुखपंचकेन्द्रियाब्धेषु /
देयो ऽवमेषु हेयो नवसप्तद्वित्रिखयमेषु //१३//

8–10 quoted by Utpala on BS 2 (p. 31)
7b यंत्रक्षेत्राणि a, य(र्घ CF)त्र क्षेत्र्याणि β तांड(ड्र D)वच्छाया aβ, comm. T.-D.
7c उपक(का B)रणाद्य° aβ 8d सौम्य° a, सौम्य° β, सोम° Utpala T.-D., सौम° Dikshit 9b द्विघ्ने(घ्ने F) β 9d °स्त्रिंशद्घ्न° a द्विघ्नः β, sa:ghnaḥ Utpala 10c °सिद्धान्तो a यो β 11a दि(द्वि C)घ्नाः aβ, comm. Kharegat, Sengupta साष्ट° aβ, comm. Sengupta नवरस a दिवसाः om. β कृतु°(त्नु° D) a, रु(स C)तु° β, कृतर्तु° Sengupta, कृतु° Kharegat 11d °स्त्रिकृ(क F, ऋ D)तद्वि° aβ 12a °दशमध्य(ग्र) दस्रा° A, °दशम-दस्रा° D, दश दस्रा° β, comm. Kharegat, Sengupta °दमांशदौ°धमासार्धं β स्वरांत्वरैः काब्धैः a 12c पंचकृ(ऋ D)ता aβ द्विकुमितै° a, द्विसंस्थितै° β 13a °मासयेषु β 13b sa:pekīkartuṃ aβ, sa:pekaṃ ekartu° Kharegat °यांशेषु aβ, comm. Kharegat

I,7. the prime vertical, the rising of the Moon, magical diagrams and geometrical constructions, the gnomon shadow, and useful matters such as the Sine of terrestrial latitude, the Sine of colatitude, and the declination.

I,8. Substract the Śaka year 427 (from the given Śaka year) at the beginning of the first half-month (śuklapakṣa) of Caitra, which begins a Tuesday, when the Sun has half-set at Yavanapura.

I,9. Convert (the number of lapsed years) into months, add the (number of lapsed solar) months (of the current year), and put it down in two places; multiply it (in one place) by 7 and (divide) by 228; increase it (in the second place) by the resulting intercalary months. Multiply (the sum) by 30, add (the number of lapsed) tithis (of the current month) and put it down in two places.

I,10. Multiply it (in one place) by 11, add 514, and (divide) by 703; subtract the result (from the other place; the remainder is) the ahargaṇa. This is in the Romaka-siddhānta; it is not very different in the Pauliśa.

I,11. In the opinion of Pauliśa, the solar days multipled by 10, increased by 698 and divided by 9761 are the intercalary months; there is an omitted tithi every 63 days.

I,12. One should give a tenth of a tithi every 107 days for the purpose of (computing) the intercalary months, (and one omitted tithi) every 25 135 tithis for the sake of (computing) the omitted tithis.

I,13. Add one more to the intercalary months every 5506 years; subtract 1 out of every 203 279 omitted tithis.

वर्षायुते धृतिघ्ने नवनवसुगुणरसरसाः सुरधिमासाः /
सावित्रे शरनवकेन्द्र्यार्णवाशास्तिथिघ्नलयाः //१४//
रोमकयुगमर्केन्दुर्वेर्वाण्याकाशपंचवसुपक्षाः /
खेन्द्र्यद्रिशो ऽधिमासाः स्वरकृतविषयाष्टयः घ्नलयाः //१५//
युगवर्षमासपिण्डं रविमानं साधिमासकं चान्द्रम् /
अवमविहीनं सावनमैन्दवमब्दाभिवर्तं वार्क्षम् //१६//
मुनियमयमद्रियुक्ते युगणे शून्यद्विपंचयमभक्ते /
प्रतिराशि सर्तुदहनैर्लब्धं वर्षाणि यातानि //१७//
तानि प्रपन्नसहितान्यग्निगुणान्यब्धिवर्जितानि हरेत् /
सप्तभिरेवं शेषो वर्षाधिपतिः क्रमात् सूर्यात् //१८//
त्रिंशद्धृते मासाः प्रपन्नसहिता द्विसङ्गुणाः कार्याः /
सप्तोद्धृतावशेषे मासाधिपतिस्तथैवार्कात् //१९//

16 quoted by Utpala on BS 2 (p. 30); 16a on BS 21,7; 17–18 on BS 2 (p. 31); 19 on BS 2 (p. 32).
14d °न्द्रिया — (र्स्यैवा CF)शा° β 15b पंचघ्नेस्तु (घस्तु C, घ्ने सु F)पक्षाः β
15d स्वकृ (अED) त° a, स्यात्कृ (स्यकृ CF)त β, com. T.-D. 16a युगवर्षेण सपिंडं β
16d तार्क्षं β, त्वार्क्षम् Utpala 17c प्रतिराश्च a, गतिरा (ए F) श्च β, com. T.-D. 17d पातानि (मि D) a
18b °न्यग्निगुणा° om. B °न्यब्धिवर्जिता a, °न्यद्रि (ब्धि C) वर्जितानि β, °न्यब्धिवर्जितानि Utpala Kharegat
19b प्रप (अC) मवसहिताः β व्येका: Utpala 19c °वशेषो Utpala
19d °स्तथैवार्घ्या (र्घ्यं F) त् BF

I,14. In the Sāvitra (i.e. Sūryasiddhānta), in 180 000 years there are 66 389 intercalary months and 1045 095 omitted tithis.

I,15. The yuga of the Sun and Moon according to the Romaka is 2850 years; the intercalary months are 1050; the omitted tithis 16547.

I,16. The sum of the (solar) months in the years of a yuga is the measure of the Sun; increased by the intercalary months, it is (the measure of) the lunar (months). (This total multiplied by 30 and) diminished by the omitted tithis is the number of civil days; the lunar (months) increased by the number of years are the sidereal months.

I,17. Increase the ahargaṇa by 2227 and divide (the sum) by 2520; with respect to the (remaining) amount, divide it by 360; the quotient is the number of lapsed years (in the current cycle of 7).

I,18. Increase these by the current year, multiply by 3, and subtract 2; divide by 7, and the remainder is the lord of the year, beginning with the Sun.

I,19. Divide (the augmented ahargaṇa) by 30; increase the (resulting) months by the current one and multiply by 2; the remainder after division by 7 is the lord of the month beginning with the Sun.

सप्तोद्धृते दिनेशस्त्रिगुणो व्येको युतश्च होराप्तिः /
पंचघ्नः सप्तहृतो विज्ञेयः कालहोरेशः //२०//
वर्षाधिपश्चतुर्थो मासाधिपतिस्तथा तृतीयो ऽब्दः /
होराधिपश्च षष्ठो निरन्तरं दिवसनाथश्च //२१//
वर्षे यद्यस्य फलं मासे च सुनिष्पणीतमालोक्य /
तत्तद्धृत्तैर्वल्ये होरानन्त्रोत्तरविधानैः //२२//
द्युगणे रूपाभ्यधिके पंचर्तुगुणोद्धृते मगाब्दाः स्युः /
त्रिंशद्धृते शेषं ज्ञेयं राश्यंशकेन्द्राणाम् //२३//
कमलोद्भवः प्रजेशः स्वर्गेशश्शास्तृरुद्रमन्युवसवः /
कमलानलान्तरवयः शशीन्द्रगोनिर्ऋतयः क्रमशः //२४//
हरविबुधगुरुपितृवरुणा बलदेवसमीरणौ यमश्चैव /
वाक् श्रीधनदौ गिरयो धात्री वेधाः परः पुरुषः //२५//
करणावतारः //

20 quoted by Utpala on BS 2 (p. 35); 21 on BS 2 (p. 36); 22 on BS 19 intr.
20b °गुणे aBC ऽब्धे (ऽप्ये C) कश्च (श्च C) होराप्तिः a/β, व्येको युतश्च होराप्तिः Utpala 20c पंचघ्ने a/β, पंचघ्नः Utpala °हृ (हृ F) ते a/β, °हृतो Utpala विज्ञेया a काय (ध्य C, श्च F) होरेशः β °होरेशाः a 21a °ऽब्दतुर्थे a/β 21b ततोयो a, ततोयो β 21c होराधिपतिश्च β 21d दिवसनाथः स्यात् Utpala 22a E begins with वर्षे यद् om. β (suppl. E²) 22c तत्तद्धृत्तै° om. a/β, suppl. Utpala वल्ये aC 22d °विधाने Utpala 23a कगणे β 23b °गुणोद्धृते a, °गुणोध्व (ध्य CF) जे β मगाब्दाः] ऽश्च मासाः a/β 23d राश्यंशवें (चें F, यं E) द्राणां a/β, corr. T.-D. 24a कमलोद्भवा a प्रजेसा a 24b स्वर्ग्ये शस्त्रं द्रु (द्रु D) मान्यवासांसि a, स्व (स्व BE) र्गः (र्यः C) शस्त्रं रु (corr. CF) द्रु—ा (त्रा E) न्यवासांसि β 24d °नियतयः a/β, corr. T.-D. 25a हरत्रव °β °गुरु° a °वरुणा a, वरुण (णां C) β 25b °समीकरणौ a 25c श्रीधनबौ (वै C) β 25d पुरुषः a

I,20. When one divides (the augmented ahargaṇa) by 7, (the remainder) is the lord of the day. Multiply (this remainder) by 3, subtract 1 and add the (elapsed) hours; multiply (the result) by 5 and divide by 7; (the remainder) is to be known as the lord of the hour.

I,21. The lord of the next year is the fourth (in order of the week-days); the lord of the next month is the third; the lord of the next hour is the sixth; and the lord of the next day is the next.

I,22. Whatever is the (astrological) result of each (planet) in a year or in a month, that I shall explain with mastered rules of horoscopy in the future after examining the opinions of the sages.

I,23. Increase the ahargaṇa by 1 and divide by 365; (the quotient) is years of the Magas; when one divides (the ahargaṇa increased by 1) by 30, the remainder is to be known as belonging to the lords of the degrees of the signs.

I,24. Kamalodbhava, Prajeśa, Svargeśa, Śāstṛ, Rudra, Manyu, Vasu, Kamalā, Anala, Antara, Vayaḥ, Śaśi, Indra, Go, and Nirṛti in order;

I,25. Hara, Bhava, Guru, the Pitṛs, Varuṇa, Baladeva, Samīraṇa, Yama, Vāk, Śrī, Dhanada, the Giris, Dhātrī, Vedhāḥ, and Paraḥ Puruṣaḥ.

The Incarnation of the Karaṇa.

कृतगुणमृतुसुतमेकर्तुमनुहृतं षड्यमेन्दुभिर्विभजेत् /
शशिखखखयमकृतस्वरनवनववसुषट्कविषयोनैः //१//
रसगुणनवेन्दुयुक्ते शशिगुणखगुणोद्धृते घना द्युगणे /
शेषे नवभिर्गुणिते गतयो ऽष्टजिनैः पदं शेषम् //२//
घनषोडशहृतशेषं प्रोज्झ्याधस्त्रिगुणितं यदुर्वीकम् /
आदि कला द्विगुणघनाः शशिमुनिनवयमा राश्याद्याः //३//
विषयधृतयो गतिघ्ना गतिषष्टांशोनिताः कलाः प्रोक्ताः /
वेदार्काः पदसंख्या गत्यर्धं घनमृणं परतः //४//
गत्यर्धे भगणार्धं देयं लिप्ताचतुष्कसंयुक्तम् /
शेषपदसमाशांशास्तैश्च घनर्णात् फलं देयम् //५//
व्येकपदमिन्द्रियघ्नं कृतनवदशसंयुतं विभक्तं च /
मनुवेदयमेभ्यः पदगुणे त्रिषष्ट्युद्धृते लिप्ताः //६//

1a कृतगुणषय(षय D)मृतयुतमैकर्तु° a, कृतगुणषट्क्र(ड्रु C, ट्रृ E, ड्रृ E^2, ड्रु F)तु-युतमैकर्तु(र्त्तै C) β, com. Kuppana Sastri. 1b °र्विभजेत् aβ 1c °स्वरकृ(क्र a)त° aβ, com. Kharegat, Kuppana Sastri. 2a °युक्त a, °युक्तं(क्तुं C) β, com. T.-D. 2b घ्नता a 2d प्रदं β 3a घ्न(घ EF)नषोडश-हृ(ट्रृ E, com. E^2)तं शेषं aβ 3b प्रोज्झ्याद्य° a, प्रोज्झाध्य° β, com. Kuppana Sastri. 3c कल β 3d °यमाश्च(श्च a BC) राश्या(शा a)द्याः aβ 4b गृ(ग A)तितिषष्टांशो° a, गृ(ग C)तिघ्ना(घ्ना CF) षष्टांशो° β 4c पादसंख्या aβ, com. Kuppana Sastri. 4d च(र्च CF) गत्यर्धं β 5b लिप्ताचतुष्क° aβ, com. T.-D. 5d घनणा(रा F)त्फलं β दृ(दं A)त्यं(त्यं β) aβ, com. T.-D. 6b द्विघ्नं β 6d त्रिषष्ट्योद्धृते aβ

Chapter II

II,1. (One should) multiply (the ahargaṇa) by 4, add 6, divide (the sum) by 1461, and subtract (successively) 126 diminished (respectively) by 1, 0, 0, 0, 2, 4, 7, 9, 9, 8, 6, and 5.

II,2. If one increases the ahargaṇa by 1936 and divides (the sum) by 3031, (the quotient) is (called) ghanas; if the remainder is multiplied by 9 and divided by 248, (the quotient) is (called) gatis and the remainder the pada.

II,3. Divide the ghanas by 16; put the remainder aside below; multiply it by 3 and divide it by 4; (the quotient) in signs and so on (is to be subtracted; add) minutes (equal to) twice the number of ghanas, (and) $2^s\ 9;7,1°$; (the result) is (the longitude of the Moon) in signs and so on.

II,4. The gatis multiplied by 185 and diminished by $^1/_6$ of the gatis are called the minutes. A half of a gati is 124 padas; it is positive (in the first half), negative in the other.

II,5. In the (first) half of a gati one must give 180° plus 4 minutes. Take degrees equal to the padas or to the remainder (after subtracting 124); add to these the contribution from the positive or negative (halves of the gati).

II,6. Multiply by 5 the padas diminished by 1; add 1094 to it (in the first half) and subtract it (in the second) from 2414; multiply (each sum) by the padas and divide by 63; the results are minutes (of the longitudinal increment).

शास्यर्धाटलं त्रिकृतिघ्नमृज्वसंशस्थिता मुहूर्ताः स्युः /
व्यर्केन्दुटलं विषयाहतं तिथिस्तद्युदेवोक्तः //७//
मकरादौ गुणयुक्तो मेषादौ तिथियुतो रविर्दिवसः /
कर्कटकादिषु षट्सु त्रयस्त्रिकाः शर्वरीमानम् //८//
कर्कटकादिषु शुक्लं द्विगुणं मध्यस्थिनी भवेच्छाया /
मकरादिषु चाप्येवं किं चास्मिन् मण्डलाच्छोध्यम् //९//
मध्याह्नच्छायार्धं सन्निघ्नमर्को ऽयने भवेद्याम्ये /
उदगयने संशोध्यं पंचदशघ्नो रविर्भवति //१०//
द्वादशभिः सच्छायैर्मध्याह्नोनैर्भजेद्रसहुताशम् /
अपराह्णे चक्रार्धाद्विशोध्य सार्कं भवति लग्नम् //११//
व्यर्के लग्ने लिप्ताः प्राक् पश्चाच्छोधितास्तु चक्रार्धात् /
कार्यश्छेदः शून्याम्बराष्टलवणोदधृतानाम् //१२//
लब्धं द्वादशहीनं मध्याह्नच्छायया समायुक्तम् /
सा विज्ञेया छाया वासिष्ठसमाससिद्धान्ते //१३//
नक्षत्रादिच्छेदः //

7a श (om. D) शादलं a, श (om. C) शस्वटमं β, com. T.-D. 8b मेखादौ aBC.
8c सत्सु aβ, com. T.-D. 9a चलं β 9c वाप्येवं a 9d यस्मिन् aCF, त्वस्मिन् Kuppana Sastri मण्डलाच्छोध्यं a, मण्डलात् (त् om. F) शो (सो BE) ध्यां β, com. T.-D. 11a द्वाशभिः AC 11b °द्रसजनताशं a, °द्रसहृ (ह्र F) तांशाः β, com. T.-D. 11c चन्द्रार्धा° aβ, com. T.-D. 12b त्राक्यश्चाच्छोधितास्तु a चक्राद्यु (त् द्यु E²) तिः BEF 12c काय (यः C) च्छेदः aβ, com. T.-D.
13c quoted by Utpala on BS 2 (p. 64).
13a लघ्वं a 13b समायुक्ता β

II,7. Multiply a fourth of the Moon's (longitude in signs) by 9; the product is the nakṣatra; the degrees (which remain) are muhūrtas. Half of the elongation between the Sun and the Moon (measured in signs) multiplied by 5 is the tithi; (the muhūrtas) are explained in the same way (as above).

II,8. At the beginning of Capricorn, (the longitude of) the Sun (in signs) plus 3 (muhūrtas) is the length of daylight; at the beginning of Aries, add 15 (muhūrtas); in the six signs beginning with Cancer, (add) 9 (muhūrtas to get) the measure of the night.

II,9. In the (six) signs beginning with Cancer, multiply the (number of signs from Cancer 0°) traversed (by the Sun) by 2; the result is the noon shadow. In the six signs beginning with Capricorn, do the same thing and subtract (the product) from 12.

II,10. Half the noon shadow plus three signs is the (longitude of the) Sun (in signs) in the southern ayana; in the northern ayana it is the same, subtracted from 15 (signs).

II,11. One should divide 36 by 12 increased by the shadow and diminished by the noon shadow; add the (longitude of the) Sun (in signs to the quotient); (the result) is the ascendent; in the afternoon, subtract (the quotient) from 6 signs (before adding the longitude of the Sun).

II,12. Subtract the (longitude of the) Sun from the ascendent; in the eastern (hemisphere), the (resulting) minutes are to be made the divisor of 64800; in the western, they must first be substracted from 10800.

II,13. The quotient (in signs) is to be diminished by 12 and increased by the noon shadow; (the result) is to be known as the shadow in the concise siddhānta of Vasiṣṭha.

Thus the Division of the Nakṣatras and so forth.

सार्कघ्ने ऽग्निहुताशनमपास्य रूपाग्निवसुहुताशकृतैः /
हृत्वा क्रमाद्दिनेशो मध्यः केन्द्रं सविंशांशः //१//
एकाद्यष्टषट्कं रूपोना सप्ततिः खयुक्ता च /
नवषट्कसप्तकृतिश्च त्रयः कलाः केन्द्रराशिसमाः //२//
द्व्यब्धिषट्काष्टकसप्ततिः सप्ततिरेकाधिका च नवषट्कम् /
पंचकृतिश्चोपचयो मध्यमसूर्यः स्फुटो भवति //३//
<वि>नवात् पदाद्दशघ्नात् सप्तांशः साग्निसप्तरो भुक्तिः /
गत्यर्धान्ताच्छोध्यो लिप्ताभ्यो नवमुनिवसुभ्यः //४//
पट्सेकोनं पंचाष्टकघ्नमेकर्तुपक्षविषयेभ्यः /
प्रोज्झ्य पदघ्नं छिन्द्यात्रवयमसुनिघ्निः कला इन्दोः //५//
सार्काधिकं भवेद्यत् परिशोध्यं ततः पुनः शतं विंशात् /
शशिनि धनं पूर्वार्धे गत्यर्धे ऽन्त्ये क्षयः कार्यः //६//

1 quoted by Utpala on BS 2 (p. 41).

1a °निहुताशन° aBC 1b °मध्यास्य aC 1c हृत्वा a, हृ (हृ C) त्वा (त्वा C) β, com. T.-D. क्रमाद्दिनेशो a, क्रमाद्दिनेशो β 1d षेंकं β सविंशांशं aβ 2b °युक्ता β 2c °सप्तकृतिश्च a, सप्त (सप्त C) प्त (प्त F, प्त C) कृतश्च β, com. T.-D. 3a °सप्तति om. β 3b सप्ततिरेकाधिका aβ, com. T.-D. 4a विनवात् Kuppanna Sastri पदाद् (द्द् CEF) शघ्नात् (घ्नात् F, घ्नात् C) β. 4b सग्निसप्तांबरो aβ, com. Kuppanna Sastri भुक्तिः (क्ति CF) वतिक्तिः β 4c गत्यर्द्ध° BE, गत्यर्धा (र्द्धा°) CF 4d वसुमुनिनवभ्यः aβ, com. Kuppanna Sastri 5a पट्सेकानं β 5b °सेकंतु° aβ, com. T.-D. 5c प्रोह्य a, प्रोह्या (ह्या EF, ह्या C) β 6b परिशोध्या β ततः पुनः शताद्विं (द्विं EF) शात् aβ 6d त्ये (ते EF) aβ, com. T.-D.

Chapter III

III,1. Multiply (the ahargaṇa) by 120, subtract 33, and divide by 43831; the result is the mean (longitude of the) Sun in order (of revolutions, etc.). This increased by 20° (and diminished by the apogee) is the anomaly.

III,2. The negative minutes corresponding to signs of anomaly are: 11, 48, 69, 70, 54, 25.

III,3. 10, 48, 70, 71, 54, 25 are the positive ones. The mean (longitude of the) Sun is corrected (by them).

III,4. For every ninth pada, multiply (the pada) by 10 and take a seventh part (of the product; the result) increased by 702 (minutes) is the (Moon's) daily motion (bhukti); after the end of a half of the anomalistic month (gati), one must subtract (that result) from 879 (minutes).

III,5. Multiply by 40 the padas decreased by 1, subtract (the product) from 5261, multiply (the result) by the padas and divide by 729; (the result) is the minutes (of the equation) of the Moon.

III,6. Whatever (pada) is more than 120, subtract 120 from it. It is additive to the Moon in the first half-gati, subtractive in the second.

न पदं त्रिषष्टिपरतः प्रथमपदं सप्ततिं त्वतिक्रम्य /
पदयुक्तः षट्पंचयुतश्च बिन्दुस्त्रिकृतिघ्नकः // ७ //
षष्ट्यधिकं तु यदस्मिंस्तच्छोध्यं षष्टितो ऽवशिष्टं यत् /
तद्भानिं प्रथमपदे गतिदलपरतः शशिनि दद्यात् // ८ //
बिनवपदे भुक्त्यूनं इन्दुघ्न <यो>द्भुक्तदहि योत्तमे /
तद्विश्लेषाद्भुक्तिर्नीचे वैबं पदे सनवे // ९ //
बिंशतिरष्टिः सार्धा पादोनाः सप्त भाग्यपूर्वाणाम् /
बिषुवच्छायागुणिताः क्रमोत्क्रमाच्चरबिनाड्यो ऽर्धे // १० //
मेषादिषु तद्युपचितैः कर्कटकाद्येषु च तत्पचयमितैः /
दिनवृद्धिः स्याद्येन क्षयस्तुलाद्येषु वैषुवतात् // ११ //
सागरहिमाद्रिपरिधौ स्पष्टमिदं चरबिनाडिकाकर्म /
अन्यत्रापि यथैतत् स्पष्टं तन्त्रेष्वके वक्ष्ये // १२ //

10 quoted by Utpala on BS 2 (p. 63).
7 b च (om. B) तिक्रम्य Dβ 7c पद(रद)युक्ताः aβ षट्पंचगुणाश्च BC, षट्कं च (च om. E²) गुणाश्च (णाः E²) a EF 7d °स्त्रिघन (ना a EF) घ्नके (घ्नके F) aβ 8a-b षष्ट्य (ष्स F) धिकं तु यदवशिष्टं यत् β 8c तद्भानिः aβ 8d गतदल° aβ °पुरतः β शशि a दद्या (ष B, शा C) द्यात् β 9a बिनवपदै aβ. 9a-b °र्भु (भु a, र्भू C) क्त्यू (क्त्यु BE, त्सू F, सु C) नैर्बिन्दुघ्नद्भु° aβ 9b योत्तमै: a, योत्तमप (भय C) दै β 9c गतदलपरतु नैः inserted from 3d β तद्विश्लेषा° β 9c-d °द्भुक्तिनीचे β, °द्भुक्तिनवे a 9d पदै: सनवै: (पै: EF) aβ 10a °रष्टै: a सार्द्धं° Utpala 10b पादोनैना: β
घा (न्वा C) ऽपूर्वारि (पूर्वा C, पूर्वार F) गां (णां C) β 10d क्रोमोत्क्रमा° a र्द्धे a, र्द्धै: Utpala 11a मेषादिषडु (डु E, डु F, दु C) पचितं aβ, com. T.-D. 11b कर्कटाद्येषु aβ, com. T.-D. °चयमिति β 11c स्याद्येन aβ, com. T.-D.

III,7. There are no padas after the 63rd pada (in the second series). (But,) when one attains the 70th pada, that is (to be treated as) the first pada; increase the padas by 560/9.

III,8. When the padas are more than 60, they are to be subtracted from 60; whatever remains one should give to the Moon negatively in the first pada after the (second) half-gati(?).

III,9. The (longitude of the) Moon on every next ninth pada, decreased by its daily motion is the (longitude of the) Moon on that day; as the converse of this, the daily motion (is the difference between the Moon's longitude then and that) on the preceding ninth pada.

III,10. Multiply the (noon) equinoctial shadows for the (three) signs beginning with Aries by 20, $16^1/_2$, and $6^3/_4$ (respectively); these, taken in direct and reverse order, are the vināḍīs of the equation of daylight in the (first) half (of the zodiac).

III,11. In (the three signs) beginning with Aries, the increase in the (length of) daylight, (for each day) beginning with the equinoctial, is determined by adding these; in (the three signs) beginning with Cancer by subtracting them (successively); in (the six signs) beginning with Libra they are negative.

III,12. The operation (for finding) the vināḍikās of the equation of daylight is correct (for the region) bounded by the ocean and the Himālayas; how it is made accurate elsewhere I shall explain in the chapter on geometrical constructions.

यबनान्तरजा नाड्यः सप्तावन्त्यां त्रिभागसंयुक्ताः /
वाराणस्यां त्रिकृतिः साधनमन्यत्र वक्ष्यामि //१३//
त्रिकृतिघ्नात् स्वबसुहृताद्योजनपिण्डात् स्वताडिताज्जह्यात् /
अवट्टयबिवरकृतिं मूलं षड्भोद्धृतं नाड्यः //१४//
देशान्तरनाडीभ्यस्वरनाड्यर्धक्षयस्तु पूर्वार्धे /
चक्रस्यार्धे चान्त्ये वृद्धिस्तद्भागमपि जह्यात् //१५//
ऋक्षं लिप्तास्तप्तती व्यर्कान्नन्द्रातिथिर्द्विषड्भांशैः /
भुक्त्यनुपाताद्भुक्ता रवीन्दुभुक्त्यन्तराच्च तिथेः //१६//
गुणशिखिगुणाग्नियमशशिविधुता सैका सरूपसूपैका /
सैकविधुता घ भानोः षष्टिर्भुक्तिः क्रमादेवम् //१७//
सितबहुलयोः क्षयधनं षड्भागाः शीतगोर्विरवियोगात् /
लिप्ताः सर्तुहृताश्चैर्लब्धं करणं तिथिवदन्यत् //१८//

13a य(घ C) बना(ना om. C) न्त(घ्न β) रजा(ज्ञा om. β) aβ 13b सप्तावंत्यास्त्रि° aβ, com. T.-D. 14b °पिंडा(ड E) aβ, com. T.-D. स्वताडिता° β
14c-d °क्र(कृ E) तिर्मूला: (ल्या: BE) a BEF 14d षड्भोद्धृता (त्ता aB) a BEF
15a° नाडीभ्य° a 15b °नाड्यर्धं aβ 15c विक्रस्यार्द्धे β
15d वृद्धिस्तद्भोग° a, वृद्धिस्तद्भो (द्भो E², द्भा F) रा β 16a रूक्षं (क्षे C) β
लिप्ताश (शां C, थ a) ती aβ, com. T.-D. 16b °घ्नन्द्रातिथिर्द्वि° a,
°घ्नन्द्रतिथि - द्वि° β, com. T.-D. 16c भु (भू F, भ C) क्त्य (भ E, त्म F, क्ष्य C)
नुपाता° β 18a सितबज्ज (ज BC, ज्ञ EF) लघो: (घो: β) aβ, com. T.-D.
18b °भोगान् a, °योगात् β, com. T.-D.

III,13. There are $7^1/_3$ nāḍīs arising from the (longitudinal) distance between Yavana-(pura) and Avanti; nine (between Yavanapura and) Vārāṇasī. I will explain the calculation for other places.

III,14. Multiply the sum of the yojanas (between the localities) by 9, divide (the product) by 80, and square (the result); subtract from this the square of the difference between the two latitudes (of the two localities); the square-root (of the remainder) divided by 6 are the nāḍīs (of the longitudinal difference).

III,15. Subtract half the nāḍīs of ascensional difference from the nāḍīs of longitudinal difference in the first half of the zodiac, add them in the second. One should ignore any fraction of them (?).

III,16. A nakṣatra is 800 minutes. A tithi (is known) from (the longitude of) the Moon diminished by (that of) the Sun (being divided) by 12°. The limit (of a nakṣatra) is a consequence of the daily progress (of the Moon). (The limit) of a tithi is derived from the difference between the daily progresses of the Sun and Moon.

III,17. The daily progress of the Sun (in each of the zodiacal signs) is in order 60 (minutes) minus 3, 3, 3, 3, 2, 1; plus 1, 1, 1, 1; and minus 0, 1.

III,18. In the śuklapakṣa 6° are subtracted, in the kṛṣṇapakṣa they are added. The minutes of the Moon (so modified and) diminished by the longitude of the Sun (are to be divided) by 360; the result is the karaṇa. The rest is like a tithi.

बहुलचतुर्दश्यर्धात् ध्रुवाणि शाकुनिश्चतुष्पदं नागः /
किंस्तुघ्नमिति चराण्यर्धं करणं तिथेः प्रवर्त्तते //१९//
अर्केन्दुयोगचक्रे वैधृतमुक्तं दर्शसहितस्तु /
यदि चक्रो व्यतिपातो बेला मृग्यार्पितैर्भागैः //२०//
आश्लेषार्धात्तासीद्यदा निवृत्तिः किलोष्णकिरणस्य /
शुक्लमयनं तदासीत् साम्प्रतमयनं पुनर्वसुतः //२१//
विपरीतायनपातो यदार्ककाष्ठांशराशिविक्षेपः /
भवति तदा व्यतिपातो दिनकृच्छशियोगचक्रार्धे //२२//
मेषतुलादौ विषुवत् षडशीतिमुखं तुलादिभागेषु /
षडशीतिमुखेषु रवेः पितृदिवसा ये ऽवशेषाः स्युः //२३//
षडशीतिमुखं कन्याचतुर्दशो ऽष्टादशो च मिथुनस्य /
मीनस्य द्वाविंशो षड्विंशो कार्मुकस्यांशे //२४//

21 quoted by Utpala on BS 2 (p. 41).
19a बहुलयतुर्दृ (दृ F)श्यंद्ध BEF, बहुलमतुर्दृ (र्दृ C)श्यं (श्यं C)र्द्धा (तात् C) a C, com. T.-D. 19b ध्रुवाणि BEF °निश्चनुष्पदं a 19c किंस्तु (स्तु C)घ्ना (घ्न) सित β, किंस्तुघ्नामिति a, com. T.-D. 19c-d चरा (र BE)ण्यर्द्धं a/β 19d करणानि वत् प्रवर्त्तते a/β 20b दृश्यर्द्ध° a °सहितेषु a/β 20d मृग्यापि (पि a) तैर्भागैः a/β 21a अश्लेषा° a/β 21b किलोष्क° D, किलोकृ° β 21c शुक्लमयनं a 21d °मयनं a 22b °काष्ठांशराशिसविक्षेपः a/β, com. T.-D. 22d दिनकृच्छ° a 23a मेस° a विषुव a 23b षडसीति° a 23d ये a, ध्ये β, com. T.-D. विशेषाः a/β, com. T.-D. 24b ष्टादशो a 24d षड्विंशो a

III,19. From the middle of the fourteenth tithi of the kṛṣṇapakṣa the fixed (karaṇas) are Śakuni, Catuṣpada, Nāga, and Kiṃstughna; (the rest are) movable. A karaṇa is half of a tithi.

III,20. When the sum (of the longitudes) of the Sun and Moon is a revolution, it is called Vaidhṛta (yoga); but if it is a revolution plus 10 nakṣatras (133;20°), Vyatipāta. The time is to be ascertained by means of the degrees attained (by the luminaries).

III,21. When the return of the Sun was from the middle of Āśleṣā (at 113;20°), then the ayana (-correction) was positive; now the ayana is from Punarvasu (at 90°).

III,22. When the falling away (from the mean position) of the ayana is reversed, then the correction (kṣepa) for the Sun and Moon (equals) the degrees of the maximum declination (kāṣṭhā) of the Sun (23;20°). There is Vyatipāta if the sum (of the longitudes) of the Sun and the Moon is 180°.

III,23. The equator (viṣuvat) is at the beginnings of Aries and Libra. The ṣaḍaśītimukha ("eighty-six faced") is in the degrees beginning with Libra; in the ṣaḍaśītimukhas of the Sun, whatever (days) are left are days of the Pitṛs.

III,24. There is a ṣaḍaśītimukha at Virgo 14°, at Gemini 18°, at Pisces 22°, and at Sagittarius 26°.

उदगयनं मकरादावृतवः शिशिरादयश्च सूर्यवशात् /
द्विभवनकालसमानं दक्षिणमयनं च कर्कटकात् ॥२५॥
षष्टिघ्ना भुक्तिहृता रविबिम्बकला भवन्ति नाड्यस्ताः /
सङ्क्रान्तीनां कालः पुण्यो ऽतो ऽर्धेन चाप्यन्तात् ॥२६॥
तिथ्यन्तं यदि सूर्यः स्पृशत्युदेत्येष्यं वासरं चापि /
योगस्तदा त्र्यहःस्पृक् तिथित्रयस्पर्शनाद्दुष्टः ॥२७॥
अष्टगुणे दिनरात्रौ रूपेन्द्रियगीतरश्मिभिर्भक्ते /
लब्धा राहोरंशा भगणसमाश्च विपेक्षिताः ॥२८॥
वृश्चिकभागा राहोः षड्भ्यतिरेकलिप्तिकात्युषा /
आदित्यतः प्रोज्झ्य सुखं षड्भाग्नियुतं तु पुच्छाख्यम् ॥२९॥
वक्त्राद्धिकश्चन्द्रो हीनः पुच्छाश्च याति भगणोदक् /
हीनो वदने पुच्छे ऽधिको ऽमुकाभ्याति दक्षिणतः ॥३०॥

25 quoted by Utpala on BS 2 (p. 23).
25a-b मकरादौ वृत्तं (वृं om. a) त(त्त a) क a/β 25b शशिरा° β
25c °समाना Utpala 26a भु (भु BE) क्षि (क्षि[2]भु F) हृ (हृ E) ता β
26d वार्ध्यं (र्ध्यं F) ता (त्ता C) त् (कृतिः BE) β 27b स्पृशत्युदेतोशा a,
स्पृशेत्तु (तु F) देत्येशा β 27c योगस्तद (द om. B, दं C F) β त्र्यहस्पृक् a
28a दिनरात्रौ β 28b °रश्मिभिर्भ्यं (भ्यं C) क्ते β 28c राहोरंशा β
29c आदित्यर (त्या C) त β प्रोह्य a, प्रोज्य β 30a चक्राद° β
30d मुराभ्याति a/β

III,25. The northern ayana is at the beginning of Capricorn. The seasons beginning with Śiśira depend on the Sun; (each) is equal in time to (the Sun's passage through) two zodiacal signs. The southern ayana begins at Cancer.

III,26. The minutes in the (diameter of the) disc of the Sun multiplied by 60 and divided by the daily progress are nāḍīs; this is the auspicious time of the saṅkrāntis, half before and (half) afterwards.

III,27. If the Sun rises touching the end of a tithi and also the coming day, then this is the yoga "touching three days"; (there is a yoga) for a day from its touching three tithis.

III,28. If the ahargaṇa is multiplied by 8 and divided by 151, the degrees of Rāhu are obtained; one should add (a number of) degrees equal to its revolutions.

III,29. The beginning (i.e. the longitude at epoch) for Rāhu is 26° of Scorpio diminished by one minute. Subtracting (its motion) from that (one obtains) the "head" (the ascending node); (this) plus six zodiacal signs is called the "tail".

III,30. When the Moon goes north of the zodiac, it increases (its latitude as it proceeds) from the head and decreases (it as it approaches) the tail; when it travels south from that, it decreases (its latitude) at the head and increases (it) at the tail.

आगतवत्या राहोश्चन्द्रो ऽन्तरितो ऽतिमहति विक्षेपे /
लिप्तात्रयतद्दुयरमे ऽत्यशीतिमनुपातो ऽतो ऽत्र //३१//
तिथिनक्षत्रच्छेदा प्रतिपत्तिर्यदि तथा ततः साध्नुः /
न तथा च भद्रविष्णोस्तथापि विनिवर्त्तते लोकः //३२//
न सुगपद्दुदयो भानोरस्तमयो वापि भवति सर्वत्र /
कस्मिन् देशे ऽस्तमयः पाठाद्दिनेन भुक्तं विदुः //३३//
मार्गादुपेतमेतत् काले लघुता न तावदतिदूरे /
स्वविषयभूताष्टरसैरब्दैः पक्ष्यास्य विनिपातम् //३४//
रोमकमहर्गणं पाटमर्कैमिन्दुं च गणयतां ग्राह्य /
चैत्रस्य पौर्णमास्यां नवम्यां नक्षत्रमादित्यम् //३५//
कालापेक्षा विधयः श्रौताः स्मार्ताश्च तत्प्रचारेण /
प्रायश्चित्ती भवति द्विजो यतो ऽतो ऽधिगम्येदम् //३६//

31b भिमहति β 31c–d °दुयेत्यशीति (तβ) म° aβ 31d °पाततो a, °पातो ते (तC) β 32b °पत्ति यदि aβ, com. T.-D. 32d °पि om. a 33a सुगपद्दु (द्दु C, दु E²) दयो β 33a–b भानुर (र्नु E, नोर E²) स्तमयो aβ, com. T.-D. 33d भुक्तिमिदं a, भक्तिमिन्दुः β 34b तावदतिदू (दु C) रो (रो om. E, र add. E²) β 34c र (र om. B, रो E) विषय° β 35b ग्राह्या aβ 35d नवमी aβ

III,31. The Moon, being 90° distant from Rāhu, at its maximum latitude goes 280 minutes; elsewhere proportion (is to be used).

III,32. If the beginning (pratipatti) occurs when there is a separation of tithi and nakṣatra, then it is good. But it is not so in a bhadra tithi and Viṣṇu's nakṣatra (Śravaṇa); for thus does the world disappear.

III,33. There is not simultaneously everywhere a rising of the Sun or its setting. In what place is its setting? From that basis they know what has passed of the day.

III,34. This is arrived at from a method; there is no quickness in so very long a time. Look at its (the world's) destruction in 68550 years.

III,35. Taking the Romaka ahargaṇa as the basis, let one calculate (the longitudes of) the Sun and the Moon on the full-moon (tithi) of Caitra; on the ninth (tithi) the nakṣatra is Āditya (Punarvasu).

III,36. The śrauta and smārta regulations depend on time; because a twice-born through offending them is a prāyaścittī (i.e., he has to perform propitiatory rites), therefore he studies this (i.e., time).

कुकरणविटो द्वित्रा ये कथयन्त्यस्फुट<म>सत्यं <य गणितम्> /
कुकरणकारसहि<ताश्च> ते ह्यणं नरके कृतवासाः ॥३७॥
स्फुटगणितविटिह लब्ध्वा धर्मार्थयशांसि दिनकराटीनाम् ॥३८॥
इति पौलिशसिद्धान्तः ॥

37a अकरणविटो β द्वित्र्यो a, द्वित्यो β 37b कथयन्त्यस्फुटं a, कथ(यं E)सत्यं β 37c अकरणकार° β °सहते aβ ह्यनं A, ह्यनं D, om. β
38a लब्ध्वा(घ्रा F) aβ, com. T.-D. col. इति om. a

III,37. Whatever twice-born men, knowing a bad karaṇa, say that (astronomical) calculations are inaccurate and false, they, together with the makers of bad karaṇas, instantly make their homes in hell.

III,38. (But) one who knows accurate calculations of the Sun, and so on, obtains dharma, wealth, and praise in this world.

Thus the Pauliśasiddhānta.

षष्टिशतत्रयपरिधेर्वर्गदशांशात् पदं स विष्कम्भः /
तद्दिग्दांशचतुष्कं संत्रकलस्य राश्यष्टभागज्या ॥१॥
व्यासार्धकृतिर्ध्रुवसंज्ञिता कृतांशास्ततः स मेषस्य /
ध्रुवकरणी मेषोना द्व्योस्तु राश्योः पदं ज्याः स्युः ॥२॥
शेषेष्विष्टेषु धनुर्द्विगुणपदायोगशेषगुणहीना /
त्रिज्या तदर्धवर्गो द्विगुणार्धैक्यकरणीसमायोज्यः ॥३॥
तत्स्थ> पदोऽभिमतज्या ध्रुवा तदूनावशेषपिण्डस्य /
ध्रुवकरणीदलमध्यार्धसंज्ञको ऽन्यो ऽत्र विधिरुक्तः ॥४॥
इष्टांशाद्विगुणोनत्रिभज्ययोना त्रयस्य यापज्या /
षष्टिगुणा सा करणी तया ध्रुवोनावशेषस्य ॥५॥
मेषज्याः स्वरतिथयो गुणश्चावृतिभिश्च विंशतिः सहिता /
पंचनरकं शतार्धं त्रिसमेतं षष्टिरिति लिप्ताः ॥६॥

1a-b °परिधे वर्ग° aβ, com. T.-D. 1b विष्कंभः a 1c तद्दिग्दां(द्दा β)शा शतुष्कं aβ, com. T.-D. 1d संत्रकलस्य a, त्रकलं β, com. T.-D. राश्यष्ट° β 2a °कृते ध्रुव° aβ 2b कृतांशाः स्ततः a शेषस्य aβ, com. T.-D. 2c मेषोना a, येषो (यो BE) ना (ना om. BC) β 2d द्व्योस्तु a, द्व्यो (यो: C) स्तु β, com. T.-D. 3a-b धनुर्द्वि° a 3b °गुणापदा° β °योज्य° a, °ज्योज्य° β °गुणहिना aβ, com. T.-D. 3c तृज्या a, त्रज्या β, com. T.-D. सपा (प β) दार्द्धार्द्धगै aβ, com. T.-D. 3d द्विगुणकारयो (द्यो a) समा (र्या a) यो (र्त्रो β) ज्यं aβ 4a तस्य T.-D. 4b तदूना° a °शेषे β 4d °संज्ञामन्यो aβ, com. T.-D. विधिरुक्तः a 5a इष्टांश° a °द्विगुणेन a 5b नाय (प E) ज्या aβ, com. T.-D. 5c स aβ, com. T.-D. करणी a 5d ध्रुवोनामशेषस्य aβ, com. T.-D. 6a शेषज्या aβ, com. T.-D. स्वस्वर° β °तिथयः aβ 6b °भिज्ञा aβ, com. T.-D. वि (भि B) तिः β

Chapter IV

IV,1. The square-root from the tenth part of the square (of a circle) whose circumference is 360 is the diameter. In this (circle), by one establishing four parts (i.e., quadrants), the Sine of an eighth part of a zodiacal sign (3;45°) (is to be determined).

IV,2. The square of the radius is called the dhruva. A fourth part of this is (the square of the Sine) of Aries (i.e., of 30°). The dhruva-square is diminished by (the square of the Sine) of Aries; the square-root is the Sine for two zodiacal signs (i.e., 60°).

IV,3. When the remaining (Sines) are desired, the radius is diminished by the Sine of the remainder of the subtraction of twice the arc from a quadrant; the square of half of that (remainder) is to be added to the square of half (the Sine) of double (the arc).

IV,4. The square-root of that is the desired Sine. The dhruvā diminished by that (square is the square) of the remaining sum. Half of the dhruva-square is called the adhyardha (i.e., (square of the Sine of) one and a half (signs, or 45°)). Here another rule is described.

IV,5. The Sine of the arc of three (signs) is diminished by the Sine of three signs diminished by twice the given degrees; (the remainder) multiplied by sixty is the square (of the Sine of the given arc). The dhruva diminished by that (square) is the square of the remainder (i.e., of the Cosine).

IV,6. The Sines in Aries are 7, 15, 20 plus 3 (= 23), plus 11 (= 31), and plus 18 (= 38), 45, 50 plus 3 (= 53), and 60 minutes;

सैकाब्जे पंचाशत् पंचाष्टकपंचवर्गवेदाश्च /
त्रिंशच्चतुर्भिरधिका षट्पंचाशच्छराः शून्यम ॥७॥
षट्त्रयोटशैकोनविंशतिस्त्र्यष्टको ऽयतस्त्रिंशत् /
युक्ताम्बरपंचनवत्रिज्ञगतिभिर्लिप्तिका वृषभे ॥८॥
चत्वारिंशट्टामा मुनयो ऽर्धांशतं च सैकं त्रिभोगतिः /
द्वादश षष्टिहीना मनुभिर्विषयैर्वृषे विकलाः ॥९॥
गुणरसनवद्वादशविद्या द्वित्रिभूतभूपान्तरज्ञाः /
ज्यालिप्ताः पिण्डो ऽयं द्वितीयराशावतो विकलाः ॥१०॥
धृतिगुणधृतिपरिहीना षष्टिः शून्यं शतार्धमनलोनम् /
वेदा व्येकार्धांशतं पंचेति तदन्तरज्याः स्युः ॥११॥
मुनयो ऽब्जे व्येकान्ते रसत्रयं पंचकौ कृताग्निर्गविः /
शिखिपक्षचन्द्रशून्या द्विर्द्विर्मिथुने कला ज्यास्युः ॥१२॥

7a सैकाये β 7c °तुर्भिर (र om. B) येका β 7d षट्पंचाशच्छराः a
8a षट्त्रयो° β °ट् (टे D) शैकात्र° aβ, com. T.–D. 8b °विंशतित्र्यष्ट° β
°कान्यत° aβ, com. T.–D. °स्त्रिंशत्तृ (तृ D) a 8c युक्तांबर° A
8c–d °चवा (वां AC) द्वि (द्वि AD², हि E) भागतिभि (भी a) र्लि (लि a) सिका
(काष्ट BEF) aβ 9a चत्वा (चा CF) रिंशट् (ट्ट B) मा β 9b सैकमिति गति
aβ 9c षष्टिहीना aβ, com. T.–D. 9d मनुभिर्विषयै° a
10a गुणनवरसकादश° aβ 10b भिश्च (श्च β) aβ, विद्ये T.–D.
द्वित्रिभूतभूनतभुक्तं (क्तयं a) तरसा aβ, com. T.–D. 10c ज्यापिण्डा aβ
10d °राशायतो β 12a मुनयो a, गुन (ण CF, com. F²) यो β ज्ये aβ,
com. T.–D. 12b पंचको β, को a कृताब्जे गविः a, कृता – (वे C, ब्धे F) गविः
β 12c शिखिपकृतचन्द्र° a 12d द्विर्द्विर् मिथुने a

IV,7. in Aries 50 plus 1 (= 51), 5 times 8 (= 40), 5^2 (= 25), 4, 30 plus 4 (= 34), 56, 5, and 0 (seconds).

IV,8. In Taurus (they are) 6, 13, 19, 3 times 8 (= 24), and 30 plus 0 (= 30), plus 5 (= 35), plus 9 (= 39), and plus 13 (= 43) minutes;

IV,9. in Taurus 40, 3, 7, 50 plus 1 (= 51), 13, 12, and 60 minus 14 (= 46), and minus 5 (= 55) seconds.

IV,10. The minutes of the Sines for the intervals are 3, 6, 9, 12, 13, 3 times 5 (= 15), twice (= 10), and 16; this sum is (added to the Sine for) the second sign (i.e., 1,43;55). Then the seconds:

IV,11. 60 minus 18 (= 42), minus 3 (= 57). and minus 18 (= 42), 0, 50 minus 3 (= 47), 4, 50 minus 1 (= 49), and 5. These are the differences between the Sines:

IV,12. 7 in Aries, diminished by 1 in the last (Sine, thus 6); three sixes, two fives, and three fours in Taurus; twice each of three, two, one, and zero are the minutes in the Sines in Gemini.

मेषे विकलार्धशतं सैकं व्येकेन्द्रियेश्वरं त्रिंशत् /
द्व्युद्विंशतिस्त्रिवर्गः <पंचाशच्च विषयसंयुक्तम्> //१३//
ख<समुद्र>गुण<द्विकृताः> - - - - - - - - - /
कृतार्णव<द्वि>यमनवे<न्द्र>यसमुद्र शिखिस्वर्गै<शाः> //१४//
मनुविषयतिथिरसाः स्युस्त्रिगुणाः पंचाष्टकं स्वरोपेतम/
सप्तदश नवपंचकं षोडश चेति क्रमान्मिथुने //१५//
जीवा व्यर्धशतांशाः साङ्गुलिप्ता टिनेशकाद्धतः /
चन्द्रस्य स विक्षेपस्तदपक्रमो राशिपादेभ्यः //१६//
लिप्ताशतमशीतिं दशत्रिसंयुक्ताभिन्द्रियमनूनाम् /
गवि मनुभवमुनिरूपैश्च <त्रि>गुणैः संयुतं च शतम् //१७//
नवतिस्त्रियुता षष्टिश्चत्वारिंशच्छिवाश्च मिथुनान्ते /
मेषादितो गत उदग्दक्षिणतो ऽदस्तुलादिषु च //१८//

13b सैक्यं (का F) β व्येकेन्द्रियस्व (स्व BE)रं aβ, com. T.-D. 13c द्व्युद्विंश° aβ, com. T.-D. 14c-d °यमनवकसमुद्रा aβ 14d शिखिवर्गैः (र्गै B) aβ 15c नव (व om. B)पंचकं β 16a व्या – (सा C)र्द्ध सितांशाः β, व्यार्द्धशतांशाः a 16b सैका षष्टि टिनेश° aβ 16d °स्तदपक्रम aβ 17b दशस्त्रिष (श BE)° aβ °युक्त (क्त A)°a 17c गविसेमनु° aβ 17d संयुतवशतं β 18b after °च्छिवाश्च a adds याम्योत्तरे कार्ये विषुवद्दिनसमध्य from 19c–20a; β adds याम्योत्तरे and Han omits 18b मिथुनान्ते to V 9c तद्दृग्दयकाले प्रतिनूं (मति E)पत्र एक add. CEF; अग्रो नास्ति add. β मिथुनान्तरे a 18c मेषाद्गतागतसमु° a

IV,13. In Aries the seconds are 50 plus 1 (= 51), minus 1 (= 49), minus 5 (= 45), and minus 11 (= 39), 30, 22, 3^2 (= 9), ⟨and 55⟩.

IV,14. ⟨In Taurus they are 4⟩0, ⟨2⟩3, ⟨4⟩, 44, 2⟨2⟩, ⟨5⟩9, 34, and 1⟨1⟩.

IV,15. In Gemini they are, in order: 14 times 3 (= 42), 5 times 3 (= 15), 15 times 3 (= 45), 6 times 3 (= 18), 5 times 8 plus 7 (= 47), 17, 9 times 5 (= 45), and 16.

IV,16. The Sine of the maximum declination (kāṣṭhā) of the Sun is 50 minus 2 (= 48) parts and 9 minutes. (As) there is a latitude of the Moon, (so) is there a declination (of the Sun; it is) for fourths of a sign:

IV,17. 180 minutes plus 10 (= 190), plus 3 (= 183), minus 5 (= 175), and minus 14 (= 166); in Taurus 100 plus 14 times 3 (= 142), plus 11 times 3 (= 133), plus 7 times 3 (= 121), and plus 1 times 3 (= 103);

IV,18. 90, 60 plus 3 (= 63), 40 plus 3 (= 43), and 11 at the end of Gemini. As (the Sun) proceeds from the beginning of Aries, it is to the north; in the (six signs) beginning with Libra, to the south.

शङ्कुश्चतुर्विस्तारे वृत्ते छायाप्रवेशनिर्गमनात् /
अपरैन्द्रीदिक्सिद्ध्यैवैच्छ यास्योत्तरे कार्ये //१९//
विषुवद्दिनसममध्यच्छायावर्गात् सवेदकृतरूपात् /
मूलेन शतं विंशद्विषुवच्छायाहतं छिन्द्यम् //२०//
लब्धं विषुवज्जीवा यापर(मे)तो ऽल्पो ऽथवा यथेष्टदिने /
मेषाद्यपक्रमयुतस्तुलादिषु विवर्जितः स्वाद्यः //२१//
अयनोनयुताच्चज्या तत्त्रिज्याकृतिविशेषमूलेन /
छिन्द्याद्द्वादशगुणितां लब्धा माध्याह्निकी छाया //२२//
विषुवज्ज्यायामार्धं वर्गविशेषमूलमवलम्बकः /
क्रान्तिज्यात्रिज्याकृत्यन्तरात् पदद्विगुणितव्यासः //२३//
अजवृषमिथुनापक्रमजीवाः षड्घ्नास्तु वेदमुनिवसवः /
त्र्यष्टकतिथिषट्काष्टक(के)विकलाग्र्याधिकाः परिज्ञेयाः //२४//

20-21 quoted by Utpala on BS 2 (p. 62); 22 quoted by Utpala on BS 2 (p. 63); 23 quoted by Utpala on BS 2 (p. 62).

19a संकु (कु D) श्चतुर्विस्तारे a 19b-c °निर्गमनाच्चपरैद्री° a, com. T.-D. 19c-d °सिद्ध्यैवाच्छ a, com. T.-D. 20a-b °सममध्यच्छाया° a 20b °रूपात् a 20c शते a 20d छिन्द्यात् Utpala 21b ऽथवैवमिष्टदिने Utpala 21d स्वोच्चः a 22a अपमोन° Utpala °युताच्चज्यां a Utpala, com. T.-D. 22b तात्रिज्याकृति° a, त्रिज्यातत्कृति° Utpala, com. T.-D. °मूलां a 22c छिन्द्याद्द्वादशगुणितां Utpala 22d माध्याह्निकी a 23a °छायामर्ध्यार्द्ध° a 23b °मूलवलं[बो]लंबः A, °मूलम्बो लम्बः D 23c-d °ज्याक्रांत्यंतरात् a क्रान्तित्रिज्याकृत्योरन्तरपदं द्विगुणं दिनव्यासः Utpala 24b षड्घ्या (ष्टया D, com. to ड्घ्या D²) स्तु a, com. T.-D. 24c-d °षट्काषड्विकलाग्र्याधिका a, com. T.-D.

IV,19. From the entrance and exit of a shadow into a circle whose diameter is four times (the length of) the gnomon is the attainment of the directions west and east; north and south are to be determined by means of barley-corn (figures).

IV,20. Multiply the equinoctial shadow by 120 and divide (the product) by the square-root of the square of the noon equinoctial shadow increased by 144.

IV,21. The result is the Sine at the equinox; its arc is the terrestrial latitude. Or else, on any given day, (the Sun's coaltitude at noon) increased by the declination (of the Sun when it is) in Aries and so on, and decreased (by the declination) in Libra and so on, is one's terrestrial latitude.

IV,22. The Sine of terrestrial latitude, increased or decreased by the declination (of the Sun), is to be divided by the square-root of the difference between the squares of that (Sine so increased or diminished) and of the radius; the quotient, multiplied by 12, is the noon shadow.

IV,23. The square-root of the difference between the squares of the Sine at the equinox (i.e., the Sine of terrestrial latitude) and of the radius is the Sine of terrestrial colatitude. The diameter of the day (-circle) is twice the square-root of the difference between the squares of the Sine of declination (of the Sun) and of the radius.

IV,24. The Sines of the declination (of the Sun at the ends) of Aries, Taurus, and Gemini are (respectively) 4 times 6 (= 24), 7 times 6 (= 42), and 8 times 6 (= 48); they are to be increased by 3 times 8 (= 24), 15, and 6 times 8 (= 48) minutes (respectively).

<पंचत्रिंशत्>ज्यष्टकसरूपधृ<ति>तरसंयुतो> क्रमाद्विशती /
पंचाष्टकतिथिविकलाधिको वृषात्यौ दिनव्यासः //२५//
व्यासक्रान्तिज्याघ्नी विषुवज्ज्या लम्बकच्युतैर्भ्यर्हृता /
तच्चापकलात्र्यंशाश्चरखण्डविनाडिकाः स्पष्टाः //२६//
चरखण्डकपञ्चांशज्याघ्नमहर्व्यासमुद्धरेत् स्वजिनैः /
द्विः कृत्वा तद्धृतात् क्रान्तिज्याकृतिसुतान्मूलम् //२७//
तेन विभजेत् क्षितिज्यां व्यासार्धगुणामवाप्तमवज्या /
नवतेरल्पोनायाः क्रमशो ज्या लम्बको ऽवयवैः //२८//
ऽपक्रमज्याकृतिविश्लेषमूलर<गुणिताद्> विस्तारात् /
स्वव्यासहृताच्चापं दिग्घ्नं राश्युद्यमविनाड्यः //२९//
वसुमुनिपञ्चा व्येकं शतत्रयं त्रिष्टिकाग्नयश्चाज्जात् /
परतस्त एव वामाः षड्भक्रमास्ते तुलाद्यर्धे //३०//

27-28 quoted by Utpala on BS 2 (p. 62); 30-31 quoted by Utpala on BS 2 (p. 63).

25a पंचत्रिंशत् suppl. T.-D. 25b °ष्टकृताक्रमाद्विशति a, com. T.-D. 25c-d °विकलाधिको a, com. T.-D. 25d वृषात्यौ a, com. T.-D. 26b लंबि[को]क° A, लक° D ([ब] add. D²) 27b °महसमुद्धरेत् a 27c व्यावृद्धि (द्धि D) कृत्वा तद्धृत् a 27d °युतान्मूलं a 28a क्षितिज्यां a, स्थितज्यां Utpala, com. T.-D. 28b °वाप्त (प्त om. D, add. D²) पञ्चज्या a 28c °रल्पोसोनाया a 29a ऽपक्रम° a 29a-b °ज्याकृतिविशेषमूल-विस्तरात् a, com. T.-D. 29c स्वव्यास्हृताचाप a, com. T.-D. 29d दिग्घ्नं a, com. T.-D. 30b °ग्नयश्चाज्जात् (ञ्ज् D, com. to न् D²) a, °ग्नयश्चाङ्कैः T: Utpala, com. T.-D. 30d षड्भक्रमास्ते तुलाद्यर्धे a

IV,25. The diameters of the day-circles are in order 200 plus 35 (= 235), 200 plus 3 times 8 (= 224), and 200 plus 18 plus 1 (= 219); (those for the ends of) Taurus and the last sign (Gemini) are increased by 5 times 8 (= 40) and 15 minutes.

IV,26. Multiply the Sine at the equinox (i.e., the Sine of terrestrial latitude) by the diameter and by the Sine of the declination (of the Sun); divide (the product) by the Sine of terrestrial colatitude and by the diameter of the day (-circle); a third of the minutes of the arc of that (Sine) is the accurate vināḍikās of ascensional difference.

IV,27. Multiply the diameter of the day (-circle) by the Sine of half of the ascensional difference and divide (the product) by 240; put this (earth-Sine) down twice. (Take) the square-root of the squares of this increased by the square of the Sine of the declination (of the Sun).

IV,28. Multiply the earth-Sine by the radius and divide by this; the result is the Sine of terrestrial latitude. The Sine of 90° diminished by the terrestrial latitude is the Sine of terrestrial colatitude.

IV,29. Multiply the diameter by the square-root of the difference between the squares of the Sines of the declinations (of the Sun) and (of the Sines of the ends of the several) signs and divide (the products) by the (respective) diameters of the day (-circles). The arc from this, multiplied by 10, (equals) the vināḍīs of rising of (each) of the signs.

IV,30. From Aries they are 278; 300 minus 1 (= 299); and 323; afterwards they are the reverse. These six in reverse order are in the half (of the zodiac) beginning with Libra.

चरकालटलक्षीणास्त्रयस्त्रयः संयुताः प्रतीपैस्तैः /
उदयक्षैतुल्यकालेन यान्ति तत्सप्तमास्तास्तम् //३१//
दृष्टोत्तरगोलापक्रमांशकज्यां स्वभास्करव्यस्ताम् /
हृत्वाद्यजीवया तच्चापाद्भुदयेन तत्कालः //३२//
तस्मिन् दिनकृत् कुरुते सममण्डलसंश्रयं दिनार्धे /
तावच्छेषे परतो न तुलादिषु विद्यते चैतत् //३३//
स्वाभिनघ्नी क्रान्तिज्या लम्बहृता भुजगुणा द्युदैर्घ्यहृता /
तच्चापस्य रसांशः सकलः स्याद्दिनरविवृद्ध्यर्धः //३४//
उत्तरगोले ऽर्कज्या काष्ठान्तरगुणा भुजज्यया भक्ता /
ताः शङ्कुलिप्तिकास्यास्तास्थिताः सममण्डलच्छाया //३५//
सममण्डललेखासंप्रवेशवेलां करोति यो ऽर्कस्य /
तत्प्रत्ययं च जनयति जानाति स भास्करं सम्यक् //३६//

32-33 quoted by Utpala on BS 2 (p. 42); 35-36 quoted by Utpala on BS 2 (p. 43).

31a चरटलकाल° Utpala, चरकालटत्रा° a, com. T.-D. 31b प्रतीपैस्ते a 31d यंति तत्सप्तमास्तान् a 32b स्वतस्कराभ्यस्तां a, स्वभास्कराभ्यस्तां Utpala 32c हृतात्वजीवजा a 33b°संश्रया a दिनार्धे वा Utpala 33d चैतच्च a 34a स्वभिनघ्नी a, com. T.-D. 34a-b [क्रांतिज्या लंबघ्नी] A 34b द्युदैर्घ्या (घ्य D) हृतात् (त् om. D) a, com. T.-D. 34c तच्चापंत्रा a, com. T.-D. 34d सकलसदिनवृध्यर्द्धः a 35b काष्ठांतरगुणा a 35d सममण्डले छाया Utpala 36a °मंडललेषा° a 36b °वेलाः a करोतिर्यो कस्य a

IV,31. (The right ascensions of) three (signs) are diminished by half the times of the (local) ascensional difference, (those of the next) three are increased by these in reverse; in a time equal to that of the sign which is rising the seventh (sign) from it sets.

IV,32. Multiply the Sine of the given degrees of declination in the northern gola by 120 and divide (the product) by the Sine of terrestrial latitude. From the arc of that (Sine is known) the time (since Sun-) rise;

IV,33. in this (time), which is in the first half of day (-light), the Sun reaches the prime vertical; so much (is the time) on the other side (to the west) in the remainder (of daylight). This is known not (to apply when the Sun is) in the (six signs) beginning with Libra.

IV,34. Multiply the Sine of declination by 240, divide (the product) by the Sine of colatitude, multiply (the quotient) by (the Sine of) the terrestrial latitude, and divide (the product) by the diameter of the day (-circle). A sixth of the arc from this (Sine) is all of a half of the increase of day (-light).

IV,35. (When the Sun is) in the northern gola, multiply the Sine of (the longitude of) the Sun by (the Sine of) its maximum declination (kāṣṭhānta) and divide (the product) by the Sine of terrestrial latitude. These are called "the minutes of the gnomon"; by means of them (is found) the shadow (when the Sun is) at the prime vertical.

IV,36. Whoever computes the time of the Sun's entrance into the prime vertical and produces confidence in that, he knows the Sun completely.

वर्षेण भगणमर्को यदि भुंक्ते किं ततो यथेष्टदिनैः /
अज्ञो ऽप्येवं गणयति किं न रविं लोष्टरेखाभिः ॥३७॥
कृतदिग्ग्रहणे वृत्ते रेखां पूर्वापरां यदा छाया /
प्रविशति सम्यक् शङ्कोः सममण्डलगस्तदा सूर्यः ॥३८॥
इष्टक्रान्तिज्याघ्नं व्यासार्(शै)कलं लम्बकोत्थमुष्णांशुः /
समपूर्वापररेखामतीत्य यात्यस्तमुदयं वा ॥३९॥
तेन हृता स्वार्कघ्नी क्रान्तिज्या लम्बको ऽस्य <यो>घ्नापम् /
तेन नवतिर्विहीना यच्छेषं ते ऽक्षभागाः स्युः ॥४०॥
तत्कालघटिकाडीष्टिदशांशं द्विघ्नमन्नतुलाद्येषु /
षड्घ्नीभ्यो नाडीभ्यो ऽन्नात् संयोजयेच्चापि ॥४१॥
तज्ज्या स्थितज्यया संयुता वियोजिता<न्नतु>लाद्येषु /
अविशोधनेन जीवा षड्घ्नीनामे<व> कर्तव्या ॥४२॥

38 quoted by Utpala on BS 2 (p. 43); 41-44 quoted by Utpala on BS 2 (pp. 63-64).

37a °मर्को a, com. T.-D. 37b तयो a, com. T.-D. 38a कृतदिग्ग्रहणे a 38c शंकुः a 38d सममंडलगतस्तदा a 39a °ज्याघ्ना a 39b व्यासकल°a, व्यासशकल° T.-D. लम्बकांशमु° a 39d °मती(ली D, com. to ती D^2) त्यमात्यस्त° a, com. T.-D. 40a हृता a, com. T.-D. स्वार्क(स्यु D)घ्नी a, com. T.-D. 40b स्यन्नापं a, com. T.-D. 40c-d °हीना ह्यषेद्यत्ते क्षभागाः a, com. T.-D. 41a-b °नाडीसदृशांशं a 41c षड्घ्नीभ्यो a 42a तज्ज्या a 42b वियोजितातालाद्येषु a 42c जीवा a 42d षघ्नी(घ्नां A)नामेकर्तव्या a

IV,37. If the Sun traverses the zodiac in a year, how much (does it traverse) in any given (number of) days? How does even an ignorant fellow not compute (the longitude of) the Sun thus by means of rows of markers?

IV,38. When the shadow of the gnomon completely enters into the east-west line in a circle wherein the directions have been indicated, then the Sun is on the prime vertical.

IV,39. Multiply the radius by the Sine of the given declination and divide (the product) by the Sine of terrestrial colatitude; (the result is the Sine of amplitude). The Sun, having passed the east-west line by an equal (amount) sets or rises.

IV,40. Multiply the Sine of the declination by 120 and divide (the product) by that (Sine of amplitude); whatever is the (corresponding) arc of that (result) is the terrestrial colatitude. Whatever is the remainder after that (terrestrial colatitude) has been subtracted from 90 is the degrees of terrestrial latitude.

IV,41. (Put down) in two places a twentieth part of the vināḍīs of ascensional difference for that time; (as the Sun is) in Aries and so on, or in Libra and so on, one should subtract (this) from, or add it to, the nāḍīs multiplied by 6.

IV,42. The Sine of that (amount) is to be increased or diminished by the Sine of what has been put aside (as the Sun is) in Aries and so on, or in Libra and so on. The Sine (of the nāḍīs) multiplied by 6 without any correction is to be found.

एवं कृत्वा हन्याद् द्युव्यासेनावलम्बकघ्नेन /
<छिन्द्यात् खखाष्टवस्वब्धिभिः फलं शङ्कुलिप्ताख्यम् //४३//
तत्कृतिविनाकृतानां खखवेदसमुद्रशीतरश्मीनाम् /
पदमर्कघ्नं शङ्क्वङ्गुलाख्यलिप्तोद्धृतं छाया //४४//
छायाद्वादशकृत्योर्योगान्मूलेन लम्बकघ्नेन> /
खखवस्वब्धिमुनीन्दून् विभज्य लब्धा प्रथमजीवा //४५//
तद्द्युक्रान्तिज्याघ्नी विषुवज्ज्या लम्बकोद्धृता स्याप्ता /
प्रथमज्या विश्लेष्या मेषाद्ये ऽन्यत्र संयुक्ता //४६//
तत्स्थितजीवे गुणिते खजिनैर्द्युव्यासभाजिते चापे /
युतवियुते ऽजतुलादिषु षड्धृता नाडिका लब्धाः //४७//
षड्घ्ने ऽथवा द्युमाने छिन्ने सद्वादशैर्विमाध्याह्नैः /
छायाङ्गुलैर्गतास्ता नाड्यः प्राक् पृष्ठतः शेषाः //४८//

48–49 quoted by Utpala on BS 2 (p. 64).

43a कृधा a हन्या a 43c–45b om. a 45a–b suppl. T.–D.
45c खखवस्वब्ध्मु° a, corr. T.–D. 45c–d °नींद्वाद्विभज्य a
46a तद्युज्या (– D, ज्या add. D²) क्रांत्रीज्याघ्नी a, corr. T.–D. 46b विषुवज्ज्या a, corr. T.–D. 46c विश्लेषा a, corr. T.–D. 46d सेषाद्ये a, corr. T.–D. नात्र a, corr. T.–D. 47a तस्थितिजीवे a, corr. T.–D. 47b खजिने द्युव्यास° a, corr. T.–D. 47c यतुलादिषु a, corr. T.–D. 47d षड्धृतो a, corr. T.–D.
48a षट्ह्ये a ऽथ स्वद्युमिते Utpala 48b सद्वादशे विमध्याह्ने a
48c °गतास्छा a 48d नाद्य: a प्रष्टतो a

IV,43. Having done thus, one should multiply (the Sine) by the diameter of the day (-circle) multiplied by the Sine of terrestrial colatitude, and divide (the product) by 28800; the result is called "the minutes of the gnomon" (i.e., the minutes of the Sun's altitude).

IV,44. Of 14400 diminished by the square of these (minutes) (take) the square-root; multiply (it) by 12 and divide (the product) by the minutes called "the digits of the gnomon" (i.e., by the minutes of the Sun's altitude); (the result is) the shadow.

IV,45. Take the square-root of the sum of the squares of the shadow and 12 and multiply it by the Sine of terrestrial colatitude; divide 172800 by the product; the quotient is the "first Sine".

IV,46. Multiply the Sine at the equinox (i.e., the Sine of terrestrial latitude) by the Sine of declination on that day, and divide (the product) by the Sine of terrestrial colatitude; put (the quotient) down (in two places). The "first Sine" is to be diminished (by this, if the Sun is) in Aries and so on, otherwise it is to be increased (by it).

IV,47. Multiply both, that (Sine) and the Sine which was put aside, by 240 and divide both (products) by the diameter of the day (-circle); the two (corresponding) arcs are to be added together or subtracted one from the other (as the Sun is) in Aries and so on, or in Libra and so on. The resulting (degrees) divided by 6 are nāḍikās.

IV,48. Or else multiply the length of daylight by 6, and divide (the product) by the digits of the shadow increased by 12 and diminished by (the digits) of the noon (shadow). (The result is), in the east, the nāḍīs that have passed, in the west the remaining ones (that are to come).

छायार्की नाडीभिर्हीनमानं षड्घ्नमुद्धरेत्तत्र /
लब्धं द्वादशहीनं मध्याह्नच्छायया सहितम् //४९//
दृष्टा नाड्यो द्युनिशे चन्द्रोदयनाडिर(का)युतविहीनाः /
ताभिस्तत्कालेन्दोर्भानोरिव चिन्तयेच्छायाम् //५०//
चरनाड्य(ऽ)क्रम(टि)विधिना द्युव्यासापक्रमविशेषम् /
अस्तमये पूर्वविधिः शेषाणां युक्तिरुन्नेया //५१//
छायार्कवर्गयोगा(त्) पदविभाज्यार्कसङ्गु(णि)ण(तो) त्रिज्या /
विषुवज्जीवागुणिता लम्ब(क)कभक्ता तु सूर्याग्रा //५२//
काष्ठा(ष्टे)तार्कैर्मौर्व्या लम्बकहृतया विहीनसंयुक्ता /
सूर्याग्राज्जतुलादौ कर्णौ त्रिज्ययापहृता //५३//
लब्धाङ्गुलानि कोटिस्तच्छायावर्गविवरमूलं (यत्) /
स च बाहुर्दिग्ग्रहणे सममिति कोट्या तु देशमृजु //५४//

49a नाडिभि° a 49b षड्घ्नम्° a 50a द्युनिशं a, com. T.-D.
50b°नाडियुतविहिता a, com. T.-D. 50c °स्तत्कालंदो° a, com. T.-D.
51a चरनाडीक्रम° a 51b द्युव्यासाग्र्यक्षमतिविशेषं a
51c अस्तमयो a, com. T.-D. पूर्वविधिः a 52a °योगा a, com. T.-D.
52b पदे a °सङ्गुणा a 52d लंकाभक्ता a, com. T.-D. 53a काष्ठे यार्के°
a, com. T.-D. 53b विहितसंयुक्ता a, com. T.-D. 53c सूर्याग्राच्चतुलादौ a,
com. T.-D. 54a काटि° a, com. T.-D. 54b यत् suppl. T.-D.
54c बाहु (हु D)र्दिग्ग्रहणे a, com. T.-D. 54d कोट्या a, com. T.-D.
देशमृणं a, com. T.-D.

IV,49. Multiply the length of daylight by 6, and divide (the product) by the nāḍīs (which have passed); diminish the quotient by 12 and increase it by the (digits of the) noon shadow. (The result is) the shadow of the Sun.

IV,50. The observed nāḍīs are to be increased or decreased by the nāḍīkās of the rising of the Moon as it is day or night; by means of these one should find out the shadow of the Moon at that time as (one finds out that) of the Sun.

IV,51. By means of the rules (for computing) the nāḍīs of ascensional difference and the declination (of the Sun, one should compute) the diameter of the day (-circle), the declination, and the latitude (of the Moon). The previous rules (apply also) for setting. For the rest (of the planets) it is to be thought out by reasoning.

IV,52. The radius multiplied by 12 is to be divided by the square-root of the sum of the squares of the shadow and of 12; (the quotient) is to be multiplied by the Sine at the equinox (i.e., the Sine of terrestrial latitude), and (the product) divided by the Sine of terrestrial colatitude; (the result) is the Sine of the amplitude of the Sun.

IV,53. Multiply (the Sine of) the maximum declination (of the Sun) by the Sine of the Sun's (longitude), and divide (the product) by the Sine of terrestrial colatitude; the Sine of the amplitude of the Sun is to be decreased or increased (by that amount, as the Sun is) in Aries and so on, or in Libra and so on. Multiply (the result) by the hypotenuse, and divide (the product) by the radius.

IV,54. The digits (thus) obtained are the koṭi; whatever is the square-root of the difference between the squares of that and of the shadow is the bāhu. In determining the directions, (the bāhu) is level (on the east-west line) and is to be given as forming a right angle with the koṭi.

छायासमरेखान्तरगुणिता त्रिज्या स्वकर्णभक्तास्या: /
एकत्वे ऽन्तरितैष्या सूर्याग्रा संयुतान्यत्वे //५५//
लम्ब(क)गुणिता सा ज्या काष्ठामौर्व्या हृतार्क: स्यात् /
सूर्योदयेन विधिना ग्रहास्ततो ऽन्ये ऽपि कर्तव्या: //५६//
इति करणाध्यायश्चतुर्थ: //

55c तिर (र om. A) तेष्या a 55d सूर्यग्रा a, com. T.-D. 56a लंबगुणिता a, com. T.-D. 56b मनोर्क: a 56d ग्रहास्त्वतो a, com. T.-D.

IV,55. Multiply the radius by the distance between the shadow and the east-west line, and divide (the product) by its (i.e., the shadow's) hypotenuse. If (this and the koṭi are) in the same direction, their difference is to be taken; if in opposite directions, their sum. (The result) is the Sine of the amplitude of the Sun.

IV,56. Multiply this Sine by the Sine of the terrestrial colatitude, and divide (the product) by the Sine of maximum declination; (the quotient) is the Sun's (longitude). By the rules applying to the Sun the other planets are to be calculated.

Thus the fourth chapter, the Karaṇa.

अयनान्तरसंयुक्तान्नटूनगुणेच्छशाङ्करविविवरात् /
मूलेनायनविवरे छिन्ने विक्षेपसंगुणिते //१//
फलमिन्दुकेविशेषाच्छोध्यं त्वयनानुकूलविच्छिसे /
तच्छत्यासे देयं विपरीतं पूर्वसन्ध्यायाम् //२//
दिनकृत्समम्भवनात्तेनोदयनाडिकाद्वयं यदि वा /
वियति विमले तदेन्दोर्लोकस्यालोकमायाति //३//
द्विगुणाच्चे तिथ्यंशाः शृङ्गमुदक्कुंसुडुगणाधिपतेः /
देयं च भुजाद्देतच्छौक्ल्यं कर्णोद्विषट्कांशः //४//
अर्यनान्तरविक्षेपावेकान्यत्वे युतोनितौ कोटिः /
कर्णो रवीन्दुविवरं तत्कृतिविवरात् पदं बाहुः //५//
सविता यतः शशाङ्कात् कोट्या परिकल्पितस्ततः कोटिः /
देयांशकाङ्गुलसमा भुजकर्णौ याङ्गुलैरेव //६//

1–10 quoted by Utpala on BS 4,15
1a अयनांतर° a, अपमान्तर° Utpala 1b °त्तटूनयुक्ताच्छशांक° a °विवरात् a, °विवरे Utpala, com. T.-D. 1c मूलेनापमविवरे Utpala 2a फलसिंध्वर्के° a 2b त्वयनानु° a, त्वपमानु° Utpala °विच्छिसो a 3b °त्तेनोदयानाडिका° a 3c तटिंदो° a 4a द्विगुणेछे a, द्विगुणेच्छा Utpala तिथ्यंशः a Utpala 4b °सुदक्कुंसुडुगणाधिपतिः a 4d कर्णाद्वि° a, कर्णाद्वि° Utpala °षट्कांशम् Utpala 5a अनांतर° a, अपमान्तर° Utpala 5b °वैकानत्वे a, °वैकान्यत्वे Utpala, com. T.-D. यातोनिता a 5d तत्कृति° a बाहो: a 6b कोज्या परिकल्पितकोटिः a

Chapter V

V,1. Multiply the difference of (the longitudes of) the Sun and Moon increased by the difference of their declinations (corresponding to this elongation), by the (first difference) diminished by that (second difference); by the square-root (of the product) divide the difference of their declinations, multiplied by (the Moon's) latitude.

V,2. The result is to be deducted from the difference between the Sun and Moon if the (Moon's) latitude is in the same sense as its declination; if it is in the opposite sense, it is to be added. In the case of the eastern twilight, (the procedure) is reversed.

V,3. If that (result) has two nāḍikās of rising—(to be taken) from the sign that is seventh from the Sun—then, if the sky is clear, visibility of the Moon comes to the world (of men).

V,4. In the diameter of the Moon are 15 parts; its horn is elevated. A twelfth of the hypotenuse is the illuminated portion; it is laid off from the bhuja.

V,5. The difference of the declinations it to be added to or subtracted from the (Moon's) latitude as they are in the same or in the opposite directions; (the result is) the koṭi. The hypotenuse is the difference of (the longitudes of) the Sun and Moon. The square-root of the difference between the squares of these (i.e., of the koṭi and of the hypotenuse) is the bāhu.

V,6. On whatever side the Sun is from the Moon, on that side lies the koṭi. The koṭi is laid off with parts equal to digits; the bhuja and the hypotenuse are also (laid off) with digits.

शशिमध्यात् प्राक् कर्णः कोटिरतो ऽतो भुजः शशाङ्कगतः /
परिधावल्लो नाम शौल्क्यमध्यात्तदनु <स> सूत्रम् //७//
याम्योदग्विक्षेपाट्टिषुवच्छाया<या>घ्नाद्रविभक्तांशाः /
उदये शशिनो वृद्धिः क्षयो विपर्यस्तमस्तमये //८//
एवं व्यर्कान्<न्द्र>योनोना राशयः षडधिका वा /
तदुदयकालेन दिवा निशि च शशाङ्कोदयो वाच्यः //९//
कृत्वैवं क्षयवृद्धिं व्यर्कं चन्द्रं विशोध्य यत्रार्धात् /
शेषोदयकालसमे निशि दिवसे ऽस्तं शशी याति //१०//
इति शशिदृग्गणितम् //

7a प्राक्कर्णः a 7c नाम: a 7d शौल्क्यं a Utpala मध्यातदनुसूत्रं a, मध्याद्भनुस्तत्र Utpala 8b °ट्टिषुवज्याघ्नाद्रविस्तरार्बांशाः a, °ट्टिषुवत्याघ्नाद्रविभिन्नरबाणांशः Utpala 8d विपर्यस्तमय एवम् Utpala 9a–b व्यर्कान्द्र्योनोना a, व्यर्कान्द्र्योद्यूना Utpala 9b षडधिकाया a 9c तदुदयाकालेन a β begins °न दिवा 10a तद्यै (यै F, त्रै C) वं β क्षयवृद्धी Utpala 10c मेस्थो (था C) दय° aβ 10d श (श्रा E) शिदिवसा (त्या F) र्द्धे शशि (शी a Utpala) मध्ये aβ Utpala, com. T.-D. col. इति om. a

V,7. First (is drawn) the hypotenuse from the center of the Moon, then the koti; then the bhuja goes toward the (center of the) Moon. On the circumference (of the Moon) is the akṣa; after that, from the midpoint of the illuminated portion (i.e., from the akṣa) (is laid off) the sūtra.

V,8. Multiply the equinoctial shadow by the latitude to the south or north; divide the resulting degrees by 12. (The result) is positive or negative at the rising of the Moon, the opposite at its setting.

V,9. The signs (resulting) from the subtraction of the Sun from the Moon (or these) increased by 6 (signs) are to be diminished by this. The rising of the Moon by day or at night is to be described (as occurring) in the rising-time of these (signs).

V,10. Making it thus negative or positive, subtract the Sun from the Moon and subtract (the remainder) from 180°; the Moon sets at night or by day in a time equal to the rising-time of the remainder.

Thus the Visibility of the Moon.

नैष्यास्तिथिनाड्यो ऽर्कोदयाच्चक्रार्धोनेन्दुरविविवरात् /
पाण्डवघ्नाच्च शोध्याः स भवति तत्कालशशी लिप्तः //१//
राहोः सषट्कृतिकलां हित्वांशं तच्छशाङ्कविवरांशैः /
ग्रहणं त्रयोदशान्तः पंचदशान्तस्तमस्तस्य //२//
विक्षेपकलाकृतिवर्जितस्य पंचोनषष्टिवर्गस्य /
मूलं द्विगुणं तिथिनाड्यन्त्य कालः स्थितेर्भवति //३//
शशितिमिरविवरभागैस्त्रयोदशोनाः शराहताः क्षेप्याः /
स्थित्या विनाडिकास्ता राहावधिके ऽन्यथा हानिः //४//
किं त्वन्तरांशहीनैः पंचदशोनाहता दृशा कृतघ्नाः /
तत्सदृमेकाच्छिद्यं पंचांशो ऽस्माद्विमर्दकलाः //५//
स्थितिदलविमर्ददलयोर्विशेषकाले ऽसकलं तमो ऽत्तीन्दुम् /
ग्रग्रहमोक्षे शशिराहुविवरभागैश्च दिग्बाध्या //६//

1b sर्को (र्के β) दृ (दे β) याच्चंदृ (दृ BE) स (य BE, ध्य F) मेन्दु (दु aF, दू C) रविवरात् (नृ a) aβ 1c व (पं D) शुद्धघ्नाच्च a, स्यु (स्यु CE) दृ (–दृ BE) बाधवः (ब्धः E, om. B) β 1d °शशि aβ, com. T.-D. after °शशी a adds दिवसार्द्धे
2a सषट्तति° β 2b हिवा (ग्या CF) यं β तच्छशाङ्कः° β
2d पंचदशान्तसमस्तस्य β 3a°कलाकृति° a 3c मूल्यो aβ, com. T.-D.
5a यं (य C) तराशहीनैः β 5b पंचाप्ती (प्ति C) रू (रु CE) ना° β
दृशा a, दृ β कृतघ्नाः a 5cd °मेकाच्छि (च्छि BE) – (– om. C) पंचांशो β
6a स्थिदल° a 6b°विशेषको (का β) मे aβ सकलीमतीत्तीं (त्तीं om. β) न्दुं (दुः BE, दं F) aβ 6c ग्रग्रहण (ण om. F)° β °मोक्ष a, मात्र β, com. T.-D.

Chapter VI

VI,1. The lapsed nāḍīs of the (current) tithi at sunrise are to be subtracted from (i.e., diminished by) five times the difference between (the longitude of) the Sun and (that of) the Moon diminished by 180°; the Moon at that time is obscured.

VI,2. Put down the degree of the ascending node increased by 36 (or by 26?) minutes. (Operate) with the degrees of the difference between this and (the longitude of) the Moon; if they are within 13°, there is an eclipse, and if within 15°, a darkening of it (the Moon).

VI,3. Subtract the square of the minutes of (the Moon's) latitude from the square of 55; double the square-root (of the remainder). From dividing this up as (is done) with a tithi there results the time of the duration (of the eclipse).

VI,4. Subtract the degrees of the difference between (the longitudes of) the Moon and the node from 13° and multiply (the result) by 5. The (resulting) nāḍikās are to be added to the duration of the eclipse if the ascending node is greater (in longitude), otherwise subtracted.

VI,5. Multiply 10 diminished by (the remainder from) 5 diminished by the degrees of difference (between the Moon and the node) by that remainder, and multiply (the product) by 4; multiply the square-root of that (product) by 21. A fifth part of that (product) is the minutes of the totality of the eclipse.

VI,6. In a time equal to the difference between half the duration and half the totality the darkness eats the Moon, but not entirely. The directions of first contact and last contact are to be determined by means of the degrees of difference between (the longitudes) of the Moon and the node.

विक्षेपविपर्यासस्तुरीयभागे हृते त्रयोदशघ्ना /
परिघौ प्राक्प्रवृतीन्दोर्ग्रहणाशा⟨स्तद्⟩वदेत् पर्व ॥७॥
शशिपरिधिदलार्धघ्ने स्वेन्दुन्तरभागसङ्गुणे भाज्ये /
सप्तरूपाष्टहृते प्राग्वलनं वामं परे सव्यम् ॥८॥
⟨तिथ्यन्ते ग्रहमध्यं प्राक् परतः स्थितिदलेन भाज्यौ /
रक्तकपिलौ च वर्णौ बुधाधःस्थे परे नितराम्⟩॥९॥
सर्वग्रासिन्येवं वर्णविशेषं वदेत्त्रिशानाथे /
उदयास्तमये भूम्नं खण्डग्रहणे सलिलर⟨ं⟩शम् ॥१०॥
राहुं मुखोनचक्रं त्रियमद्विगुणं शशिर⟨हीने⟩संयुक्तम् /
अभिलक्षो ऽयमुच्चः क्रियादिः कन्यान्तगो नीचः ॥११॥
सप्तदशाष्टत्रिंशत्तद्युतिलिप्तामितेन सूत्रेण /
शशिराहुस्थितिवृत्तान्येकस्थानि वा संलेख्य ॥१२॥

9–10 quoted by Utpala on BS 5,18.
7a–b °विपर्यासां (सं D)तरीयभागे aβ 7b क्रते a, तते β
च (om. F)योदशघ्ना (घ्न D) aβ, com. T.-D. 7c परिघौ a प्राक्प्रवृतोंदो° BC
7d °ग्रहणास्तांशो a, °ग्रहणास्वां (श्वां B) शो β 8a °दलाद्धि (द्धी F, द्धि C) घ्ने aβ, com. T.-D. 8b वाच्ये aβ, com. T.-D. 8c सप्तरूपाष्टहृते β प्राग्वलना aβ, com. T.-D. 8d युते a, च्युते β, com. T.-D. 9 om. aβ 10a पर्वग्रासिन्ये (न्ये C) वं β 10b वेदत्रिशानाथे β 10c उदयास्तगांसभूम्नं aβ 10d after खण्डग्रहणे a adds च सलिलाभं aβ 11a राहुमुखोनं यक्रं aβ
11b शशाङ्कसंयुक्तं (क्तन् a) aβ 11c एषि (यि C)क्षेशो aβ यमुच्च aβ
11d नीचः β 12a सप्तदशाष्टा° aβ, com. T.-D. 12a–b त्रिंशात (त om. C)द्युत° β
12b °लिप्तामतेन a 12c शशिना (न F) वहुस्थिति° aβ, com. T.-D.
12c–d °वृत्ता (ता F) नि एकस्थ (स्थ aC) नो (नो aC) नि aβ 12d वालेख्य a

VI,7. The direction of (first contact in) the eclipse is opposite to (the direction of) the (Moon's) latitude, on a quadrant of the circumference of the Moon, beginning from the east (-point), divided 13 times. One should say that this is the parvan (i.e., the point of contact).

VI,8. Multiply a quadrant of the Moon (i.e., 90°) by the terrestrial latitude and multiply (the product) by the degrees of difference between (the longitudes of) the (mid)-heaven and the Moon; divide (the product) by 8100. The (resulting) deflection is to the north (if the Moon is) in the east, to the south (if the Moon is) in the west.

VI,9. The middle of the eclipse is at the end of the tithi; (the times of) its beginning and end, to the east and to the west, (are determined) by half its duration. Blood-red (rakta) and reddish-brown (monkey-colored: kapilla) are the colors when (the impact is) respectively up and down, especially in the west.

VI,10. One should say that there is a distinctive color (or: a diversity of colors) in the Moon when it is totally eclipsed. It is smoke-colored (dhūmra) (when the eclipse occurs while the Moon is) at the ascendent or at the descendent; it is cloud-colored if the eclipse is partial.

VI,11. (The longitude of) the ascending node, (or) 360° diminished by (the longitude of) the ascending node, [multiplied by 223,] is diminished or increased by (the longitude of) the Moon; the result is (the direction of) impact (of the eclipse). It is high (if the Moon is) at the beginning of Aries, low if it is at the end of Virgo.

VI,12. Draw the circles (representing) the Moon, the shadow, and the (maximum) duration of the eclipse, (all) having one center, by means of a string measuring (respectively) 17, 38, and their sum (55) in minutes.

प्रोक्तायाम(सं)शकलकान(तू)पूर्वापरयोश्च पार्श्वयोश्चापि /
आयामिन्यो रेखास्त्रयोदश समान्तराः कार्याः //१३//
चन्द्रच्छेद्यकमेतच्छास्त्रागम्यं समासतो ऽभिहितम् /
ग्रासविमर्दे स्थितयः संस्थानेनात्र दृश्यन्ते //१४//
स्वे भूच्छायामिन्दुः स्पृशत्यतः स्पृश्यते न पश्चार्धः /
आगच्छे ऽर्कमिन्दोः प्राक्त्रग्रहणं रवेर्नात्र //१५//
चन्द्रग्रहणं षष्ठो ऽध्यायः //

15 quoted by Utpala on BS 5,12.
13a प्रोक्तायांसकलंका a, प्रोक्तायोंसबूलंका β 13b पूर्वापयोश्च a
13d समान्तराः a, समांतारा: β कार्यः β 14a चन्द्रछेदकं° a, चन्द्रछेदक° β,
com. T.–D. 15a भूम(य om. C)च्छायामिंदु β 15b स्पृशतः a, स्पृश्य(श्र C)तः β
पश्चार्द्धं Utpala 15c आगच्छे aβ

VI,13. In the two sides to the east and west of the afore-mentioned radii are to be drawn thirteen long lines having equal intervals (between them).

VI,14. This projection of the Moon, which is to be approached with a commentary, has been summarily set forth; in it are seen, by means of the representation, the first contact, totality, and duration of the eclipse.

VI,15. In its own (eclipse) the moon touches the shadow of the earth; therefore its western half is not touched. In an eclipse of the Sun, (the Moon touches) the Sun; (therefore) the first contact of the Moon is in the east, but not that for the Sun.

The sixth chapter: the Eclipse of the Moon.

दिनमध्यमसंज्ञाता यावत्यो नाडिका व्यतीता वा /
ताभ्यः षड्गुणिताभ्यो ज्या त्रिंशांशास्तिथेर्नामः //१//
पंचघ्नास्त्रियमासा <छेपो> ऽछे मुखपुच्छयोर्धनर्णे: /
तद्राशिचरणायनगुणं धनमृणं नाड्यो द्विकविभक्ताः //२//
उदगयने पूर्वार्धे धनमृणं दक्षिणे प्राच्याम् /
पश्चाद्धनं तु याम्य उदगृणं वामतः पृच्छे //३//
दिनयातशेषनाड्यश्चन्द्रायनसङ्गुणास्त्रशीतिहृताः /
मेषतुलाद्यृणं धनं विपरीतं वामतः पृच्छे //४//
राहोः सषट्कृतिकलां हित्वांशां तच्छराङ्कविवरांशैः /
ग्रहणं त्रयोदशान्तः शशिनो भानोस्तथाष्टान्तः //५//
तद्दुर्गमपास्येन्दोर्नतिरूपाद्भवेः कृतरसाघ्न /
तन्मूलं पाटोनं स्थितिकालश्चन्द्रभान्वोश्च //६//
पौलिशसिद्धान्ते रविग्रहणं सप्तमो ऽध्यायः //

1 equals VIII 9. 5a-c equal VI 2 a-c.

1b यावत्यो β वत (त् B, त्त E, त्तत् C) aβ, corr. T.-D. 1b ज्यास्त्रिंशांशास्तिथि (थि F) नी (नि D, corr. to ना D²) म aβ, corr. T.-D. 2a-b पंचघ्नास्त्रिघ्नासा-दछा-मुख° aβ 2b °पुछयोर्दुनर्णे a, °पुष्टयोर्दुनर्णे β 2c तत्र राशि° a, तत् राशि° β 2d धनमृणना (त्ता β) इयो aβ 3b धनं ऋणं aCF दिणे a, दक्षिणं β, corr. T.-D. 3c-d याम्ये दृगृणं a, याम्ये दृ (दृ C) गुगृणं β 3d पुष्टे β 4a-b °शेषं नाड्यश्चन्द्रायन (य C) त्र° β 4b °सङ्गुणास्त्रशीति° a, °सङ्गुणाश्चा (स्त्र CF) शीति° β, corr. T.-D. °कृताः C, °छताः E, °—ताः F 4c शेषतुलादि ऋणधनं aβ 5a °कृतिकिलां a, °कृतिकला β 5b हित्वांसं a, हित्वांस β, corr. T.-D. 5d °स्तथाष्टीतः β 6a-b तद्दुर्गसमासेन्दोश्च व (ग β) र्तुरूपाद्भवे aβ, corr. T.-D. 6b कृतरसा (स EF) घ्न aβ 6d °भानोश्च aBE, °भान्योश्च C

Chapter VII

VII,1. As many as are the nāḍikās till noon is attained or that have passed (since noon), multiply them by 6 and (take) the Sine (of the product); a thirtieth part (of the Sine) is called the "displacement of the tithi" (parallax in longitude).

VII,2. Multiply the nāḍīs by 5 and divide (the product) by 23; divide (again) by 2. The lunar latitude is added to the terrestrial latitude at the ascending node (i.e., if the latitude is northern), subtracted from it at the descending node (i.e., if the latitude is southern). Add or subtract this (sum or difference) to the declination of a fourth of the zodiacal signs (i.e., of the nonagesimal). (Take the Sine of this and) multiply it (by the amount found at the beginning of the verse).

VII,3. In the northern ayana it is positive in the east, in the southern (ayana) negative in the east; in the southern ayana it is positive in the west, in the northern negative. (The signs are) reversed at the descending node.

VII,4. Multiply the nāḍīs that have passed or that yet remain in the day by the declination of the Moon and divide (the product) by 80; (the result) is negative in Aries and so on, positive in Libra and so on. (The signs are) reversed at the descending node.

VII,5. Put down the degree of the ascending node increased by 36 (or by 26?) minutes. (Operate) with the degrees of difference between this and (the longitude of) the Moon; if they are within 13°, there is an eclipse of the Moon, and if within 8°, an eclipse of the Sun.

VII,6. For the Moon, deduct the square of its (distance from the node) from 169; for the Sun, deduct the square of its (distance from the node) from 64. The square-roots of these (differences), diminished by their fourths, are the times of duration of their eclipses for the Moon and Sun.

The seventh chapter: the Eclipse of the Sun in the Pauliśasiddhānta.

रोमकसूर्यो द्युगणात् खतिथिघ्नात् पंचकर्तुपरिहीणात् /
सप्ताष्टकसप्तकृतेर्द्व्योद्धृतान्मध्यमः क्रमशः //१//
रविशशिनोः स्फुटकरणं स्वकेन्द्रुनवनाड्यंसंमितैः खण्डैः /
तत्क्रमशश्च पुनस्तैर्भिद्युनटलं शोध्यते ऽकैस्य //२//
तिथिमनुदशकृतसहिता रसमनुरंबि)हीना च विंशतिर्हृता /
धृतिविषयोना द्विदशाष्टिधृतिषु वृद्धिः कला विकलाः //३//
खखरूपाष्टगुणघ्नात् कृताष्टनवकैकवर्जितात् द्युगणात् /
त्रिविषयाङ्कखकृताशापरिलब्धान्मध्यशीतांशुः //४//
शून्यैकैकाग्न्यस्ताच्चवशून्यरसाब्धितादिनसमूहात् /
रूपत्रिखगुणनक्तात् केन्द्रुशशिनो ऽस्तगमवन्त्याम् //५//
मनुनवयमसहितेंऽशो वसुहोत्रा वर्जितो धृतिकृतश्च /
विषयकृतिरष्टिषट्कं नवतिहीनं <हृ)तं चन्द्रेण //६//

1 quoted by Utpala on BS 2 (p. 41).
1a रोमसूया (र्यो D) a 1b °परिहृी (हृि C) णाच्च (त् न E) aβ, com. T.-D.
1c सप्ताष्टकया (णा C, आ E) त्त (त्य C) तते° β 1d °द्विद्रु (न्द्रु β) योधृ (द्धु a) ता-
न्मध्यमा: aβ, com. T.-D. क्रमशः aβ, सूर्यः Utpala 2a स्फुरठकरणं β
2b स्वकेन्द्रु° aβ, स्वखेन्द्रु° Dikshit, com. T.-D. 2d क (क्र C) स्य (स्य C) β
3b रसमनुहीनाग्न्यविंशतिर्हृी (हृी β) ना aβ 3d °धृतिष्ट β कला
द्विरकि (क E) ला aβ, कलाद्विरकिला Dikshit, com. T.-D. 4a° रूपाष्टगुणाष्ट-
घ्नात् (त् om. C) aβ, com. T.-D. 4b क्र (क्रा F) ताष्ट° aβ, com. T.-D.
°वर्जिता (ता om. β) द्युगणात् aβ, com. T.-D. 4c त्रिविषये च स्वकृताशा° aβ,
com. Dikshit 4d °परिशुद्धान्मध्य° aβ °शीतांशोः aβ, com. T.-D.
5a शून्यैकैकाग्न्यस्ता° aβ, com. T.-D. 5d स्तगमवद्यां a, स्तगमवट् (द्दृ EF) गाम्
β, com. T.-D. 6a-b °सहितांशौ वसुहोता वर्जितौ धृतिकृतौ च aβ, com. T.-D.
6c विषयकृति° a °रष्टव (य C, क E) षट्कं (द्धु C, द्व EF) aβ 6d नवतिहीनौ न चंद्रेना aβ

Chapter VIII

VIII,1. Multiply the ahargaṇa by 150, subtract 65 (from the product), and divide (the remainder) by 54 787 in order; from this (is obtained) the mean (longitude of the) Sun (according to) the Romaka.

VIII,2. The calculation of the true longitudes of the Sun and the Moon are by means of segments measured in halves of zodiacal signs of their anomalies, (both) in direct order of these and in reverse. A half of Gemini (i.e., 75°) is subtracted from (the mean longitude of) the Sun.

VIII,3. The minutes are 20 plus 15 (= 35), plus 14 (= 34), plus 10 (= 30), plus 4 (= 24), minus 6 (= 14), and minus 14 (= 6); the seconds are minus 18, minus 5, plus 2, plus 10, plus 16, and plus 18.

VIII,4. Multiply the ahargaṇa by 38 100, subtract 1984 (from the product), and divide (the result) by 1 040 953; from this (is obtained) the mean (longitude of the) Moon.

VIII,5. Multiply the ahargaṇa by 110, add 609 (to the product), and divide (the sum) by 3031; from this (is obtained) the anomaly of the Moon at sunset at Avantī.

VIII,6. A degree plus 14 (= 1;14°), 11 (= 1;11°), and 2 (= 1;2°); 4 times 18 minus 8 times 3 (= 0;48°); 5^2 (= 0;25°); and 6 times 16 minus 90 (= 0;6°); (these are) used with the Moon.

खनवनगाः शशिभुक्तिः कृतवसुमुनयः शशाङ्ककेन्द्रस्य /
यातस्फुटान्तरे दिवसभुक्तिरागामिकी नैशी //७//
त्र्यष्टकगुणिते दत्त्वाद्रसर्तुयमषट्कपंचकान् राहोः /
भवरूपाग्न्यष्टिहृते क्रमाज्जमषात् सोच्यते वक्त्रम् //८//
दिनमध्यमसंप्राप्ता यावत्यो नाडिका व्यतीता वा /
ताभ्यः षड्गुणिताभ्यो ज्या त्रिंशांशस्तिथेर्नाम: //९//
उदयात् प्रभृति च नाड्यो याः स्युः प्राग्लग्नमानयेत्ताभिः /
तस्मात्तु नवसमेताट्पक्रमांशा विनिश्चित्याः //१०//
लग्नासुरविर(बे)रज्यां द्विगुणां खरसांशमपक्रमांशात् /
नह्याद्यन्त्यत्यासे विद्येपैक्ये तयोर्योगः //११//
उत्तरमल्पाच्छुद्धं याम्यं साद्धं च दक्षिणं विद्यात् /
उत्तरमल्पाधिकमुत्तरमेवं विजानीयात् //१२//

9–18 quoted by Utpala on BS 5,18; 9 equals VII 1.
7b क्रत° a, तल्ल om. C) त्त (तू C) β, com. T.-D. 7d° भुक्ति आगामिकी aβ, com. T.-D. 8a त्र्य (त्र्य om. E, add E²) ष्टगुणिते (ते BE) β 8b°पंचकाद्राहोः a 8d क्रमा (मात् CF) aβ, com. T.-D. क्रमांत्तोव्यते a, द्रु (उ CF) खां (खो F) तोच्यते β वक्त्रां a 9b या (त्या C) यत्या β दिनाद्दिका a
9c षड्गुणितायो aβ 9d °स्तिथिर्नो (नी D, ना D²) म aβ 10a व a
10b पु: प्रा (फा C) लग्नमानये (वे C) ताभिः β 10c नवम (म om. E, add. E²) मेता° aβ 10d° क्रमांशान् Utpala विनिश्चित्या a, द्विनिश्चित्य β, विनिश्चित्य Utpala, com. T.-D. 11a वग्नासुरविरज्यां a, लग्नासु (स्स C) रविरज्यां β, लग्नज्यगु-विबरज्यां Utpala 11b सवसांससंयुतयममरान् a, या (यर F, मर C) सांस (रू C) सं-पुतय (य om. C) ममरान् β, खरसांशसंमितामपमात् Utpala 11c जह्याद्यन्त्य (ग्व C) त्यासौ aβ 11d विद्येपैके aβ 12b यद्दि (द्दीद्व C) णं β 12c उत्तमल्पा° β

VIII,7. The daily progress (bhukti) of the Moon is 790 (minutes), (that) of the Moon's anomaly 784. In the difference between the past (and present) true longitudes (are found) the day's bhukti (and that) for the coming night.

VIII,8. Multiply (the ahargaṇa) by 24, add (to the product) 56 266, and divide (the sum) by 163 111; the (result, counted) in (reverse) order from Pisces, is called "the face of Rāhu" (i.e., the ascending node).

VIII,9. As many as are the nāḍikās till noon is attained or that have passed (since noon), multiply them by 6 and (take) the Sine (of the product); a thirtieth part (of the Sine) is the deplacement of the tithi (i.e., the parallax in longitude).

VIII,10. By means of those nāḍīs which (have elapsed) since sunrise one should calculate the ascendant; from this increased by 9 (zodiacal signs) the degrees of declination are to be determined.

VIII,11. Multiply the Sine of the difference between the (madhya)lagna (the nonagesimal) and the node by 2 and divide (the product) by 60; one should subtract (the result) from the degrees of declination if the directions are opposite, add them together if the latitude (and declination) are in one direction.

VIII,12. If (the result) is northern and is subtracted from the terrestrial latitude or if it is southern and is added to it, one should know that (the result) is southern; if it is northern and is greater than the terrestrial latitude, one should know (the result) is northern.

तज्ज्याघ्नीं शशिभुक्तिं हृत्वा धृतिभिः शतैः स्फुटावनतिः /
मध्यममानं त्रिंशद्भानोः शशिनश्चतुस्त्रिंशत् //१३//
समलिप्तराहुविवरज्याभक्ता मूर्ध्ना नवहृता च /
अवनत्या युतविक्षेपिता च टिक्साम्यवैलोम्ये //१४//
मध्यमसाभक्ता स्फुटभुक्तिर्मध्यभुक्तिनिघ्ना च /
भवति कलापरिमाणं तत्कालीनं रविहिमांश्वोः //१५//
अवनतिवर्गं नवाद्भवेन्दुपरिमाणयोगदलवर्गात् /
तन्मूलात्तु द्विगुणात्तिथिभुक्तवधादिशेत् कालम् //१६//
रविशशिमानस्मृतिदलादवनतिहीनाद्भवन्ति या लिप्ताः /
तान्यङ्गुलानि विभाद्भानोश्छायानि चन्द्रमसा //१७//
अर्धोनालिख्य रविं दत्वावनतिं यथादिशं मध्यात् /
अवनत्यन्तान्तरं विलिखेद्व्यासार्धमर्धेन //१८//
इति रोमकसिद्धान्ते ऽर्कग्रहणमष्टमो ऽध्यायः //

13a तज्ज्याघ्नीं (घ्नी β) aβ 13b हृत्वा (घा F) β स्मृतानवधिः aβ
13c-d त्रिंशद्भानोः β 13d °स्त्रिंशच्च a 14a-b समलिप्ताद्भविवरज्यान्यस्ता a, समलिप्तिभ (त्त E, प्ति E²)ता (ता om. E, add. E²) द्भविवरज्यान्यस्ता β 14b नवहृ (द्भ EF) ताश्च aβ Utpala 14c अनवद्या a, अ (व्र F) वन (म C) घ्या (घ्न C) β 14c-d युतविक्षि-षिप्ताश्च β, युतविक्षेपिताश्च a 14d टिक्साम्ये aβ 15a मध्यमभा (भा EF) ता (ताE) न्यस्ता aβ 15b स्फुट (टे E) भुक्ति (भुक्ति om. BE) मध्यम-भुक्तिघ्नका aβ 15c कलापपरिमाणं aβ 15d हिमांश्वो (श्वो om. BC) शोः β 16a °वर्गं a 16b °द्भविन्दु° aCF °वग्गति β 16c तन्मुलात्तु a 16c-d द्विगुणा तिथि° β 17b °द्भवति aβ 17d °द्भानोश्छायानि aC चंद्रमद्भ (द्भ om. A; "illegible" written above it by D²) मसा (स्म D, स्स and then प्स D²) a 18b दत्वा (त्रा C, घा F) नवतिं aβ 18c अवनत्यां (त्या β) नश्चंद्रं aβ 18d विलिखेत् (त F, त्तु E) ग्यासा° β col. इति om. a रोमफसिद्धान्ते a

VIII,13. Multiply the velocity (bhukti) of the Moon by the Sine of that (result) and divide (the product) by 1800; (there results) the accurate avanati. The mean measure (of the diameter) of the Sun is 30 (minutes), (that) of the Moon 34.

VIII,14. Multiply the Sine of the difference between the longitude of the Moon at conjunction (samalipta) and the node by 21 and divide (the product) by 9; (the result) is added to or subtracted from the avanati as their directions are the same or opposite.

VIII,15. Multiply the accurate velocity by the mean measure (of the diameter) and divide (the product) by the mean velocity; (the result) is the accurate measure in minutes of (the diameter of) the Sun or Moon at that time.

VIII,16. One should subtract the square of the avanati from the square of half the sum of the measures of the Sun and Moon; multiply the square-root of that (remainder) by 2. From this one should indicate the time (of the eclipse) as (is done) in the case of the lapsed portion of a tithi.

VIII,17. Subtract the avanati from half the sum of the measures of the Sun and Moon; one should find that the minutes that result are the digits of the Sun that are covered by the Moon.

VIII,18. Draw the Sun with (a radius equal to) half (of its measure) and lay off the avanati from its center in the proper direction; one should draw the Moon with (a radius equal to) half (of its measure) from the end of the avanati for the sake of (determining) the magnitude (of the eclipse).

Thus the Solar Eclipse in the Romakasiddhānta: the eighth chapter.

युगणे ऽर्को ऽष्टशतघ्ने विपञ्चवेदार्णवे ऽर्कैसिद्धान्ते /
स्वरसाद्रिद्विनवयमोद्भूते क्रमाद्दिनदले ऽवन्त्याम् //१//
नवशतसहस्रगुणिते स्वरैकपञ्चाम्बरस्वरर्तूने /
षड्व्योमेन्द्रियनववसुविषयजिनैर्भाजिते चन्द्रः //२//
नवशतगुणिते दस्राद्रसविषयगुणाम्बरर्तुयमपक्षान् /
नववसुससप्ताष्टाम्बरनवाब्धिहते शशाङ्कोच्चम् //३//
शशिविषयघ्नानीन्दोः सार्काग्निहृतानि मण्डलानि त्वृणम् /
स्वोच्चे दिघ्नानि धनं स्वररन्ध्रयमहृतानि विकलाः //४//
त्रिघ्नशतघ्ने नवकैकपञ्चरामेन्दुदहनषट्सहिते /
करयमवसुभूतार्णवगुणधृतिहते क्रमाद्राहुः //५//
चक्रात् पतितं वक्त्रं षड्राशियुतं च पुच्छाख्यम् /
तिमिरविवरस्य लिप्ता विक्षेपः सप्ततिर्द्विशती //६//

1 quoted by Utpala on BS 2 (pp. 41 and 67).
1a युगणे a र्के aβ 1c-d स्वरसा (स्वा F) द्रिद्धि (द्रिद्धि om. F) नवयमोद्भू (द्भू β) ते aβ 1d वत्यां a, व (य C) त्या β 2b °पञ्चाबर° a °स्वरर्त्तु (र्त्तै a) ने (ने om. C) aβ, corr. T.-D. 2c षड्नेंद्रिय° a, षय्य (ड्य्य C) नेंद्रिय° β, corr. Dikshit 3a °गुणितं aCF 3b °गुणाबर° a °पञ्चात् β 3c-d °सप्ताष्टास्वरनवाब्धिहते a 4a °विषयघ्नीनींदो: β 4b सर्काग्निहृतानि aβ, corr. T.-D. भद्र (झ F) णं aβ 4c स्वोच्चे a दिघ्नानि aβ, corr. T.-D. 4d स्वरदस्रयमोद्भू (द्भू β) ते aβ, स्वररन्ध्रयमोद्भूते Dikshit
5a दिद्धनगजघ्ने aβ, corr. Kuppanna Sastri and Sarma स्व (न् च CF) कै° β
5b °दहन (न om. a) शब्दाः स (त्र BE) हिते aβ, corr. Kuppanna Sastri and Sarma
5c चरयमबसुधृतार्णव° a, बरयमबसुभूतार्णव° β 5d °गुधृतिहृत a, गुणाधृति हू (हु F, मू C) ता β, corr. Kuppanna Sastri and Sarma हा (सा β D, corr. to हा D²) द्राहोः aβ 6a वक्त्रं] चक्रं aβ, corr. T.-D. 6b व a, त्व β, corr. T.-D. 6c तिमिर°] सहित° a, ग्रहति° β 6d सप्तताद्विशती aβ

Chapter IX

IX,1. In the Sūryasiddhānta, if the ahargaṇa is multiplied by 800, if 442 is subtracted (from the product), and if (the remainder) is divided by 292 207 in order, (the result) is (the mean longitude of) the Sun at noon at Avantī.

IX,2. (If the ahargaṇa) is multiplied by 900 000, if (the product) is diminished by 670 217, and if (the remainder) is divided by 24 589 506, (the result is the mean longitude of) the Moon.

IX,3. (If the ahargaṇa) is multiplied by 900, (if) one adds (to the product) 2 260 356, and if (the sum) is divided by 2 908 789, (the result) is the apogee of the Moon.

IX,4. Multiply the revolutions of the Moon by 51 and divide (the product) by 3120; (the result, in seconds,) is negative. In the case of its apogee, multiply (the revolutions) by 10 and divide (the product) by 297; (the result), in seconds, is positive.

IX,5. (If the ahargaṇa) is multiplied by 2700, if 6 313 219 is added (to the product), and if (the sum) is divided by 18 345 822 in order, (the result determines the position of) the ascending node.

IX,6. This subtracted from a circle (i.e., 360°) is the (longitude of the) ascending node, and that increased by 6 signs is the "planet" called the descending node. The minutes of (the Moon's) distance from its node (determines its latitude; the maximum) latitude is 270 minutes.

अंशाशीत्या हीनो ऽर्कः केन्द्रं स्वोच्चवर्जितश्चन्द्रः /
तज्ज्यार्कस्य मनुघ्नी रूपाग्निगुणा शशाङ्कस्य //७//
व्योमरसानलभक्ते तच्चापं द्विस्थितं शशाङ्करवौ /
प्रथमे चक्रस्यार्धे चयश्चयः पश्चिमे भागे //८//
सौम्यं स्थापितचापं तद्भुक्तिघ्नं सखाष्टियमभक्तम् /
प्रथमवटर्के कार्यं चन्द्रे च दिवाकरवशेन //९//
पंचाशता त्रिभिस्त्र्यंशसंयुतैर्योज्यनैश्च नाड्येका /
समपूर्वपश्चिमस्थैर्नित्यं शोध्या च दृक्सा च //१०//
नवतिः सप्तशतीन्दोः सचतुस्त्रिंशद्विलिप्तिका भुक्तिः /
षष्टिर्वैका विकलाष्टकं च मध्या सहस्रांशोः //११//
सप्तकला विन्त्यंशाश्चन्द्रोच्चस्येन्दुभुक्तिरनयोना /
केन्द्रस्य परिज्ञेया स्फुटभुक्तिश्चानया कार्या //१२//

7a अंशाशीत्यो a, अ (म्र F) शाशत्यो (त्वो B) β, com. T.-D. द्वि (द्वि C) नो aβ, com. T.-D. 7b कें (केकें C) दुच्चः aβ, com. T.-D. 7c तज्ज्यार्कस्य aβ, com. T.-D. 7d °गुणि (ण D) ता a 8b शशाङ्कवशात् aβ 8c प्रथमे om. β 9b सखाष्टिव (ष्टिश्च E) यमभक्तं aβ, com. T.-D. 10a पंचा (चां a BF) शतास्त्रिभि° aβ, com. T.-D. 11a नव (च a) तु aβ, com. T.-D. सप्तस (स om. C) तींदो: aβ, com. T.-D. 11b सुभुक्तिः β 12a त्रिभिश्चे (त्रिं C) त्र्यं (त्रं C) शा° β 12b °रतयोना a 12d स्फुटभुक्ति° (क्तिं C) β °ज्ञात (त् BEF) या aβ, com. T.-D.

IX,7. Diminish (the mean longitude of) the Sun by 80°, (that of) the Moon by its apogee; the results are their arguments. The Sine of this for the Sun is multiplied by 14, that for the Moon by 31.

IX,8. Divide (the products) by 360; put the arcs (corresponding to) these (Sines) down in two places. They are subtractive for (the mean longitudes of) the Sun and Moon in the first half of the circle, additive in the latter part.

IX,9. Multiply the arc determined for the Sun by its velocity (bhukti) and divide (the product) by 21 600; this is to be applied to the Sun as was done previously. (Operate) for the Moon according to (the rule for) the Sun.

IX,10. One nāḍī is always to be subtracted or to be added for every $53^1/_3$ yojanas to the east or west of the prime meridian.

IX,11. The mean velocity (bhukti) of the Moon is 790 (minutes) and 34 seconds; (that) of the Sun is 59 (minutes) and 8 seconds;

IX,12. (that) of the Moon's apogee is 7 minutes diminished by $^1/_3$ (= 0;6,40°); the (mean) velocity of the Moon diminished by that (same amount) is to be known as the (mean) velocity of the anomaly. These are to be made into the true velocities.

केन्द्रान्तरज्यागुणिता तिथिवर्गेणोद्धृता च परिणाम्य /
तत्कार्मुकं क्षयचयौ भुक्तौ मृगकर्कटाद्येषु //१३//
तत्कालभुक्तिरेषा ज्ञेयाहोरात्रिकी शशिविशेषात् /
व्यासार्धहता भुक्तिः स्फुटभुक्तिहृता स्फुटः कर्णः //१४//
मुनिकृतगुणेन्द्रियघ्नः स्फुटकर्णः सकृतभाजितो ऽर्कस्य /
कलेति चन्द्रकर्णो दिग्घ्नः कला शशाङ्कस्य //१५//
खवसुखमुनीन्दुविषया भानोः सकृतर्तुरंध्रसुगुणाः शशिनः /
तात्कालिकमानार्थं स्फुटकलाभ्यां पृथग्विभाजेत् //१६//
मध्याह्नलम्बितिथेरन्तररेराक्षुद्भुमैः प्रतीपांशाः /
प्राक्समलिप्तादानिः क्रमेण पश्चाद्धनं कार्यम् //१७//
तन्मध्यविलग्नाख्यं तस्माच्चापक्रमांशकाः क्रमशः /
तैरक्षविसृतयुक्तैर्या ज्या मध्याद्दिनाना सा //१८//

13b °वर्गेणोद्धृ (द्धृ β)ता aβ, com. T.-D. 13d भुक्तौ β 14b ज्ञेयाहोर्नेदुकी a, ज्ञेया – होर्नेदुकी β, com. T.-D. 14d °हृ (फृ C, ह्र E) ता aβ, com. T.-D. 15b सकृ–भाजितो a, स्वकृत–भाजितो β, com. Kharegat, Shukla 15c-d चंद्रकरणोंदिग्घ्नः a, चन्द्रकर्णो (र्णें EF, र्णे C) दिग्घ्नः β, com. Kharegat, Shukla 16a सखवसुख °aβ, com. T.-D. °मुनीन्दुविषया aβ, com. Kharegat, Shukla 16b सन्त (त EF, न C) तर्तु° β °वसुगुणाः Kharegat, Shukla 17a मध्या (ध्य F) र्के° aβ 17a-b °तिथेरन्तराक्षुद्भुमैः a, °ती (ति F) थेरन्तरा-क्षु (क्षयु B) द्भु (द्भु C) मैः (व्यैः B, गैः F) aβ 17b प्रीतिपांशाः β 17d पश्चाद्ध (द्भु C) न aβ, com. T.-D. 18d ज्या कृतिं (कृतिं om β) सद्या (द्या E, ध्या C) द्दिनाना aβ com. T.-D.

IX,13. Multiply (the mean velocity of the anomaly) by the tabular difference between the Sines of the anomaly and divide (the product) by the square of 15 (= 225); reduce (the result) and take that arc. (The latter) is subtractive or additive to the velocity as it is in Capricorn and so on, or in Cancer and so on.

IX,14. The progress during a nychthemeron for the (given) time is to be known by means of the difference between (two true longitudes of) the Moon. Multiply the (mean) velocity by the radius and divide (the product) by the true velocity; (the result is) the true hypotenuse.

IX,15. Multiply the true hypotenuse of the Sun by 5347 and divide (the product) by 40; (the result) is called the orbital radius (kakṣā). The hypotenuse of the Moon multiplied by 10 is the orbital radius of the Moon.

IX,16. One should divide separately by their true orbital radii 517 080 for the Sun and 38 640 for the Moon in order to obtain the measures (of their diameters) at any given time.

IX,17. The degrees (on the ecliptic) corresponding to the rising-times of the zodiacal signs (at sphaera recta) between the depressed (end of the) tithi (i.e., the time of the conjunction) and noon are subtracted from the longitude of the conjunction (samalipta) if it is in the east, but added in the west.

IX,18. That (result) is called the madhyavilagna; (take) the degrees of its declination and add to or subtract from them the terrestrial latitude; the Sine of the result is called the madhyā (jyā).

तिथ्यन्तविलग्नज्या काष्ठान्तज्याहता स्वलम्बहृता /
मध्यज्याघ्नी व्यासार्धभाजिता वर्गिता सा च //१९//
मध्यज्याकृतिविश्लेषिता पृथक्स्थाप्या मूलमेकस्याः /
सवितुर्दृक्क्षेपाख्यं संस्मृत्यर्धं पृथक्स्थाप्यम् //२०//
दृक्क्षेपकृतिं जह्यात् त्रिज्यावर्गात्ततो ऽस्य यन्मूलम् /
लग्नार्कविवरमौर्व्या गुणितं त्रिज्योद्धृतं शङ्कुः //२१//
शङ्कुगुलाख्यविंशतिशतकृत्योरन्तरेण विश्लेषि<त>ात् /
स्थितवर्गान्मूलं द्विनवकाहतं तद्विभाज्य कलाभ्याम् //२२//
भागविशेषात्तिथिवत्तिथ्यन्तो ऽतः पुनः पुनस्तत् स्यात् /
एवं मृग्यः कालस्तूत्पन्नो यावद्विशेषः //२३//
अविशेषाद्दृक्क्षेपं वस्वेकघ्नं विभाज्य कलाभ्याम् /
लब्धान्तरचापांशा मध्यज्यादिग्वशेन नतिः //२४//

19a °विलग्ना ज्या aβ, com. T.-D. 19b स्वलम्बहृ (हृ C)ता β
20a मध्यज्यान्त (न्त C)ति° β °विश्लेषि (षि β)तां aβ 20c °हृ (हृ β)क्षेपाख्यं aβ com. T.-D. 21a दृ (दृ β)क्षेप° aβ, com. T.-D. 21b °वर्ग (र्गा EF)घ्न (न्न EF, न्त C) तो (न्तो EF) aβ, com. T.-D. स्य वन्मूलं a 21c °विवेर (वरे C) β
21d त्रिज्योद्धृ (द्धृ C, ध्नृ EF)तं aβ, com. T.-D. 22a शंकुंगुलाख्यं β
22b °कृशोनंतरेण a, °न (न om. C)शोनंतरेण β, com. T.-D. विश्लेषात् aβ
22c स्थितिवर्गा° aβ, com. T.-D. 22d सद्विभाज्य aβ, com. T.-D. कलाभ्यां a
23a °विशेषास्ति (स्ति a)थि° aβ 23b °स्तिथ्यर्धो (र्द्धो β)त्ता (ता β) मतः (नः β)aβ
23d °स्तूत्पन्नो a, स्तत्पन्नो β, com. T.-D. 24a °हृ (हृ C)क्षेपं aβ, com. T.-D.
24b घस्वेकघ्नं β

IX,19. Multiply the Sine of the (madhya)vilagna at the end of the tithi by the Sine of the maximum declination (of the Sun) and divide (the product) by the Sine of terrestrial colatitude. Multiply (the result) by the madhyajyā and divide (the product) by the radius; square (the result).

IX,20. Subtract (this) from the square of the madhyajyā, put (the result) down separately (in two places), and (take) the square-root of one (of them); this is called (the Sine of) the zenith distance (dṛkkṣepa) of the Sun. Put it down separately in order to remember it.

IX,21. One should subtract the square of the dṛkkṣepa from the square of the radius, and (take) the square-root (of the remainder). Multiply this by the Sine of the difference between (the longitudes of) the ascendant-point and the Sun, and divide (the product) by the radius; (the result is) the Sine of (the Sun's) altitude.

IX,22. Subtract the square which has been put aside (i.e., the square of the dṛkkṣepa) from the difference between the squares of the so-called śaṅkvaṅgula (i.e., Sine of the Sun's altitude) and of 120; multiply the square-root (of the remainder) by 18 and divide (the product) by the two orbital radii (i.e., by that of the Sun and by that of the Moon).

IX,23. From the difference in the degrees (of these two arcs is found) the end of the tithi, in the same way as (is found what has passed, or is to come, of) a tithi; from that (the procedure) is (to be iterated) again and again. The resulting time is to be investigated thus, until there is no remainder.

IX,24. Multiply the dṛkkṣepa (for that time) which has no remainder by 18 and divide (the product) by the two orbital radii; the degrees in the arc between the (two) results is the parallax in latitude, whose direction is that of the madhyajyā.

न्याविधिना विक्षेपं तत्कालं प्राप्य तेन सहितोना /
स्पष्टा गतिः प्रमाणैः स्वैः स्वैर्ग्रासं स्थितिं च वदेत् //२५//
अवनतिवर्गं जह्याद्भवीन्दुपरिमाणयोगदलवर्गात् /
तन्मूलात्तु द्विगुणात्तिथिभुक्तवटादिश्रुतेः कालम् //२६//
तिथ्यवनामो ग्रहणादिना च विक्षेपितः स्थित्या /
गोलान्यत्वे ऽप्येवस्त्ववनामो〈सौ〉चिकस्यैवम् //२७//
इति सूर्यसिद्धान्ते ऽर्कग्रहणं नवमो ऽध्यायः //

25b प्राप्य a 25c स्पष्टगतिः aβ, com. T.-D. 25d स्वैर्ग्रासं a, स्वैर्ग्रासं (सं om. CF) β, com. T.-D. स्थितं aβ 26a-b जह्यात् र° aβ, com. T.-D. 26b °परिपरिमाण° β 26c तन्मूलात्त aβ, com. T.-D. 26d °तिथिभुक्तिव °aβ, com. T.-D. °टादिके (कृत् E) β 27a तिथ्यवनाम aβ, com. T.-D. 27b स्थित्यां aβ, com. T.-D. 27c गोलान्य (न C) ये β 27d °नामोचिकोस्यैवं aβ, com. T.-D. col. इति om. EF

IX,25. Obtain the latitude (of the Moon) at that time by means of the Sines; the parallax in latitude increased or decreased by this is correct. By means of their proper measurements one should describe the magnitude and the duration (of the eclipse).

IX,26. One should subtract the square of the avanati from the square of half the sum of the measures (of the diameters) of the Sun and Moon; multiply the square-root of that (remainder) by 2. One should predict the time from this as in the case of what has passed of a tithi.

IX,27. Take the difference between the displacement of the tithi (i.e., the parallax in longitude) and the duration at the beginning of the eclipse; if (the eclipse) is in the other (i.e., western) hemisphere, the displacement is to be added. (Do) likewise for the (time of) release.

Thus the ninth chapter: the Eclipse of the Sun in the Sūryasiddhānta.

रविकला नवतिगुणा षडहृदस्रोद्धृतेन्दुकलायाः /
छेदः षट्त्रिघ्नाया लब्धेनोनश्च षड्वर्गः //१//
विषटकैगुणे शशिकलया हृते कार्मुकं तमोव्यासः /
चन्द्रतमोव्यासयुतिं द्वाभ्यां हृत्वा ततो वर्गात् //२//
विक्षेपवर्गहीनाद्व्यासचपदे विषद्विचन्द्रघ्ने /
सूर्येन्दुशुक्तिविवरोद्धृते स्थिते नाडिका लब्धाः //३//
ग्रस्तहृणेन्दोः कृत्वा विक्षेपरमोनतो ऽनया स्थितिर्भवति /
एवं भूयो भूयः स्थित्यविशेषः कृतो यावत् //४//
अर्केन्दुशुक्तिविवरं वांछितनाडीहतं तु षष्टिहृतम् /
स्थितिलिप्तास्ताभ्यस्तु तात्कालेन्दोश्च विक्षेपात् //५//
कृतियोगपदं शोध्यं शशिराहुकलाधमानयोगदलात् /
यच्छेषं तद्ग्रस्तं ज्ञेयं तत्कालमर्केन्दुः //६//

1a रविकल्या a नव(वा C)तीगुणा β 1b °टस्रोद्धृ(द्धृ β)ते° aβ, com. T.-D. °कल्यायाः aβ, com. T.-D. 1c षड्त्रिघ्नाया a, षट्त्रि(त्रि C)घ्नाया β, com. T.-D. 1d लब्धोनो(ना β)न(त β)श्च aβ, com. T.-D. 2a विषटकैगुणे β 2a-b °कल्यायाः aβ, com. T.-D. 2b हृ(हृ C, ऋ F)ते β तमोर्व्यासः(ध्रः β) aβ, com. T.-D. 2c-d °यतिर्द्वाभ्यां aβ, com. T.-D. 2d हृ(कृ C, ऋ F)त्वा(त्या C, घ्ना E, चा F) aβ, com. T.-D. 3b विषद्वि° aβ, com. T.-D. 3c-d °विवरोद्धृते aβ, com. T.-D. 4a ग्रस्तहृणेन्दुः aβ, com. T.-D. 4b विक्षेपतो aβ, com. T.-D. स्थितेर्भवति aβ, com. T.-D. 4d स्थित्यवशेषः aβ, com. T.-D. 5c-d °स्ताभ्यस्ताता(त्ता a)त्काले°aβ 5d विशेषात् aβ, com. T.-D. 6a-b om. C 6b °कलाधमा(म β)ण° aβ, com. T.-D. 6c यच्छेषं aβ, com. T.-D. 6d °मर्केन्दोः β

Chapter X

X,1. Multiply the orbital radius (kakṣā) of the Sun by 90 and divide (the product) by 286; (the result) is the divisor of the orbital radius of the Moon after it has been multiplied by 36. Diminish the square of 6 (i.e., 36) by the quotient.

X,2. Multiply (the remainder) by 120 and divide (the product) by the orbital radius of the Moon; the (corresponding) arc is the diameter of the shadow. Divide the sum of the diameters of the Moon and of the shadow by 2 and square the result.

X,3. Take the approximate square-root (of this square) diminished by the square of the (Moon's) latitude and multiply it by 120; divide (the product) by the difference between the velocities (bhuktis) of the Sun and Moon; the quotient is in nāḍikās.

X,4. Calculate the latitude of the Moon at the (time of) first contact; then, by this (procedure), there results the (half-) duration (of the eclipse). Thus the (half-) duration is calculated again and again until there is no remainder.

X,5. Multiply the difference between the velocities of the Sun and Moon by the stated nāḍīs (of the half-duration) and divide (the product) by 60; (the result) is the minutes (of arc) of the (half-) duration. (Take the square) of these (minutes) and of the latitude of the Moon at any given time.

X,6. Subtract the square-root of the sum of these squares from half the sum of the measures (of the diameters) of the Moon and the shadow taken in minutes (of arc) and so on; whatever is left is to be known as the obscured (portion) of the Sun or the Moon at that time.

अन्त्याद्ययोर्विशेषार्धैक्यतिविक्षेपवर्गविवरपदम् /
द्विगुणं तिथिवत् कृत्वा विमर्दकालो sर्कचन्द्रमसो: //७//
चन्द्रग्रहणं दशमो sध्याय: //

7a अत्याद्ययार्वि° β 7a-b °शेषाववब (व om. β) क्तितिविक्षेप° aβ
7d sकै° om. β

X,7. Multiply by 2 the square-root of the difference between the square of half the difference between the diameter of the eclipsed body (antya) and the diameter of the eclipsing body (ādya) and the square of the Moon's latitude; compute (with the result) as in the case of a tithi. (The result) is the duration of total obscuration of the Sun or Moon.

The tenth chapter: the Eclipse of the Moon.

षष्ट्या विध्यङ्गुलया वृत्तं परिलिख्य संन्नसार्यं दिशः /
अन्त्याद्यदलैक्येनाद्यमपरमर्धेन चाद्यस्य //१//
चन्द्राम्बरान्तरांशात् क्रमज्यया ज्यां निहत्य वैषुवतीम् /
स्वार्कांशानुद्यास्तमयात्तूदग्याम्यतो दद्यात् //२//
सन्निगृहस्य हिमांशोरपक्रमांशान् यथादिशं कुर्यात् /
प्रागपरसिद्धिरेवं बकाद्यास्योत्तरे ज्ञेये <च> //३//
दिग्व्यत्ययेन शशिनो विक्षेपस्तद्दिगात्मकं सूत्रम् /
स्पृशेद्द्वितीयं वृत्तं तस्मादन्यं <लि>खेन्मध्यात् //४//
तत्संपाते स्पर्शो मोक्षो ऽप्येवं विपर्ययात् साध्यः /
तात्कालिका स्वकृत्या मोक्षादिक् संविधातव्या //५//
लिप्ताद्वयेन हरिज्ञे त्रयेण मेषूरणे ऽङ्गुलं भवति /
अनुपातो ऽन्तर<स्थे>ये कर्तव्यो दृष्टिसूत्रार्थम् //६//
अर्<न्>वर्णनमेकादशो ऽध्यायः //

1a षष्ट्या aβ, com. T.-D. विधित्र्यंगुलया aβ, com. T.-D. 1b दिशं (शां C) aβ, com. T.-D. 1c अंताद्य (द्यृ β)दलैक्येना° aβ, com. T.-D. 1d °द्यदपरम° a, °त् पदपरम° β, com. T.-D. 2a चंद्राबतरां° β 2a-b °शोत्क्रम° aβ 2b °ज्या (ज्य CF)ध्या (ज्या F) β विहत्य aβ, com. T.-D. 2c-d स्वार्कांशांशाद्युदयादस्तमयोत्तूदग्याम्यतो a, स्वर्कांशांशांबुरदयास्तमयोत्तूदग्याम्यतो β 3b °मांशाद् (त् CF) β 3c °सिद्धिरेवं a 3d बकाद्यास्योत्तरे a 4b विक्षेपां तद्दि° aβ 4c स्पृशद्वि° a, स्पर्शद्वि° β 4d °दन्यश्चेन्मध्यं a, °दन्यश्चे (त् चे CF)न्मध्या β 5a °न्न (त्य C) संपाते (तं B) β 5b विपर्ययशोध्यः β 5c °त्स्वकृध्या a, °स्वकृत (त om. CF) वृध्या β 5d मोक्षत्वादिक् (क्षू EF) aβ 6b मेषुरणं aβ, com. T.-D. 6c न्नरः (रCEF)स्थे aβ, com. T.-D. col. अवर्णनात्येकादशो aβ

Chapter XI

XI,1. Draw a circle by means of a staff measured in digits with (a radius equal to) the sum of the halves of the diameter of the eclipsed and of the eclipsing body; distinguish the directions. Now (draw) another (circle) with (a radius equal to) half of the diameter of the eclipsing body.

XI,2. Multiply the Sine of terrestrial latitude by the Sine of the degrees between the Moon and midheaven; (take) an 120th part (of the product). One should apply (the result) to the north or south as (the Moon) is towards its rising or setting.

XI,3. One should compute the degrees of declination of (the longitude of) the Moon increased by 3 zodiacal signs (and use it) in the proper direction; thus is obtained the east and west (points). The north and south (points) are to be known from a fish (-figure).

XI,4. A string—the latitude of the Moon—going in the opposite direction (to the latitude) and ending at that direction (of deflection) should touch the second circle; from the center one should draw another (line to that point on the second circle).

XI,5. At that point of intersection (with the first circle) first contact (takes place); release (i.e., last contact) is thus to be ascertained from the reversal (of this). The direction at any particular time is to be determined by one's calculation from the release.

XI,6. A digit equals two minutes on the horizon, three at midheaven; proportion is to be used (when a body) is in between, in order for (calculation) to coincide with observation.

The eleventh chapter: (Graphical) Description (of a Lunar Eclipse).

रविशशिनोः पंच युगं वर्षाणि पितामहोपदिष्टानि /
अधिमासस्त्रिंशद्भिर्मासैरवमो द्विषष्ट्याहाम् //१//
ह्रासं शकेन्द्रकालं पंचभिरुद्धृत्य शेषवर्षाणाम् /
युगणं माघसिताद्यं कुर्याद् युगणं तदह्नि युद्यात् //२//
सैकषडंशे युगणे तिथिर्भमार्कं नवाहते ऽभ्यर्कैः /
दिग्रसभक्तैः सप्तभिरूनं शशिभं धनिष्ठाद्यम् //३//
प्रागर्धे पर्व यदा तदोत्तरातो ऽन्यथा तिथिः पूर्वा /
अर्कोने व्यतिपातो युगणे पंचाम्बरद्युताशैः //४//
<सत्रि>धृति<मे>रणयुग्मोत्तरगे त्वगतयुमपि च याम्यसंस्थे /
द्विघ्नं शशिरसभक्तं द्वादशहीनं दिवसमानम् //५//
इति पैतामहसिद्धान्तो द्वादशो ऽध्यायः //

1–3 quoted by Utpala on BS 8, 22.
1c अधिमासास्त्रिं°(त्रि C) aβ Utpala 1d °र्मासिर° β °वमस्त्रिषष्यामुं a, °वमास्त्रिषष्ट्यार्का (र्हां F, यं C) β 2a युग (यूग F Utpala)नं aβ Utpala, com. T.-D. 2b पंचभिरुद्धृत्य a, पंचभिरुद्धृ (द्ध E, द्धु C) त्य β 2c माघ (स C) सिताद्यं aβ 2d कुर्याद्युगणं a, कुर्याद्भु (त् भ्रु F, त् द्यु C) युग (गु E)नं β, कुर्याद्युगभानि Utpala, com. T.-D. तदह्नि (द्धु F) द्यात् (न् E) β, तदह्नि युद्यात् Utpala 3a त्रिं (त्रिं C E)श (शा F) त्वं (त्वं β) ये aβ, सैकत्रिंशे Utpala 3b नवा (वा a) हस्ते (स्ते a) aβ, नवाहतो Utpala ष्टर्कैः a, ष्टकैः β 3c दिग्रह° a, दिग्रस° β, दिग्रसभागैः Utpala 3c–d सप्तभिरूनं a 4b तदोत्तरात्तो a, तदात्त (त C F) ए (रां C) सो (तो C, स्तो F, षो E²) β, com. T.-D. 4c व्यापिपाता aβ 4d पंचांबरंद्यु (द्यू E) ताशैः β 5a–b धृतिरनयायुत्तरयो स्व (सू β) मृणं ग (ग om a) तद्यमपि च याम्यास्थ aβ 5c द्विघ्नं aβ, com. T.-D. col. इति om. a पि (पी F) तामह° β °सिद्धान्ते aβ

Chapter XII

XII,1. Five years are taught by Pitāmaha to be a yuga of the Sun and Moon. (There is) an intercalary month (adhimāsa) every 30 months, an omitted tithi (avama) every 62 days.

XII,2. Diminish the time of the Śaka king by 2 and divide (the remainder) by 5. One should calculate the ahargaṇa of the remaining years, beginning with the first half (śuklapakṣa) of (the month) Māgha; this ahargaṇa begins in the day from sunrise.

XII,3. If the ahargaṇa is increased by a 61st part, (the result) is the tithis; if it is multiplied by 9 (and the product divided) by 122, (the result) is the nakṣatra of the Sun; (if the ahargaṇa) is diminished (by itself multiplied) by 7 and divided by 610, (the result) is the nakṣatra of the Moon beginning with Dhaniṣṭhā.

XII,4. When the last tithi in the first half (of the month) is a syzygy (parvan), after it is the first (tithi) in the other (half of the month). If the ahargaṇa is multiplied by 12 and (the product divided) by 305, (the result) is the vyatipāta.

XII,5. (When the Sun) is in the northern (ayana), increase the days by 183 times 4 (= 732); (when it is) in the southern (ayana), increase the future days (by 732). Multiply (the sum) by 2, divide (the product) by 61, and diminish (the quotient) by 12; (the result) is the measure of the day(-light in muhūrtas).

Thus the twelfth chapter: The Paitāmahasiddhānta.

पंचमहाभूतमयस्तारागणपंजरे महीगोलः /
बे ऽयस्कान्तान्तस्थो लोह इवावस्थितो वृत्तः //१//
तरुनगनगरारामसरित्समुद्रादिभिश्चितः सर्वैः /
बिबुधनिलयः सुमेरुस्तन्मध्ये ऽधः स्थिता दैत्याः //२//
सलिलतटासन्नानामवाङ्मुखी दृश्यते यथा छाया /
तद्वदुदितरसुराणां मन्यन्ते ते ऽप्यधो बिबुधान् //३//
गगनमुपैति शिखिशिखा(खिसमपि) क्षितिमुपैति गुरु किंचित् /
यद्वदिह मानवानामसुराणां तद्वदेवाधः //४//
मेरोः सममुपरि बियत्यद्यो व्योमस्थितो ध्रुवो ऽधो ऽन्यः /
तत्र निबद्धो मरुता प्रवहेण भ्राम्यते भगणः //५//
भ्रमति भ्रमस्थितेव क्षितिरित्यपरे वदन्ति नोडुगणः /
यद्येवं श्येनाद्या न स्युः पुनः स्वनिलयमुपेयुः //६//

1–4 quoted by Utpala on BS 2 (p. 57); 1 quoted by Nīlakaṇṭha on Golapāda 6; 2–3 quoted by Pṛthūdaka on BSS 21,3; 5 quoted by Utpala on BS 2 (p. 58) and by Pṛthūdaka on BSS 21,4; 6–8 quoted by Utpala on BS 2 (pp. 58–59); and 6c–d quoted by Pṛthūdaka on BSS 21,4.

1c यस्कां (स्का β) तां (तों a) त (तर EF) स्थो aβ, यस्कान्तान्त: स्थो Utpala, Nīlakaṇṭha, T.-D. 2a तरुनगरत्न (त om. a) रामर aβ 3a °तन्नासं (से C) ताना° aβ 3c तद्वग (द्व D, ग written above D^2) ति° a, तद्वर्व (र्व C) गति° β 3d–4d मन्यन्ते to °सुराणां om. a 3d बिबुधानां β 4b क्षितमपि om. β, suppl. Utpala 4c तद्वदि (द्वि C) द β 5a समुप β, समोपरि Pṛthūdaka 5b व्योम्नि स्थितो Pṛthūdaka, Utpala ऽन्य: (व्य: D) aβ 5c निबद्धो a मतुला a, महता β 5d द्राद्दवे (वद्दे CF) त β 6a °स्थिते य β 6b स्थितिरि° Utpala °त्पपरे a 6c श्येनाद्या aβ

Chapter XIII

XIII,1. The sphere of the earth, which consists of the five elements, stands in the cage of the constellations in the sky like a round piece of iron standing at the end of a loadstone;

XIII,2. it is all covered by trees, mountains, towns, parks, rivers, oceans, and so on. In the middle of it is Sumeru, the abode of the wise (gods); the Daityas stand below.

XIII,3. As the reflection of those who sit on the shore of (a body of) water is seen to be facing downwards, so the motion of the Asuras (appears to the gods); and they (the Asuras) think that the wise (gods) are below.

XIII,4. As here among men the flame of a fire ascends to the sky and something heavy when thrown descends to the earth, so (does it happen) below among the Asuras.

XIII,5. Directly above Meru in the sky is (one) fixed pole, below in the sky is another; bound to these the constellations are turned around by the pravaha wind.

XIII,6. Others say: "The earth, as if situated on a potter's wheel (bhrama), revolves, not the constellations." If that were so, hawks and so on would not come back again to their abodes from the sky.

अन्यश्च भवेद्भूमेरहा भ्रमरहंसध्वजाटीनाम् /
नित्यं पश्चात् प्रेरणमथात्मगा स्यात् कथं भ्रमति ॥७॥
अर्हत्प्रोक्ते ऽर्केन्दू द्वौ द्वावेकान्तरोदयौ किल तौ /
यद्येवमर्कसूत्रात् किं ध्रुवधिहं भ्रमत्यहा ॥८॥
प्रोद्यद्विरमराणां भ्रमत्यजाटौ कुवृत्तगः सव्यम् /
उपरिष्ठाल्लङ्कायां प्रतिलोमध्रामरारीणाम् ॥९॥
मिथुनान्ते च कुवृत्ताद्भ्रमत्युदिंशतिं (दि)हायोद्यैः /
भ्रमति हि रविरमराणां समोपरिष्ठात्तटावन्त्याम् ॥१०॥
नष्टच्छायाप्येवं छायोदक् तत्र भृत्युदक्स्थानाम् /
तद्दक्षिणदेर्(शा)नां मध्याह्ने दक्षिणा छाया ॥११॥
मेषवृषमिथुनसंस्थे दिवसो ऽर्के कर्कटादिगे रात्रिः /
यैरुक्ता विबुधानां मेरुस्थानां नमस्तेभ्यः ॥१२॥

9–34 quoted by Utpala on BS 2 (pp. 59–61); 9 quoted by Pṛthūdaka on BSS 21, 6; 12 quoted by Pṛthūdaka on BSS 21, 7 and by Parameśvara on Golapāda 14.

7b °रन्य(°त्र B)द्भूमणोद्भू(द्भू C, द्भ्रु F)माध्वजा° β, °रहाद्भ्रमणोद्भ्रमाध्वजा° a 7c पश्चाद्ये(च्ये C, ध्ये EF)रण° β 8a र्केंदू(द्भू CE) aβ 8b तौ a 8c °मर्कैस्तत्र β 8d ध्रुवधिद्भू(द्भू CF)हां(हां C) β, ध्रुवसूत्रं Utpala भवत्यहा a, भवत्यह्ना(– F) द्भू(द्भू E)ह्ना β 9b °त्यजागो aβ कुवृत्तगः a, बूभू(मू C)वृ(नृ C)तगः β 9d °मरारीणां β 10a कुवृत्ता°(च्चा C, च्चा EF) aβ 10b °चतुर्धिराति a हायोद्यैः a, हापोद्यैः β 10d समोपष्ठात्त° a °टावत्यं β 11b °टक् च भृत्युस्थाना a, °टक्यभृत्युदस्थानां β 11c–12d तद्दक्षिण° to मेरुस्थानां om. β 11c तटदक्षिणादेर्नां a, तद्दक्षिणगानां Utpala, corr. T.-D. 12a °मियुन° a 12b दिनं रवौ Utpala, दिनमर्के Parameśvara कर्कटादिके Pṛthūdaka 12c–d मेरुस्थितदेवतानामिति यैरुक्तं नमस्तेभ्यः Parameśvara

XIII,7. Another thing: if there were (a revolution) of the earth (every) day, bees, geese, flags, and so on would always be driven to the west; if it were moving slowly, how would it revolve (once a day)?

XIII,8. According to what is said by the Arhats, there are two Suns and two Moons which rise one after the other; if this were so, why does a fixed mark from the sūtra of the Sun revolve in a day?

XIII,9. For the gods, the rising Sun at the beginning of Aries, moving on the terrestrial equator, revolves to the right; (for those) at Laṅkā it revolves overhead; and for the foes of the gods in the opposite direction.

XIII,10. At the end of Gemini the Sun revolves, going up 24° from the terrestrial equator for the gods, (while) it is directly overhead (for those) at Avantī.

XIII,11. Thus the (noon) shadow is destroyed (there); the (noon) shadow is to the north for those dwelling in the north of that (place); for those places which are to the south of it the shadow at noon is southern.

XIII,12. Reverence be to those who say: "For the wise (gods) who dwell on Meru it is day when the Sun is in Aries, Taurus, and Gemini, night when it is in Cancer and so on."

येष्वेवोदग्घोषाद्याति स्थानेषु संनिवृत्तो ऽपि /
तेष्वेव कथं दृश्यः पुनर्न दृश्यश्च तत्रस्थः //१३//
दृश्ये चक्रस्यार्धे त्रयः स्वमध्यात्तु राशयस्तेषां ऽशाः /
नवतिस्तानि च खण्डान्युदयात् परिकल्पनीयानि //१४//
एकैकों ऽशो नवभिर्नवभागोनैश्च योजनैर्भवति /
समदक्षिणोत्तराणां प्रत्यक्षे ध्येयः स्वमध्यात् //१५//
एवं च नवत्यंशैरष्टौ दृष्टानि योजनशतानि /
तत्त्रामाणाद्देशो मध्याह्ने दृष्टुरुदयो यः //१६//
उज्जयिनी लङ्कायाः संनिहिता योत्तरेण समसूत्रे /
तन्मध्याह्नो मृगपाद्विषमो दिवसो विषुवतो ऽन्यः //१७//
योजनशतानि भूमेः परिमाणं षोडश द्विगुणितानि /
तापयति मेरुमध्याद्विषुवस्थो ऽर्कः क्षितिमेवम् //१८//

14a quoted by Utpala on BS 2 (p. 56)

13b °द्यादि a/β संनिवृत्ते a, सन्निवृत्तेशे β 13d दृश्यश्च β 14a चक्रस्या (स्याC) र्द्धे β 14b स्वमध्यात a, स्वमध्यते β राशयस्तेषां Utpala (some manuscripts) 14c-d स्व (ष BE) ईंगानि उ (न्यु BE) दयात् (त CF, त्त BE) a/β 15a एकैकांशो Utpala नवतिर्न° a/β 15b योजनैर्यान्ति (ति EF) a/β 15c स च दक्षिणो° Utpala °त्तराय (प β) णं a/β 15d प्रत्यक्षः Utpala ध्ये (ध्ये BE) य (प्य β) मं मध्यात् a/β, से ऽप्ययं मध्यात् Utpala 16a व a, om. β नवत्यांशै° a, नववृत्त्यांशै° β 16b °रष्टौ दृष्टौ दृष्टानि β 16c सहितत्त्रमाणदेशो a/β, तत्त्रामाण्यादेशो Utpala 16d दृष्टरु° a 17a ऊ (बु C) नी (ज्ज C, नू F) यि (पि F) नी β 17b सतिहिता β समस्तत्र (त्रो CF) β 17c तन्मध्याह्ने a/β 17d दिव (य F) से (सो E) a/β 18c तायपति a °मध्य° a CF 18d र्को a/β क्षितिरेवं a/β, क्षितिं सैवम् Utpala

XIII,13. In those places in which (the Sun) goes to the north from Aries it also returns (from Cancer); how is it both visible and again not visible while it is there?

XIII,14. In the visible half of the (zodiacal) circle, from midheaven, there are three zodiacal signs, that is 90°; these divisions are also to be reckoned from the rising (-point).

XIII,15. Each 1° equals 9 diminished by a ninth (i.e., $8^8/_9$) yojanas; for those who are to the north and south (of each other) on (the same) meridian it (the distance in yojanas) is to be considered from midheaven (i.e., zenith) in direct perception.

XIII,16. Thus 800 yojanas are seen to equal 90°; whatever is sunrise for (one) observer is at noon in a place (whose distance is) measured by that (amount).

XIII,17. Ujjayinī, which is close to Laṅkā, is on the line of (the same) meridian to the north; their noons are simultaneous, but their days (i.e., lengths of daylight) other than the equinoctial (days) differ.

XIII,18. The measure (of the circumference) of the earth is 1600 times 2 (= 3200) yojanas; the Sun, at the equinox, thus heats the earth from (a circle) whose center is Meru.

षडशीतिं पंचशतीं त्रिभागहीनं च योजनं गत्वा /
क्षितिमध्यमुदग्गत्वा लङ्कायां योजनाष्टशतीम् //१९//
प्रतिविषयमुदक् तुङ्गो हरिजाद्याबद्भुवः समध्यात्तु /
दिनकृदपि नमति विषुवति दक्षिणतस्तावदेवांशैः //२०//
त्रिशतीं त्रिसप्ततियुतां गत्वोदग्योजनत्रिभागं च /
उज्जयिनीतो विरमति पर्यस्तो ऽयं भगणगोलः //२१//
षष्टिं नाडीस्तस्मिन् सकृदुदितो दृश्यते दिवसनाथः /
परतः परतो बहुतरमाषण्मासादिति सुमेरौ //२२//
योजनपंचनवांशांस्त्र्यधिकां सप्तदुःशतीमुदग्गत्वा /
गत्वा न भानुर्मकरौ कदाचिदपि दर्शनं व्रजतः //२३//
तस्मादेव स्थानाद् ऋशीतियुक्तां सप्तदुःशतीं त्याग्य /
नोदयमिह यान्त्यमिमृगघटचापधराः कदाचिदपि //२४//

19b योजनमित्वा Utpala 19d लंकायां aβ 20a प्रतिविष (य CF) मुदक्तुंगो β
20b हरियाद्याद्याधुवः a, हिं (हि CF) रियाद्यान्वाधुवः β 20c दिनक्र (क्र C) दपि β
समति β विषुवचि a, रिषु (षु BE) वति β 20d °तस्तावदे° a 21a त्रिं (त्रि CE) शतिं (ति β) aβ 21b गत्वोद° β °ञ्जनत्रिभागं a 21c ऊ (उ β) ज्जयि (य C) नी (नि E) तो aβ विष्टपति Utpala 21d पर्यासो Utpala 22a षष्टीर्नाडीस्तस्मिन् a, षष्टीं (ष्टी CF नीं F) नाडिं (डी CF) तस्मिन् β, षष्टिर्नाड्यस्तस्मिन् Utpala, com. T.-D.
22b सप्तदुदितो β 22c बहुतर° aβ 23a योनपंच° β 23a-b °नवांशाः स्त्र्याधिक्यं सप्तदुःसतिमुदग (गा D) वंत्याः a, °नवांशाः स्त्र्यधिका स (म्त्र F) प्त (प्त EF) दुःसतिमुदग्वंत्याः β, °नवांशानधिकां च सप्तदुःशतीमुदग्गत्वाम् Utpala 23c गत्वा β भानुर्मकरं a, भानुर्मकरा β 24a-b स्थानाद्ऋशीति° a, स्थानात्य (त्र्य C) शीति° β 24b सात्यं a, त्या (सा C) गां β, गत्वा Utpala
24c नोदयमु (म a, सु BE) ह aβ, दृष्टिपथं नो Utpala, com. T.-D. यां सति° BE
24d कदाचित् Utpala

XIII,19. Going 586 (yojanas) and a yojana diminished by $^1/_3$ (= $586^2/_3$) north of Avantī (one reaches) the middle of the earth, or 800 yojanas (north) of Laṅkā.

XIII,20. In any region, as much as the north pole star is raised to the north from the horizon, by so many degrees is the Sun depressed to the south from midheaven when it is at the equinox.

XIII,21. (For one) going $373^1/_3$ yojanas north from Ujjayinī this sphere of constellations which is cast about (the earth) ceases (to exist).

XIII,22. In this (place) the Sun, having risen once, is seen for 60 nāḍīs. (As one proceeds) further and further (to the north, the length of daylight) becomes greater until it is six months at Sumeru.

XIII,23. (For one) going $403^5/_9$ yojanas to the north of Avantī Sagittarius and Capricorn never come into sight.

XIII,24. (For one) going 482 (yojanas) from that place Scorpio, Sagittarius, Capricorn, and Aquarius never rise.

षडशीतिं पंचशतीं त्र्यंशोनं योजनं च तत एव /
गत्वार्क्ष्यं चक्रार्धं नोदेत्याद्यं न यात्यस्तम् //२५//
लङ्कास्था भूलग्नां नभसो मध्यस्थितां च मेरुगता: /
ध्रुवतारामीक्षन्ते तदुत्तराले ऽत्तरोपगता: //२६//
सकृदुदित: षण्मासान् दृश्यो ऽर्को मेरुपृष्ठसंस्थानाम् /
मेषादिषु षट्सु चरन् परतो दृश्य: स दैत्यानाम् //२७//
मेषस्तेषां नित्यं लग्ने त्र्यंशश्च भूमिपुत्रस्य /
त्रिंशद्भागनवांशद्वादशभागाश्च तस्यैव //२८//
विषुवल्लेखाध्यस्तालङ्का तस्यां समो भगणगोल: /
त्रिंशद्घाड्यो दिवसस्त्रिंशत्तस्यां च सदा निशा //२९//
सलिलेन समं कृत्वा तुङ्गं फलकं यथादिशं दृष्ट्वा /
दक्षिणकोट्यां शङ्कुं फलकप्रतिमं व्यवस्थाप्य //३०//

27 quoted by Pṛthūdaka on BSS 21,8a–b.

25a षडशीतां (तीं E) षडशतीं *aβ* 25c चक्रार्ध (र्धं CF) *β* 25d नोत्पाद्यं *a*, नोसा (त्या CF) द्यं (द्यं C) *β* 26b मध्यां स्थितां च *a*, मध्याय *β* 26c ध्रुवतारामी (न्ती CF) क्षं (– E) ते *β* 26d तरेप (व C) गता: *aβ* 27b मे (मे F) कपृष्ठ° *β* 27c षट्सु (ट्सु CE, ट्टु F) *β* 27c–d वरन्यस्तो (तो C) *β* 28b लगो *β* त्र्यंशश्च *aβ* भूमिपुत्र (त्रः E) स्यात् (स्या CF) *β* 28d तस्यैव (च F) *β* 29a°ल्लेखाध्य: स्ता° Utpala 29c त्रिंशद्घाड्यो *β* 29c–d द्विनसत्रिं° *aβ* च सदा *a*, च स (श EF) टा *β*, सटा च Utpala 30a सभ (म C, भं F) कृता (क्ता CF) *β* 30c दक्षिणकोट्यां (ट्यां *β*) *aβ* 30d व्ययं (यं F) व्य (व्यं CF) व (च F) स्थाप्य *β*

XIII,25. (For one) going 586 (yojanas) and a yojana diminished by $^1/_3$ (= $586^2/_3$) from there the last half of the (zodiacal) circle does not rise and the first (half) does not set.

XIII,26. Those who dwell at Laṅkā see the north pole star touching the earth, those who go to Meru see it standing in midheaven (i.e., zenith), and those who go between (these two places) see it in between.

XIII,27. For those who dwell on the top of Meru the Sun, having risen once, is visible for 6 months in the six (signs) beginning with Aries; when it proceeds further, it is visible for the Daityas.

XIII,28. For them Aries is always at the ascendant. Its (Aries') (first) third part (i.e., decan), triṃśadbhāga (i.e., fines), navāṃśa, and dvādaśabhāga (i.e., dodecatemorion) belong to Mars.

XIII,29. Laṅkā is under the (celestial) equator; there the sphere of the constellations is even (sphaera recta). A day is 30 nāḍīs there, and a night always is also 30 (nāḍīs).

XIII,30. Having made level with water a raised surface, having seen where the directions are, and having set up at the southern tip a gnomon (whose length) is measured by (the extension of) the (prepared) surface,

मज्जुशङ्कुबुध्नविन्यस्तलोचनो नाममेत्तथा शङ्कुम् /
भवति यथा शङ्कुग्रं भ्रुवतारादृष्टिमध्यस्थम् //३१//
पतितेन भवति वेधो लङ्कायामूर्ध्वगेन तु सुमेरौ /
विततेन चान्तराले फलके व्यासार्धसूत्रसमे //३२//
तत्रावलम्बको यः सो ऽवज्या तस्य शङ्कुविवरं यत् /
विषुवट्वलम्बको ऽसौ याम्योत्तरटिक्कासिट्टिकरः //३३//
स्वप्रत्ययेन सत्तो विज्ञायैवं वदन्ति भूमध्यम् /
सकलमहीमानं वा रसमिव लवणाम्भसो ऽल्पेन //३४//
नित्यमधःस्थस्येन्दोर्भाभिर्भानोः सितं भवत्यर्धम् /
स्वच्छायया न्यग्वसितं कुम्भस्थेवातपस्थस्य //३५//
सलिलमये शशिनि रवेर्दीधितयो मूर्छितास्तमो नैशम् /
क्षपयन्ति दर्पणोदरनिहिता इव मन्दिरस्यान्तः //३६//

35a quoted by Pṛthūdaka on BSS 21,8c-d; 36 quoted by Makkibhaṭṭa on SŚ 1,1.
31a रज्जु° β °शंकुबु (कुबु om. C)ध्न°aβ 32b लम्बतधा (धा°E) β
°मूर्ध्व (र्ट्व β)गेन aβ 32c चांतराल aβ 32d क्षेप्यार्ध° a, क्षोध्यर्द्धं β
सूत्रसमो (मा: E) β 33a तत्रावलंबो को a 33b सो सज्या aβ यत्तं (ते C)β
33c विषुवट्वलंडको β 34d रसमि ⁻ a, रसमित β लवणास्वसो ल्पेन aβ
35a नि (न्नि D, com. to नि D^2)त्यमध (ध्य C)स्थस्येंदो° aβ 35b °र्भवति भानो:
aβ, com. T.-D. 35c स्वछायान्यग्वसितं aF 36a सलिलमये च शशिनि a
36b °र्दी (र्टी D)धयो a, ⁻ध (ध्नृ C)तयो β 36d इमं व मे (हं F)हरिस्यांत: β

XIII,31. with his eye directed to the base of this straight gnomon, one should depress the gnomon until the tip of the gnomon is at the middle of one's sight of the north pole star.

XIII,32. At Laṅkā the observation is with (the gnomon) fallen down, at Sumeru with it upright, and in an intermediary place with it depressed. If the (extension of the) surface is equal to a string representing the radius,

XIII,33. whatever is the perpendicular (from the tip of the gnomon to the horizontal surface) there is the Sine of terrestrial latitude, and whatever is the distance between (the base of the perpendicular and the base of) the gnomon—(a line) which determines the north and south directions—is the Sine of the terrestrial colatitude.

XIII,34. By their own intelligence good men, investigating thus, proclaim what is the center of the earth or the measure (of the diameter) of the whole earth just as (they proclaim) what is taste by means of a little salty water.

XIII,35. One half of the Moon, which is always below (the Sun), is bright because of the Sun's light, the other half is dark because of its own shadow, just like a pot standing in the sunshine.

XIII,36. The rays of the Sun, reflected on the Moon which consists of water, destroy the darkness of the night just as, falling on the surface of a mirror, (they destroy the darkness) within a house.

प्रतिदिवसमेवमर्कात् स्थानविशेषेण शौक्ल्यपरिवृद्धिः /
भवति शशिनोऽपराह्णे पश्चाद्भागे घटस्येव //३७//
असितात् सिताश्च पश्चादसितं पश्चार्धमर्कमीक्षन्ते /
शशिच्छयाद्भयतो न भास्यरूपा> तु शीतकरसंस्थाः //३८//
चन्द्राद्भूर्ध्वं बुधसितरविकुजजीवार्कजास्ततो भानि /
प्राग्गतयस्तुल्यजवा ग्रहास्तु सर्वे स्वमण्डलगाः //३९//
तैलिकचक्रस्य यथा विवरमराणां घनं भवति नाभ्याम् /
नेम्यां स्यान्महदेवं स्थितानि राक्षस्यन्तराण्यूर्ध्वम् //४०//
पर्येति शशी शीघ्रं स्वल्पं नक्षत्रमण्डलाधःस्थः /
ऊर्ध्वस्थस्तुल्यजवो विचरति तद्वा> महदर्कसुतः //४१//
मासाधिपा यथोर्ध्वं चन्द्रात् सौराद्भश्च होरेशाः /
ऊर्ध्वं क्रमेण त्रिनघाश्च पंचमा वर्षपाः स्पष्टाः //४२//
त्रैलोक्यसंस्थानं नाम त्रयोदशोऽध्यायः //

39 quoted by Utpala on BS 2 (p. 44); 40–41 quoted by Utpala on BS 2 (p. 44); 42 quoted by Utpala on BS 2 (p. 35).

37a °मेवमर्वा (र्यो F) क् (कू F) β 37b °विदोषेण शौ (शो C) क्ल्य (क्र C, त्स F)° β 38a असिता β 38b °मी (मि C) क्षते β 38c राशित्रया° a, शशित्रया° β °ट्भूयतो म a 38d भो यत (येत्त C, but crossed out) aβ गे (गेति C, but crossed out) तीतकर° β 39a चन्द्राद्भू (द्भु C) र्ध्वं (ध्व C, र्द्धुं E, र्द्ध्व F) aβ, com. T.-D. बु (पु E, षु F) धस्वि (स्वी C) त° β 39c प्राग्ग (गा β) तय (रा β) स्तु (- β) ल्यजवा (या F) aβ 40b विपर° β नाभ्यास्या β 40c म्ये (म्ये C) म्यं β स्यान् om. Utpala 40d संस्थितानि Utpala °राण्यूर्ध्वं a, °राण्यूर्द्धुं (र्ध्वां C, र्द्धुं F) β 41a रात्री (त्रि E) β 41b नक्षत्रमंडलमधः स्थः a, नक्षत्रमंडलमध्य (मंध्यमंडल C) स्थः β 41c ऊर्ध्व° a, ऊर्द्धु° β 41d sपि संस्थितस्तथा न महद् Utpala विवरति β न महद्° aβ, com. T.-D. 42c त्रिनघा च a, त्रि (ष्म B, टि E, णि F) घा च β पंचमास्याः aβ col. नाम om. a

XIII,37. Every day, because of the change in its position from the Sun (since conjunction), there is an increase in the illuminated portion of the Moon just as there is on the western part of the pot in the afternoon;

XIII,38. (this is) from after the kṛṣṇapakṣa, but the dark (portion increases) from after the śuklapakṣa. Those who dwell on the Moon see the Sun for half a pakṣa on either side of the disappearance of the Moon; otherwise there is no light.

XIII,39. Above the Moon are Mercury, Venus, the Sun, Mars, Jupiter, Saturn, and then the nakṣatras. All the planets, moving in their own orbits, travel to the east with the same velocity.

XIII,40. As the interstices of the spokes of the wheel of an oil-press are small at the hub but large at the rim, so are the interstices of the zodiacal signs (as one goes) higher.

XIII,41. The Moon, which is (furthest) below the orbit of the nakṣatras, revolves fast about its small (orbit); Saturn, which is high(est), travels with an equal velocity arround its large (orbit).

XIII,42. (Ascending) up from the Moon (each successive planet) is lord of the month, (descending) down from Saturn lord of the hour. (Ascending) up in order (every) fifth (planet) is lord of the day; the lords of the year are clear.

The thirteenth chapter named: the Form (of the Universe) Consisting of the Three Worlds (of Gods, Men, and Demons).

साग्रीतिकाङ्गुलशतं विस्तीर्णवृत्तमविषमं धरित्र्याम् /
समराङ्गंकचिह्नं परिधौ सापक्रमं कुर्यात् ॥१॥
याम्योदक्समसूत्रादपक्रमांशावगाहिभिः सूत्रैः /
प्रथमवदङ्कचिह्नं वृत्तत्रयमात्रिवेन्मध्यात् ॥२॥
अग्रे चिह्नां लेखां प्रकुर्याच्च भगणचिह्नपर्यन्ताम् /
अग्रोत्तरलेखान्तरमपक्रमांशोत्थमाटाय ॥३॥
द्विगुणं प्रसार्य वृत्ते स्वे टिक् तन्नापांशदलाभ्यस्ताः /
प्रथमर्क्षचरविनाड्यो ज्ञेयाः परिशेषयोर्भिन्नाः ॥४॥
नाड्यः षड्भ्यो भागास्तन्न्या व्यासार्धत्रोधिता छाया /
माध्यन्दिनीसमेता नाड्यर्थे सा तया हीना ॥५॥
छायाहरिन्नाभ्यन्तरजीवाचापांशषष्ठभागो यः /
ता नाड्यः प्राग् याताः पश्चाच्छेषास्तथा प्राप्ताः ॥६॥

1c समराङ्गंकं चिह्नं a 1d मापक्रमं a, मायक्रमः β, com. T.-D. 2a-b °सूत्रापदक्रमा° β 2c प्रथमव (−β)टंकाचिह्नं aβ 2d वृत्तत्रुत्रयमा° β 3b कुर्याच्च a, प्रक (कु C) र्यो (या E, वे B) कै (कें C, क F) β लंगण° β °पर्यंतात् (न β) aβ, com. T.-D. 3d °मांशोच्छ (छ CF) माटाय aβ, com. T.-D. 4a-b प्रसा (स्ता C) र्यं (वें C, र्पे EF) वृत्रोन (व CF) वा (ब्रा CF) पांशका दलाभ्यस्ताः β 4c °विनाड्ये a, °विनाग्रे β 5a षड्या a, ष (ग्र C) मड्भ्या β, com. T.-D. 5a-b भागास्तन्या a, मा (सा C, भा F) गारु (ंदु . F, स C, but crossed out) β, com. T.-D. 5b छा (च्चा C) सा° β 5c साध्यंटिनी a 6a °हरिज्या° a °भ्यं (भ्यां C) तरजा जीवा β 6c यतः a, युता β, com. T.-D. 6d पश्चा (श्चा C) च्छेषास्त (स्त a) था प्राप्र (प्रो a) aβ

Chapter XIV

XIV,1. One should make on the ground a level circle having a diameter of 180 digits, with marks indicating the prime vertical, the zodiacal signs, and the degrees on the circumference, and with the degrees of the declinations (of the signs) (marked).

XIV,2. From the center (of this circle), with strings which are perpendiculars from the string marking the north-south prime vertical to the (marked) degrees of the declinations (of the signs), one should draw three circles marked as was the first.

XIV,3. One should make a line cast (from the center) towards the terrestrial latitude to the mark (for it on the circle graded like) the zodiac; take (that chord) in (the circle whose radius depends on) the degrees of declination (of the first sign) which lies between the line of terrestrial latitude and the north(-south) line (where they intersect the circumference);

XIV,4. multiply it by 2 and extend it on its own circle, and multiply half the degrees of the arc corresponding to that (chord) by 10. (The result) is to be known as the vināḍīs of ascensional difference for the first sign; (those) for the other two are composite.

XIV,5. The nāḍīs (since sunrise) multiplied by 6 are degrees; the Sine of these subtracted from the radius is the shadow (at any time) increased by the noon-shadow; in order to find the nāḍīs it (i.e., the shadow at any time) is diminished by that (i.e., the noon-shadow).

XIV,6. Whatever is the sixth part of the degrees of the arc corresponding to the Sine which lies between (the end of) the shadow (so diminished) and the horizon, these are nāḍīs; to the east those which have passed are obtained, to the west those that remain.

तिर्यग्रेखा समदक्षिणोत्तरापक्रमांशरेखायाम् /
तच्चापांशा दिग्घ्ना राक्षुट्सविनाडिकाः क्रमशः //७//
मध्याह्ने प्राक् तथा छायायामन्यतो गते शङ्कौ /
शङ्कुग्रयातसूत्राद्विषुवान्तरं यच्च क्रान्तिकृतम् //८//
विन्यस्योदक् छायां छायाग्राच्छङ्कुरपरतः पात्यः /
तत्कर्णसमं मध्यात् प्रसारयेत् सूत्रमापरिधेः //९//
तद्विषुवान्तरमत्रो ऽतो ऽक्षाच्चैवं प्रकल्पयेच्छायाम् /
दृष्टे ऽहनि बुद्ध्वायनमत्राद्यधिकं यदूनं वा //१०//
तज्ज्या तिर्यग्रेखाविषुवद्रेखास्थिता स्मृशति यस्मिन् /
तच्चापांशसमानो ज्ञेयो ऽर्को गोलभागेन //११//
छेद्यार्धयष्टिवेधाद्यत्रार्केन्दोरन्तरांशकाकांशः /
स्फुटनष्टतिथिर्ज्ञेया तस्मात् कार्या तथा चान्या //१२//

7b °राव (च β) क्र (क्रं β) मां (मा β) शं (शा° β) a/β, com. T.-D. 7c दिघ्ना: a, दि – β, com. T.-D. 7d क्रमंश: a, क्रमशा β, com. T.-D. 8a मध्यानां प्रांतधा a, मध्यान्यां धातपा (या C F) β 8b छायायामस्वतो a, छायाया (या om. C F) मन्यतो β गते तत: शंकौ (को: a) a/β 8c °या (पा C) तं (त β) त्सू (सू β) त्रा° a/β 8d विषुवांतरमाशकांङ्कु (टि B, ट्रि E) दिता: a/β 9a विन्यश्योदक् a, विष्ट (न्य C, न्यू F) न्य (न्ये C) श्योट (ट् EF) क् β, com. T.-D. 9b पाता: β 9d °परिधौ (धो EF) β 10a तद्विषुवं (षुं BE, ष्कं C) तर° a/β, com. T.-D. 10c बुध्यायनम° a, बुध्ययन° β 11a-b तिर्यग्रेखाद्विषुव° β 11c °समान a/β, com. T.-D. 11d को β 12a छेद्यार्ध° a, छेद्यार्य° β 12b °ट (टा E) केन्दो (न्दो C) रंत्व (त्य C) शाशावतकशि: β 12c °तिथिर्ज्ञेया a

XIV,7. The ecliptic is on a line (running through) the degrees of declination (marked) on parallel north-south lines (beginning at the beginnings of the signs); the degrees of arc corresponding to these (segments), when multiplied by 10, are, in order, the vināḍikās of rising of (each of) the signs.

XIV,8. (About the end of) the shadow (obtained) at noon (on the equinoctial day describe a circle); move the gnomon elsewhere, to the east (so that it lies on the east-west line); whatever is marked on (the circumference of) the circle by a string proceeding (from its center) through the tip of the gnomon is the distance from the equator (i.e., the colatitude).

XIV,9. Lay out the (noon equinoctial) shadow to the north; the gnomon is to be caused to fall to the west from the tip of the shadow. One should extend a string parallel to its hypotenuse from the center of the circumference.

XIV,10. The distance of that from the equator is the terrestrial latitude. In this way one should determine the (noon) shadow from the terrestrial latitude. Knowing on any particular day the declination (of the Sun), which is either greater or less than the terrestrial latitude,

XIV,11. place its Sine (between) the ecliptic and the equator; wherever it touches (both), (the longitude of) the Sun, depending on its portion of the sphere, is to be known as being equal to the degrees of that arc.

XIV,12. By means of an observation with the rod on half of the construction (i.e., a diopter on a semicircle) (find) the degrees between the Sun and Moon (and take) a twelfth part (of them); (the result) is to be known as the true lapsed tithis. From this is to be computed the next (tithi).

दत्वांशकेषु तेष्वेव भास्करं क्षेप्यकेन विज्ञातम् /
स भवति तस्मिन् काले निशाकरक्षेप्यकेनैव //१३//
नाभ्यासन्नच्छायाग्रमङ्कयेत्(ङ्के)त्रिस्ततो लिखेन्मत्स्यौ /
तन्मत्स्यवदनानि:सृतसूत्रद्वयपाततुल्येन //१४//
सूत्रेण बिन्दुकत्रयसंस्पर्शसमेन मण्डलं यत् स्यात् /
तेन तदाहि च्छाया शङ्कोर्गच्छत्यसंभवन्ती //१५//
तन्मण्डलमध्यार्(ध्ये)च्छङ्कुतश्च दक्षिणोत्तरं भवति /
तच्छङ्कुविवरमुद्गास्थितं च माध्यह्निनी छाया //१६//
हरिज्जमिति गगनभवनौ प्रसक्तमिव यत् प्रदृश्यते ऽन्तेषु /
सममिति पूर्वापररेखैवं च दक्षिणोत्तरगता //१७//
ध्रुवहरिज्जविवरमध्यो ऽक्षनतिविवरं च लम्बको ऽभिहित: /
लग्नोनमिति समध्यं ध्रुव्यासो ऽस्तोदय(यक्रस्य) //१८//

13a दृग्गंशकेषु अंशंश (श om. B) केषु (अंशंशकेषु om. CF) तेष्वेव β 13b भास्कर क्षेप्यकेन (त om. C) β 13c भवति हि तस्मिन् aβ, com. T.-D. 13d निशाकरात् क्षिप्य° a, निशाकर — प्य° β, com. T.-D. 14a नाभ्यासंनच्छाया° (या° β) aβ 14b °ग्रमंकये a, °ग्र (ग्रं BE) नं (न BE) कपे (वे C) β, com. T.-D. त्रिसुतो β 14c तन्मत्स्य (स्य C) व — निसृत° β 14d °पाततुल्यन β 15a सूर्येण a, स्तार्येण β, com. T.-D. 15c लिन (न F) तदाहि β 16b छंकु (क्क EF, कC) त: (त β) च aβ दक्षिणोत्तरे β 16c तच्छज्ञ (ज्ञवि C) षविवर° β 16d °स्थितश्च (:च F) β 17a हरियमिति aβ, com. T.-D. गमन° a, गम (मि C) ते β, com. T.-D. 17b प्रदृश्यंते तेषु a, प्र (घू C) दिश्यंते (त C) षु (बु C) β, com. T.-D. 17c-d पूर्वापरतो (ते C) क्षे (ये EF, यि C) व (च E) मृणं aβ दक्षिणोत्तरग (ग om C, त F) त (ग F) β 18a ध्रुवहरीरेज° β 18a-b °मद्ध: क्षिति (भि β) रवटि (वि β) वि (किं β) वरं aβ, com. T.-D. 18c मणोन° β 18d ध्रुव्यासो β स्तोदय a, स्तो β

XIV,13. (For one) adding (the longitude of) the Sun which is known by means of the (geometrical) construction to these degrees (of elongation) there results (the longitude of) the Moon at that time by means of just the construction.

XIV,14. One should thrice mark the tip of the shadow near the center (of that construction); from these (three points) one should draw two fish (-figures). (With a center) equal to the intersection of the two strings issuing from the mouths of these fish (-figures),

XIV,15. and with a string (as radius) equal to (the length necessary for) touching the three points (draw) a circle; on that day the shadow of the gnomon moves on this (circle) without leaving it.

XIV,16. The line from the center of that circle to the gnomon is the north-south line; its (the circle's) distance (from the gnomon) to the north is the noon shadow.

XIV,17. That (circle) which seems to join the sky to the earth at their ends is called the horizon; the east-west line and the north-south line are called the prime verticals.

XIV,18. The distance between the north pole star and the horizon is the terrestrial latitude; the difference between 90° and the terrestrial latitude is called the terrestrial colatitude. Midheaven is called the lagnona (nonagesimal); and the diameter of the day (-circle) is that of the circle (which passes through) the setting (-point) and the rising (-point) (of the Sun).

छेद्यवदर्ध्यकपालं सघिहमल्लोचतं सटिक्चक्रम् /
सुसमावटविन्यस्तं कुर्याच्छङ्कुं समाभ्यङ्कम् //१९//
सूत्रद्वयसंपातर(ो)च्छायाभुक्तांशका रवौ देया: /
स भवत्युदये राशिर्दिनस्य नाड्यश्च ता याता: //२०//
समभगणाङ्ककचक्रमर्धाङ्गुलबहलमायतं हस्तम् /
विस्तारमध्यभागे छिद्रं तद्व्यासमिव तिर्यक् च //२१//
मध्याह्नार्कमयूखं प्रवेश्य सूक्ष्मेण परिधिनिचरणेर(न) /
मध्यावलम्बिसूत्रातसान्तरांशास्तदुत्पाद्या: //२२//
समवृत्तपृष्ठमानं सूक्ष्मं गोलं प्रसाध्य दारुमयम् /
स्थगितार्कैर(सं)कीर्तितकालभोगरेखाङ्कुशे परिधौ //२३//
याम्योदग्रेखाया क्षणाजसन्ध्युदयतो यसेद्वेधात् /
अयनांशकाङ्कतुल्यांस्तिर्यग्वैधप्रकाशकरान् //२४//

19a °टर्ध्यकपालं a, °टर्ह्यकपालं β 19b सघि(घिC)हु(ह्युC, हूEF)मल्लौ (ल्लो B)त्र(त्त B) च β 19c सु(सC)य(पC)मावद्ध°(र्व°C) β 19d कुर्याटिक्क:(च्यु: D, क: β) αβ 20b °छायासु(सु om. C)क्ता(का C)शका αβ, com. T.-D. 20c भवति उदयो αβ 20c-d राशि(सिCF)र्दिना(ताC)इय(यC)च β 20d यात: β 21a समभगणांफक-वक्र° β 21b °मर्धांगुलबज्जस - तहस्ता β 21d तद्व्यासि a, - - - β तिर्यक्का αβ, com. T.-D. 22a मध्याह्ना(श्राC)र्क° β °मयूषं a, °मसू(सुC)षं β, com. T.-D. 22b °निचरेण a, निचरेण β 22c-d °सूत्रां तला(त्सा BE, त्सं F, त्सपं C)तरांशा° αβ 22d °टुत्पद्य: a, °टुत्पद्यं β, com. T.-D. 23b प्रसाध्य β धातुमयं a 23c स्थगितार्कैमंकित° a, स्थगिभावमिंकित° β 24b क्षस्राजसंध्या(ध्य F)भयतो β 24b °स्तिर्यग्वैध्य°(ध्ये°C) β °प्रकाशकरात् a

XIV,19. One should make a water-basin like the (plane geometrical) construction with the marks (of the degrees) and with the circle of directions, and tilt it by (the amount of) the terrestrial latitude; insert in it a very symmetrical cavity and place a gnomon to mark its center.

XIV,20. The degrees that have been passed by the shadow from the intersection of two lines (i.e., that of the circumference of the basin and the shadow at dawn) (along the day circle) are to be added to (the longitude of) the Sun; the result is the sign at the rising (-point), and (the degrees passed by the shadow, divided by 6) are the lapsed nāḍīs of the day.

XIV,21. (Make) a circle half a digit wide and a hand in diameter and mark it evenly with (the signs of) the zodiac; (make) a hole in the middle of its width. Coming through this obliquely

XIV,22. cause a ray of the Sun at noon to enter (the circle) with a small motion of the circumference. The degrees between (the spot) that is heated (by the Sun's ray) and the string hanging from the middle (of the circle) is its (the Sun's) zenith distance.

XIV,23. Construct a small sphere of wood having the measure of its surface evenly round; on its circumference (i.e., surface?) (draw) two lines (indicating) the passage of time, which are bent where the Sun stops (i.e., at the two solstices).

XIV,24. On either side of the juncture of Pisces and Aries, by means of observation, one should lay off north-south lines (perpendicular to the equator, whose lengths) equal the marks of the degrees of declination (for appropriate zodiacal longitudes); these determine (the positions of) the "illuminators of the oblique observation."

अच्चोत्क्षिप्तस्योदक् तिर्यग्वेध्यप्रकाशहरिजस्थाः /
या नाड्यस्ता यातः षडंशकसमन्विता मध्ये //२५//
षट्कृत्यति कालचक्रे मृगादिकमुदग्(ग्)ायने द्युवृद्धिः स्यात् /
व्यत्यासे तद्रात्रिर्व्यास्यात्याद्येषमिति <ग>म्यम् //२६//
गुणसलिलपांशुधर्मोज्झितानि बीजानि सर्वयन्त्राणाम् /
तैः फलके कूर्मनवयद्येष्टरूपाणि कार्याणि //२७//
गुरुरचपलाय दद्याच्छिष्यायैतान्यवाप्य शिष्योऽपि /
पुत्रेणाप्यज्ञातं बीजं संयोजयेद्यन्त्रे //२८//
अभिमतदेशाच्चवशात् कृतवेध्येनोड्वपे(र्प)पूर्णिमाकर्मे /
दृष्टिघटिकोदयांश तुल्यान्यत्वे नियुतयुक्तम् //२९//
तिथिवद्धिकृत्य लब्धं ग्रहकालेनान्वितं क्रियाद्येषु /
ध्रुवकादिष्वपि हीनं विद्युवति देशान्तरं स्पष्टम् //३०//

25a अच्चोत्क्षिप्तस्योदक् a, अच्चौ (च्चो CF) क्षिप्तस्यो (ष्यो B, प्यो E, मिनोशकाकत्येस्यो C) दक् (व् F) β, com. T.-D. 25b तिर्यग्वेद्° β °हरिज्ञास्याः aβ, com. T.-D. 25c या नाड्यस्ता a वाताः a 25c नाड्यस्ता → 27a गुण° om. C 26a षट्कृत्येति β 26b भागादिकं a, भादिक° β °मुदयातेषु वृद्धिः β, °मुदयते द्युवृद्धिः a सा aβ, com. T.-D. 26c तद्रात्रि° a 26d °मिति – म्यं a, °मिति β, com. T.-D. 27a गुणं aβ, com. T.-D. 27a-b °र्योज्झा (ज्ञी F) तानि β 28a गुरुरचपालाय a, गुरुरव्यप (प – E) ल – β, com. T.-D. 28c °ज्ञानं a 28d संयोजये – तो (नो BE) β 29b कृतवध्येनोड्डपूर्णमाकर्मे a, चलम(य C)ध्येनोट्टमरामिकर्मा (र्मे F) β 29c देष्टि° β 29c-d °घटिकोदयांसं तुल्यान्यत्वे a, °घटिकोदयांसं तुल्यान्यत्वे β 29d निद्युय (द्यु F, ध्य C) त° β 30a तिथिवद्धिन्न (त्रा β) ज्य (ज्यं β) aβ 30b ग्रहकालादि (दृ β) नान्वितं aβ, com. T.-D. क्रियाद्येषु β 30c ध्रुवकादिषु पतिहीं (हिं C) नं aβ, com. T.-D.

XIV,25. Tilt (the sphere) to the north by the amount of the terrestrial latitude (and measure the degrees between) the "illuminator of the oblique observation" (i.e., the point on the ecliptic occupied by the Sun) and (the point where) the horizon (and the day-circle) meet; the lapsed nāḍīs correspond to a sixth part (of the degrees) in between.

XIV,26. If, among the time-circles, one of those beginning with (that of) Capricorn rises, (then the Sun is) in the northern ayana and the length of daylight increases; in the reverse situation the length of daylight decreases. The rest is to be approached on the basis of what has already been explained.

XIV,27. The seeds of all magical diagrams are furnished by string, water, and sand; with these the forms as desired, of tortoises or men, are to be made on a surface.

XIV,28. The teacher should give these things only to a steadfast pupil; the pupil, having received the seed which is known not even by his (i.e., the teacher's) son, should use it in a magical diagram.

XIV,29. With an instrument adjusted to the terrestrial latitude of the given locality observe the fulness of the Moon; (the observed longitude) is diminished or increased by another (longitude computed for a time) equal to the ghaṭikās (after sunset) of the observation (which are computed) by means of the rising-time (of the longitude of the Moon);

XIV,30. convert (the result) as in the case of a tithi (into time). Add the quotient to the time of half of the equation of daylight in (the six signs) beginning with Aries, subtract (the half-equation of daylight) in (the six signs) beginning with Libra; (the result is) the accurate longitudinal distance (of the given locality from the prime meridian) along the equator.

घटिनिघ्नि निनि:सृततोयादिष्टच्छिद्रेण षष्टिभागो यः /
सा नाडी स्वमता वा स्वासाशीतिः स्यातं पुंसः //३१//
कुम्भार्धाकारं ताम्रं पात्रं कार्यं मूले छिद्रं
स्वच्छे तोये कुण्डे न्यस्तं तस्मिन् पूर्णे नाडी स्यात् /
मूलापातादूर्ध्वो वा षष्टिर्योज्या चाह्ना रात्र्या
वर्णाः षष्टिवक्राः श्लोको यत्तत् षष्ट्या वा सा स्यात् //३२//
बुध्वा राशिविक्षेपं दृष्ट्वा तारायोगाङ्कविवरं च /
संसाध्यैवं वाच्यः पश्चात्तारासमायोगः //३३//
बहुलाः षष्ठांशान्ते सार्धे हस्तत्रये च भगणोदक् /
रोहिण्यष्टलान्ते दक्षिणतस्सार्धषष्ठेषु //३४//
हस्ते ऽष्टमे ऽष्टमें ऽशे पुनर्वसौ दक्षिणोत्तरे तारे /
अर्धचतुर्थे हस्ते पुष्यस्योदक् चतुर्थे ऽशे //३५//

33 quoted by Utpala on BS 24,4-5.
31a-b निनि (नि C) सृत (तं a) तोयादिष्ट (ग्र C) च्छि (च्छि E) द्रेण aβ, corr. T.-D.
31c स्वमतो a, स्व (स C, स्व F) मतो (त्तो E) β 31d स्वासाशीतसतं aβ, corr. T.-D. घ्नस: β 32b कुण्डे β 32c मूलात्पत्वाद्ध्वो aβ षष्टिर्योज्या aβ, corr. T.-D. महा a, मद्रा β, corr. T.-D. 32d वर्णा (र्सा D) ष्टाष्टिवक्त्रा: a, वर्णा: षष्टिवक्रा: (क्त्रा: EF, त्रा: C) β, corr. T.-D. स्यात् a ~~XIV~~ 33a राशिविक्षेपं to ~~XIV~~ 7d घनवर्गानोर्धेव° placed after ~~XIV~~ 24a अ° β 33a राशिविक्षेपं β 33b कृत्वा Utpala नारा° β 33c सस्ता (स्त F) ध्यैव β, संसाध्यैव a, संसाध्य च Utpala, corr. T.-D. वक्तव्य: Utpala 34a बहुला a, षट्ला β षष्ठांशान्ते (ते F, ति CE) aβ, corr. T.-D. 34b भगणोदक (क: E) aβ, corr. T.-D. 34d दक्षिणस्तस्वार्ध° aβ, corr. T.-D. 35c-d हस्तेषु पुष्य (ष्यो C) स्योदक् β

XIV,31. A sixtieth of the water that escapes by means of a particular hole during a nychthemeron is considered to be a nāḍī, or else 180 breaths of a man.

XIV,32. A copper vessel shaped like half a pot (i.e., a hemisphere) is to be made; (pierce) a hole in its bottom and put it in clear water in a basin; when this is full, that is a nāḍī—or else the observation (is made) by means of (the striking of) the sunken bottom. For a day and a night 60 (of these) are to occur. Or else (a nāḍī is the time it takes to recite) 60 of these verses (each of which consists of 60 long syllables).

XIV,33. Knowing the latitude of the Moon and observing the distance of the Moon from a star, by calculating one should predict its conjunction with the star in the future.

XIV,34. (The yogatārā of) Kṛttikā is at the end of the sixth degree and $3^1/_2$ hands to the north of the zodiac; (the yogatārā of) Rohiṇī is at the end of $8^1/_2$ (degrees) and $6^1/_2$ (hands) to the south;

XIV,35. the two (yoga-) tārās in Punarvasu are in the eighth degree and at the eighth hand north and south; (the yogatārā) of Puṣya is in the fourth degree and $4^1/_2$ hands to the north;

दक्षिणतारा हस्ते सार्पस्यांशे तथोत्तरा तारा /
पित्र्यस्य स्वक्षेत्रे षष्ठे यांशे समायोगः //३६//
चित्रार्धाग्रमध्यागे दक्षिणतः संस्थिते त्रिभिर्हस्तैः /
विक्षेपकलान्ताद्भुलानि मध्याच्छशाङ्कस्य //३७//
विक्षेपात् सप्तदशापनीय तिथिसङ्गुणा(न्) कृताग्न्यंशः /
विष्कादङ्गुलमानं कालं दिनभोगविर(वे)रेण //३८//
विषुवच्छायार्धगुणा पंचकृतिस्तत्कलास्ततश्चापम् /
छायात्रिसप्तकयुतं दशाभिर्गुणितं विनाड्यस्ताः //३९//
ताभिः कर्कटकाद्यावल्लग्नं तादृशे सहस्रांशौ /
याम्यातो वनितासुखविशेषतिलको मुनिरगस्त्यः //४०//
गणितविषयोपलब्धच्छेद्यकयन्त्रैः प्रकाशतां याति /
सुखयति मनांसि पुंसां दिव्यं कालाश्रयं ज्ञानम् //४१//
इति छेद्यकयन्त्राणि चतुर्दशो ऽध्यायः //

39-40 quoted by Utpala on BS 13,21

36b सार्पस्यांसे a तथोत्तरात्तारा a 36c स्वक्षेत्रे a, स्व (स्प C) क्षेत्रे β, com. T.-D. 36d यां (वा β) शे aβ, com. T.-D. 37a चित्रार्धाग्रमध्यागे a, चित्रार्धा (र्द्धा CF) क्षध्यागे β, com. T.-D. 37b त्रिहस्तैः β 37c °कलान्ताद्° a, कलाता (ध्यता C) द्भू° (द्भु°F) β, com. T.-D. 37d मध्याशक्षशाकस्य β 38a-b सप्तदशायनीय β 38b °संगुणा aβ, com. T.-D. कृताग्न्यंशः β 38c °माणं a 38d दिनभोगे बि (धि β) रेण aβ, com. T.-D. 39a °छायाद्विगुणा (णणा F) β 39b पंचकृतेस्त° aβ 39c छायात्रिसप्तक° a, छायातृसप्तक° β, com. T.-D. 39d °र्गुणिता aβ, com. T.-D. 40a-b °काद्याय (प C) लग्नं aβ, com. T.-D. 40b तदृशे (तदृशे तदृशे C) β सहस्तां (स्तं C) शो (या C) β 40c याम्याता (स्ता a) aβ वनितास्तु (स्तु a) स्व° aβ, com. T.-D. 40d °विषतिलको β मुनिरगस्त्यः a 41b प्रकाशता β यातं aβ, com. T.-D. 41c र (२F, om. E) धसुखयति β col. इति om. a

XIV,36. the southern (yoga-) tārā of Āśleṣā is in the (first) degree and a hand (to the south), the northern (yoga-) tārā is also (in the first degree and a hand to the north); the conjunction (with the yogatārā) of Maghā (takes place) in the sixth degree in its own field (i.e., in Maghā);

XIV,37. (the yogatārā of) Citrā is at $8^1/_2$ degrees and 3 hands to the south. The digits (are counted) from the center of the Moon where the minutes of latitude end.

XIV,38. Subtract 17 from the latitude (of the yogatārā with respect to the Moon), multiply (the remainder) by 15, and (take) a thirty-fourth (of the product); one should know (that this is) the measure of the digits. (Compute) the time (of the conjunction) by means of the difference in the daily progresses (of the Moon).

XIV,39. Multiply half the (noon) equinoctial shadow by 5^2 (= 25); the result is in minutes. Add 21 times (half of) the shadow to the arc from this and multiply (the sum) by 10; the result is vināḍīs.

XIV,40. By means of these (compute) the ascendant from the beginning of Cancer; when the Sun stands there, to the south the sage Agastya, (like) a forehead-mark distinguishing the face of a lady,

XIV,41. shines forth because of the magical diagrams on the (graphical) constructions which are understood by means of the principles of mathematics. The divine knowledge which pertains to time delights the minds of men.

Thus the fourteenth chapter: the Magical Diagrams of the (Graphical) Constructions.

सूर्येन्दुभगणध्रात्रीसंस्थानविदो ऽधिकृत्य कथयामि /
ग्रहणं सदैव भानोः स्थानविशेषात् क्वचिद्दृश्यम् //१//
अविदितसंस्थानानां बोधो ऽपि हि जायते यद्या ध्यानात् /
क्षीरं शंखोपहितं दर्शनविनाशाच्चमं भवति //२//
संक्षेपसूत्राविशेषेण तीर्यते दिवाकरो येषाम् /
तेषां सूर्यग्रहणं स च देशः प्रतिदिनं क्वापि //३//
सकृदेव रविं ग्रस्तं पर्वं पश्यन्ति शशिगताः पितरः /
अग्रस्तमपि च पर्वं ग्रहमध्यं पौर्णमास्यां तु //४//
न कदाचिदपि ग्रहणं मेरुगता मेरुसंनिकृष्टा वा /
पश्यन्ति तिग्मरश्मेरनुच्चभावाद्विदिङ्मांद्योः //५//
अर्केन्दुदृष्टिवेधा न मेरुगाः कदाचिदपि पार्श्वस्थाः /
ते <सर्वे खलु> विवरं पश्यन्ति सदैव सूर्येन्दोः //६//

1a °भगणाध्रात्री° a 1c ग्रहाणां a 1d °विशे (शो C) षात (त्त E, om. C)- (– om. C) β क्वचिदृश्यं a, ध्रु (भ्रु C, क E) षिदृश्यं β, com. T.-D. 2a आविदितसस्थाना- नां β 2b वेद्यो (द्यौ C) β ध्यान्यां a, ध्यान्यां (नां C) β 2d दशान (न om. C) न (न om. aCF) विनाश° aβ, com. T.-D. 3a संक्षेपसूत्राव (वं β) श (शश E) शिना aβ 3b म्रियते aβ 3c तेषां om. β 3d सवदेशः a 4c अग्रस्थमपि a, अग्रस्तमवि β, com. T.-D. 4d ग्रस्तं मध्या β 5d °रनुच्च°दृविहिमांशो: (ओ: F) β 6a °वेद्यो aβ 6c स्ते विवरं aβ, com. T.-D. 6d सूर्येंदो: β

Chapter XV

XV,1. Placing those who know the relative positions of the Sun, Moon, zodiac and earth ahead I speak. There is always an eclipse of the Sun; somewhere it is visible because of the difference of localities.

XV,2. For those who are ignorant of the relative positions, understanding arises from meditation just as milk deposited in a conch-shell is able to withstand the destruction caused by teeth.

XV,3. For those for whom the Sun is crossed by an identity of all (the requisite) lines there is an eclipse of the Sun; this locality is somewhere every day.

XV,4. The Pitṛs on the Moon see the Sun eclipsed once for (a whole) half-month (pakṣa), and not eclipsed for (a whole) half-month; the middle of the eclipse is on the full-moon tithi.

XV,5. Those who live on Meru or near to Meru never see an eclipse of the Sun since the Sun and the Moon are not high (enough) up (above their horizon).

XV,6. Those on Meru (and) on its side, never make an observation of the Sun and Moon (together); they always see a distance between the Sun and Moon.

यद्यप्युदये ऽस्ते वा नीचस्थो ऽस्माकमंशुमान् भवति /
मन्द्रोपरसंभवस्थो घनवद्भानोर्भवति हेतुः //७//
अस्माकमुदयसमये येषामल्पास्तगो दिवसनाथः /
मध्याह्नो वा येषां तेषामपि न सुगमद्ग्रहणम् //८//
तदतीतमुदयगानां क्षणदूयेनैष्यदस्तदेशानाम् /
मध्याह्नदेशगानामनवरतं वर्त्तमानेन //९//
उक्तं च संहितायां मया प्रपंचे ऽस्य राहुचारादौ /
ग्रहणस्य यन्निमित्तं विनैव राहुं रविहिमांशोः //१०//
मेरोर्न दिग्विभागो यस्मात् प्राची न भास्करास्तस्मिन् /
उदयति यावद्दिनपः पर्येति वसुन्धरीं तावत् //११//
अणुमात्रदर्शनात् प्राग्विभाग इति चेत् समार्धमित्वा तु /
तस्मिन्नेवास्तमये किं वा प्राची भवेत् त्वपरा //१२//

7a यद्य (द्यं aC, द्यु F) द्युदये aβ वा om. β 7b निचस्थो β °मंशुमा a
7d घनद्भानो° a, घनद्भा (द्भा C, न्हा F) नो (तो BE) β, com. T.-D.
7d °ति हेतुः to 23d सः inserted after XIV 33a बुध्वा β 8b दिवनाथः β
8d तेषां मे (मे om. B) यिनमुग्गमतग्रहणं β 9a त (रत C) दानी (ती F, न्नी C)
तमु-यद्भंगानां β 9b क्षणदूयेनैष्यद° a, क्षणदुयेने (मे C) ष्यद° β, com. T.-D.
°स्तदोषाणां (नां EF) aβ, com. T.-D. 9c °देशे गाना° a 9d °मनप (ग C) रतβ
वर्तमान β 10a न (रन C) क्रं β संताया β 10b मवा β प्रपंचो aβ स्म a
10c यनिमितं β 10d विनैराहुं β पर (रि C) पिहिमांश (शश E) β
11b भास्करामस्मिन् β 11c नटयति β 11c-d यावद्दि (र्दि D, द्दि C) वं (वं om. β)
पर्येती aβ, com. T.-D. 11d वसुंदरी aβ 12a अनुमात्र° aβ, com. T.-D.
12b °मिचा नु a, °मित्वान्तु β, com. T.-D. 12c तस्मिवास्तमये β

XV,7. For us, even if the Sun is low down (towards the horizon) at sunrise or sunset, the Sun's being under the Moon as (under) a cloud is the cause (of the eclipse).

XV,8. (If) for us there is an eclipse at the time of sunrise, there is not one simultaneously for those for whom the Sun is almost set or for those for whom it is noon.

XV,9. It is past for those at (a place where it is) sunrise (and) in the future by (as much as) two kṣaṇas for those at a place (where it is) sunset (when it is) incessantly with the present for those at a place (where it is) noon.

XV,10. I have in detail discussed in the (Bṛhat-)saṃhitā, at the beginning of (the chapter on) the motion of the ascending node, what is the cause of an eclipse of the Sun and Moon aside from the ascending node.

XV,11. Because there is no distinction of directions on Meru, the eastern (direction) is not (indicated) by the (rising) Sun; as long as the Sun is risen, so long does it revolve about the earth.

XV,12. If (it is said): "The eastern (direction) is distinguished by the visibility (of the Sun) when it is the size of an atom", (it may be answered that) after it has travelled for half of the (ecliptic) great circle it sets at just that (point); what then is east or what west?

तेषामपक्रमवशाद्दिवसो न खलु ऽमाव्यद्यास्माकम् /
षष्टिर्नाड्यो ऽस्माकं वर्षमहोरात्रममराणाम् //१३//
वर्षे वर्षे ध्रुवनिशं सुरासुराणां विपर्ययेणाहः /
मासं तु तत्पितॄणां मनुजानां नाडिकाषष्टिः //१४//
यन्मात्रं भूवृत्तात् क्षणद्वयेनोच्चति व्रजत्यर्कः /
तन्मात्रान्तरचारिणममराः पश्यन्ति नोर्ध्वमधः //१५//
होराधिपतिर्दिनेश्वरपरम्परा न स्यात्तु यद्यास्माकम् /
षष्टिर्नाड्यस्तस्मिन्नाहोरात्रो ऽवति यस्मात् //१६//
दिनवारप्रतिपत्तिर्न समा सर्वत्र कारणं कथितम् /
नेहापि ऽवति यस्माद्भिन्नवटन्ते ऽत्र दैवज्ञाः //१७//
द्व्यगणाद्दिनवारादिर्द्व्यगणो ऽपि हि देशकालसम्बन्धः /
लाटाचार्येणोक्तो यवनपुरे ऽर्धास्तगे सूर्ये //१८//

15 quoted by Utpala on BS 17,4-5; 17-20 quoted by Makkibhaṭṭa on SŚ 2,10; 18-29 quoted by Utpala on BS 2 (pp. 32-33).

13a तेषा (या C) म (म om. E) प° β 13c षष्टिर्नोट्टो (ष्टर्धो C) स्माकं β 14a ध्रुवनिशं (शां F) β 14c तत्पितॄणां aβ, com. T.-D. 15a ऽमव (व om. CF) स्ना (त्ना CF) β 15b क्षणट्टा (वृ EF) येनोच्चति β 15c °क्रांतरचारिण° a, °क्रांत (स CE) रचारि° β 15d नोर्ध्वं (र्ध्वं β) मधः (धः CF) aβ 16b नश्यन्ते a, नट (ट C) न्ते β 16d °ऽहोरात्रो β 17a-b °प्रतिपत्ति न aβ 17b कारणे कथिता Makkibhaṭṭa 18b द्व्यगणो aβ sपि च Makkibhaṭṭa °संबन्धा a 18c लाजा° a, लाता° β 18d वास्तगे a, यास्तगे β, चास्तगे Makkibhaṭṭa, Dikshit

XV,13. For them (i.e., those on Meru) the day (is determined) by (the Sun's) declination, not, as for us, by its motion; our year is a nychthemeron (consisting of) 60 nāḍīs for the Gods.

XV,14. Every year is a day and a night for the Gods and Demons, with a reversal (of the position) of the day; (a day and a night) is a month for the Pitṛs, 60 nāḍīs for men.

XV,15. To whatever elevation from the horizon the Sun moves in two kṣaṇas, at that distance do the Gods see him moving, neither higher nor lower.

XV,16. The succession of lords of the hour and of lords of the day is not the same as ours because the nychthemeron there is not 60 nāḍīs.

XV,17. The (means of) ascertaining the week-days is not the same everywhere; since no cause is spoken of in this matter, the astrologers disagree about it.

XV,18. The week-day is obtained from the ahargaṇa; but the ahargaṇa is a combination of time and place. It is said by Lāṭācārya (to begin) when the Sun is half-set at Yavanapura;

रव्युदये लङ्कायां सिंहाचार्येण दिनगणो ऽभिहितः /
यवनानां निशि दृश्याभिर्गतैर्मुहूर्तैश्च तद्गुणा ॥१९॥
लङ्कार्धरात्रसमये दिनप्रवृत्तिं जगाद चार्यभटः /
भूयः स एव सूर्योदयात् प्रभृत्याह लङ्कायाम् ॥२०॥
देशान्तरसंशुद्धिं कृत्वा चेच्च घटते तथा तस्मिन् /
कालस्यास्मिन् साम्यं तैरेवोक्तं यथाशास्त्रम् ॥२१॥
मध्याह्नं भद्राश्वेष्वस्तमयं कुरुषु केतुमालानाम् /
कुरुते ऽर्धरात्रमुज्जयन् भारतवर्षे युगपदर्कः ॥२२॥
उदयो यो लङ्कायां सो ऽस्तमयः सवितुरेव सिद्धपुरे /
मध्याह्नो यमकोट्यां रोमकविषये ऽर्धरात्रः सः ॥२३॥
अधिमासकोनरात्रग्रहदिनतिथिदिवसमेषचन्द्रार्काः /
अयनर्तुवर्षगतिनिशाः समं प्रवृत्ता युगस्यादौ ॥२४॥

20 quoted by Nīlakaṇṭha on Kālakriyā 16
19c यवनानां शिनिशिभि° β, यवना निशीह दृशभि° Makkibhaṭṭa
19d °र्मुहूर्तैश्च aBC 20a °समयाद् Nīlakaṇṭha 20b चार्यभट: a
20c-d चार्कोदयात् Utpala, Makkibhaṭṭa, Nīlakaṇṭha 21b क्र (त्तं C, त्त E, त्व F)
चच्च (च C) β 21c कालस्यात् (त् om. C) साम्यं (म्यां C) β 21d नैरेवोक्तं a
21d यथाशास्त्रं to 22b °ष्वस्तमयं om. β 22b कुरुष्वुत्तरेषु केतुमालानां a,
तरेषु काले तुलानां β 22c °मुद्यट् a, °मुह्यन् β 23a दिनग्रो β
यो om. a 23c यमकोट्यां मध्याह्नं Utpala यमकोट्यां (ह्यां C) aβ
23d रोकवि (म्रि B) ये β ऽर्धरात्रं च Utpala 24a °कोनरात्रि° β
24b °टिवसममूषचंद्रार्काः (र्काः C) β 24c अयन – र्ते° a, अयनत्वर्ते° β
24d युगस्यादौ a

XV,19. the ahargaṇa is said by Siṃhācārya (to begin) at sunrise at Laṅkā; for the Yavanas (it is said) by their guru (to begin) at night when 10 muhūrtas have passed;

XV,20. Āryabhaṭa has said that the day begins at midnight at Laṅkā; moreover he has said that it begins at sunrise at Laṅkā.

XV,21. If, after one has made the correction for longitudinal difference, no agreement concerning the time arises in this, it is said by them in agreement with the śāstras:

XV,22. The Sun rising in Bhāratavarṣa simultaneously causes noon among the Bhadrāśvas, sunset among the Kurus, and midnight for the Ketumālas.

XV,23. Sunrise at Laṅkā is sunset at Siddhapura, noon at Yamakoṭi, and midnight in the territory of the Romakas.

XV,24. The intercalary months, omitted tithis, (mean longitudes of) the planets, the days, tithis, (lords of) the days, Aries, the Moon, the Sun, the ayanas, ṛtus, motions of the constellations, and the nights begin equally at the beginning of the yuga.

अन्यद्भोमकविषयाद्देशान्तरमन्यदेव यवनपुरात् /
लङ्कार्धरात्रसमयादन्यत् सूर्योदयाद्यैव //२५//
सूर्यस्यार्धास्तमयात् प्रतिदिवसं यदि दिनाधिपं ब्रूमः /
तत्रापि नास्तवाक्यं न च युक्तिः काचिदन्यास्ति //२६//
सन्ध्या क्वचित् क्वचिदहः क्वचिन्निशा दिवसतेः क्वचित् क्वचित् /
स्वल्पे स्वल्पे स्थाने व्याकुलमेव दिनपतित्वम् //२७//
होराबार्तापयेवं यस्माद्धोरा दिनाधिपस्माद्या /
तस्यापरिनिष्ठाने होराधिपतिः कथं भवति //२८//
अविचार्यैवं प्रायो दिनवारे जनपदः प्रवृत्तो ऽयम् /
स्फुटतिथिविच्छेदसमं युक्तमिदं प्राहुराचार्याः //२९//
ज्योतिषोपनिषत् पंचदशो ऽध्यायः //

29c–d quoted by Nīlakaṇṭha on Kālakriyā 16.
25d °दन्य (न्यः β) aβ 26a सूर्यस्यार्धास्तमयात् β 26b प्रतिविषयं Utpala दिनाधिप (ष B) त्यं β 26c नास्तं वाक्यं β 26d नवयुक्तिः a काचिदप्यस्ति Utpala 27b दिनपतिः aβ 27c स्मा (प्रस्मा C) नं aβ 27d व्याकुलमेवं aβ 28a होराबार्तापयेवं a 28b दिनाधिपद्धाद्या: (दया: B) β 28c °निष्वाने a 29a अविचिदत्रैवं Utpala (some manuscripts) 29b दिनवारौ a, दिनवारै (रौ C) β 29c स्फुरतिथि° β col. पंचदशमो β

XV,25. There is one longitudinal difference from the territory of the Romakas, another from Yavanapura; there is one (time) from midnight at Laṅkā, (another) from sunrise.

XV,26. If we say (what is) the lord of the day (by counting) every day from the setting of half the Sun, there is no accepted statement in this nor any other reasoning at all.

XV,27. Because of the Sun's being in various places, it is twilight in one place, daylight in another, and night in another; at every little (shift in) locality the lordship of the day is confused.

XV,28. Thus also is the information about the hours since the first hour belongs to the lord of the day; since that is not completely fixed, how is the lord of the hour?

XV,29. The common people for the most part deal with the (accepted) week-day without reflection; the ācāryas say that that is right which coincides with the accurate divisions between tithis.

The fifteenth chapter: the Upaniṣad of Astronomy.

एष निशार्धे ऽबत्यां ताराग्रहनिर्णयो ऽर्कसिद्धान्ते /
तन्त्रेन्दुपुत्रशुक्रौ तुल्यगतौ मध्यमार्केण //१//
जीवस्य शताभ्यस्तं द्वित्रियमाग्नित्रिसागरैर्विभजेत् /
युगणं कुजस्य चन्द्राहतं तु समाष्टषड्भक्तम् //२//
सौरस्य सहस्रगुणमृतुरसशून्यर्तुषट्कमुनिखैकैः /
यल्लब्धं ते भगणाः शेषा मध्या ग्रहाः क्रमेणैव //३//
दशदशभगणे भगणे संशोध्यास्तत्परा सुरेज्यस्य /
मनवः कुजस्य देया शनेश्च बाणा विशोध्यास्तु //४//
राशिचतुष्टयसंशद्युतं कलाविंशतिर्वसुसमेता /
नवबेदाश्च विलिप्ताः शनेर्धनं मध्यमस्यैव //५//
अष्टौ भागा लिप्तार्णवः स्वपक्षो गुरोर्विलिप्ताश्च /
क्षेपः कुजस्य यमतिथिपंचत्रिंशच्च राश्याद्याः //६//

1a बत्यां e/β, com. T.-D. 1b °ग्रहनिर्णो a, °ग्रहण β, com. T.-D. कसिद्धांते β
1d महमार्केण a, स (क्कौ म C)ध्यमार्के (र्के E, र्के CF)सा β, com. T.-D. 2a निवस्य β
2d समाष्टद्भक्तं a 3a सौम्यस्य सताभ्यस्तंद्वित्रियमाग्नित्रिसागरै (from 2a-b)
सहस्र° β 3a-b °गुणाद्भुतुरस° a, गुणाऋ (द्द F, om. C)तुरस° β 3b °सून्य° a
°मुनिखेकैः β 4a दशांशाभगणे β भगणे om. β 4c नवमः β कुकुद्भु (द्ध C)
β 4d विशोध्यास्तु a, विशोध्याः (ध्य F)स्युः β, com. T.-D. 5a राशिचतुष्टयसंशं β
5c नवबेदाश्च (श्च EF) β 5d शनेर्धनं a, शनेः β, com. T.-D. मध्यमास्येव a,
मध्यमस्त्वेयं β, com. T.-D. 6a भागा a लिप्तार्णवः a, लिप्तनवः (क C) β
6b स्वमतौ a, शेषसौ β गुरौ a, गुरू β 6c क्षे (क्ष C) वः (यः C) β
यमतिथि° a, यमतितिथि° β, com. T.-D. 6d °त्रि (त्रिं E) राश्य β

Chapter XVI

XVI,1. This is the determination of the star-planets in the Arkasiddhānta for midnight at Avantī; in this Mercury and Venus have a (mean) motion equal to that of the mean Sun.

XVI,2. For Jupiter multiply the ahargaṇa by 100 and divide (the product) by 433 232; for Mars multiply it by 1 and divide by 687;

XVI,3. for Saturn multiply it by 1000 and divide by 10 766 066. The quotients are revolutions, the remainders the mean (longitudes of the) planets in order.

XVI,4. For every revolution of Jupiter 0;0,0,10° are to be subtracted; of Mars 0;0,0,14° are to be added; of Saturn 0;0,0,5° are to be subtracted.

XVI,5. To the mean (longitude of) Saturn is added 4 signs and 2;28,49° (= 122; 28,49°);

XVI,6. to Jupiter 8;6,20°; to Mars the kṣepa is 2, 15, and 35 in signs and so on (= 75;35°).

शतगुणिते बुधशीघ्रं स्वरनवसप्ताष्टभाजिते क्रमशः /
अत्रार्धपंचमास्तत्सराश्च भगणाहताः क्षेप्याः //७//
सितशीघ्रं दशगुणिते खगुणे भक्ते स्वरार्णवाश्वियमैः /
अर्धैकादश क्षेप्या विलिप्तिका भगणसङ्गुणिताः //८//
सिंहस्य वसुयमांशाः स्वरेन्दवो विलिप्तिका शशीघ्रधनम् /
शोध्याः> सितस्य विकलाः शशिरसनवपक्षगुणदहनाः //९//
क्षेप्याः स्वरेन्दुविकलाः प्रतिवर्षं मध्यमक्षितिजे /
दश दश गुरोर्विशोध्याः शनैश्चरे सार्धसप्त मुताः //१०//
पंचाब्धयो विशोध्याः सिते बुधे साक्षिचन्द्रयुताः /
सखवेदेन्दुविकलिकाः शोध्याः सुरपूजितस्य मध्यात् स्युः //११//
सूर्यसिद्धान्ते मध्यगतिः //
शीघ्रास्यो ऽर्को ऽन्येषां भौमादीनां तु <सन्दो>परिभ्रयः <स्युः> /
द्विगुणाः पंचत्रिंशन्मनवो ऽस्य स्वरास्त्रिंशा<श्च> //१२//

7a शतगुणितं β 7c–d °पंचमौ स्तस(स्त E)राश्च β 7d °हतः क्षेपः a, °हतक्षिपा β, com. T.-D. 8b द्विगुणे (णो F) aβ, com. T.-D. स्वरार्णवाश्वियमैः a 8c अर्धैकादश a 8d विलिप्ता a 9a सिंहस्य a 9b स्वरोदधो a विलिप्तिका β 9c शो aβ, com. T.-D. 9d °पक्षगुणादहनाः (ताः a) aβ, com. T.-D. 10a शरेन्दु° β D.kshit 10b प्रतिवर्षमाध्यमक्षितिजो aβ, com. T.-D. 10d मुक्ताः β 11a पंचाद्धयो a, पंचद्धयो β, पंचद्धया D.kshit, com. T.-D. 11b स्ताक्षिचन्द्र° a °युक्ताः β 11c सखवेदेन्दुविकालिकाः a, सखवेदविकलिकाः β, com. T.-D. 11d मध्याः β सध्यशनिः β 12a अर्को β 12c °त्रिंशत्सनवो a 12d सुरास्त्रिंशाः aβ

XVI,7. (If the ahargaṇa) is multiplied by 100 and divided by 8797 in order, (the result is) the conjunction of Mercury; to this 0;0,0,4,30° multiplied by (the number of) revolutions is to be added.

XVI,8. If the ahargaṇa is multiplied by 10 and (the product) divided by 2247, (the result is) the conjunction of Venus; to this 0;0,10,30° multiplied by (the number of) revolutions are to be added.

XVI,9. Of Leo 28° and 17 minutes (= 148;17°) are added to the conjunction of Mercury; 332 961 seconds (= 92;29,21°) are to be subtracted (from that) of Venus.

XVI,10. Every year 17 seconds are to be added to mean Mars, 10 (seconds) are to be subtracted from (mean) Jupiter, and $6^1/_2$ (seconds) are added to (mean) Saturn;

XVI,11. for (the mean conjunction of) Venus 45 (seconds) are to be subtracted, and for (the mean conjunction of) Mercury 120 (seconds) are added. From the mean (longitude) of Jupiter 1400 seconds (= 0;23,20°) are to be subtracted.

Mean motion in the Sūryasiddhānta.

XVI,12. The Sun is called the conjunction of the other (planets). The manda-circumferences of Mars and so on are 35, 14, 16, 7, and 30 multiplied by 2 (i.e., Mars 70°, Mercury 28°, Jupiter 32°, Venus 14°, and Saturn 60°).

रसभवबस्त्रवेदार्का विंशतिगुणिता: कुजस्य दृश्याकोना: /
मन्दगतीनां भागा: कुजबुधगुरुशुक्रसौराणाम् //१३//
शीघ्रपरिधिभवघ्नांशा: कृतगुणपक्षा द्विवह्निशीतकरा: /
पक्षस्वरा: षडृषयो भक्ता: स्यु: कुजादीनाम् //१४//
शीघ्रान्मध्यमहीनाद्राशित्रितये गतैष्यटंशज्ये /
भुजकोटी तत्परत: षड्भ्य: पतिते स एव विधि: //१५//
स्वपरिधिगुणिते भाज्ये भर्तृगुणैर्विपरिगते <ते त> तच्च /
कोटिफलं व्यासार्धे मृगकर्क्यादौ चयापचयम् //१६//
तद्भुजकृतियोगपदैर्भाजयेत्तत्तरौ> भुजं भसूर्यघ्नम् /
तच्चापार्धं मन्दे हानिधनं शीघ्रकेन्द्रवशात् //१७//
स्फुटयित्वैवं मन्दं मध्यान्न विशोध्यं तस्य भुजम् /
परिणाम्य कार्मुकार्धं तन्मन्देनैव धनहानि //१८//

15-16 quoted by Utpala on BS 2 (p. 46)
13a रससंभवत्स्रुवेदार्को β 13b कुजस्य a दृश्याकोणा: a, दृश्याकोणस्यणा: (ट्णा: C) β, com. T.-D. 13c मंदगतिनाम° a β °लाघवं β 13d °सोराणां a
14a-b शीघ्रपरिधा (धा om. C) यथाशास्त्रत्त (त CF) द्भू (गु CF) णपक्षा β
14c पक्षस्वरा: om. β स (सं a) षष्य (ट्य CF) मा a β, com. T.-D. 14d स्यु: om. β
15a शीघ्रान्मध्यविहीना° Utpala 15b °द्भाशि° a गतैष्य (ष्य a) टं (टे C) शोज्ये a β, गतैष्यटंशज्या Utpala, com. T.-D. 15c भुजको (क C) टि β 15d पतते a β
16b भर्तृगुणैर्विपगते तच्च a, भर्तृगुणे विसुगतच्च β, भर्तृगुणैस्ते विपरिणते तच्च Utpala
16d चयापचया: a β, चयापचय: Utpala, com. T.-D. 17a °कृति° om. β
17b °र्भा (भा β) जयेत्त (त्र a) त्भू (भु D, द्भू D²) जखसर्य (य C) घ्नं (घ्न: CF, घ्र: E) a β
17c तच्चापा (या β) र्धं a β, com. T.-D. 17d शीघ्रं केंद्रवश (श E) तात् β
18a स्फुटत्ववं मंदं β 18b तस्य भुजस्तजां β 18d धनहानी a, धनहानि: β, com. T.-D. after 18d, 17d°धनं to 18d धनहानि: repeated β

XVI,13. The degrees of the slowest motion (i.e., the mandoccas) of Mars, Mercury, Jupiter, Venus, and Saturn are 6, 11, 8, 4, and 12 multiplied by 20; (that) of Mars is diminished by 10 (i.e., Mars 110°, Mercury 220°, Jupiter 160°, Venus 80°, Saturn 240°).

XVI,14. In the śīghra-circumferences of Mars and so on are 234°, 132°, 72°, 260°, and 40°.

XVI,15. If (the remainder from) the conjunction (i.e., the longitude of the Sun) diminished by the mean (longitude of the planet) is within three signs, then the Sines of the traversed and untraversed degrees are the bhuja and koṭi (respectively); if it is more than that, then it is subtracted from six (signs) and the same rule (applies).

XVI,16. Multiply (the bhuja and koṭi) by their (proper) circumferences and divide (the products) by 360; thereby are they reduced (to the bhujaphala and the koṭiphala). The koṭiphala is added to the radius in Capricorn and so on, subtracted from it in Cancer and so on.

XVI,17. Then one should multiply the bhuja(phala) by 120 and divide (the product) by the square-root of the sum of the squares of that (i.e., $R \pm$ koṭiphala) and of the bhuja(phala). Depending on the anomaly of the conjunction, half of the corresponding arc is to be subtracted from or added to (the longitude of) the apogee.

XVI,18. Having corrected the apogee thus, subtract (it) from the mean (longitude of the planet); reduce its bhuja (to the bhujaphala). Half (of the corresponding arc) is added to, or subtracted from, just that (corrected longitude of the) apogee.

मध्यात् पुनर्विशोध्यस्तस्माद्बाहुं नतस्य यद्यापम् /
तन्मध्यमे चयधनं कर्तव्यं मन्दकेन्द्रवशात् //१९//
एवं स्फुटमध्याख्यं शीघ्रात् संशोध्यं पूर्वविधिनैव /
आदिवटासं चापं स्फुटमध्याख्ये चयापचयम् //२०//
सर्वे स्फुटाः स्युरेवं चेद्येषु शीघ्राद्बुहाय रविमन्दम् /
रविपरिधिनतं बाहुं बुधे ⟨क्रे⟩बरौ⟨ज्ञे⟩ चयधनं कुर्यात् //२१//
शुक्रस्य सप्तषष्टिर्लिप्ताः शोध्याः स्फुटीकृतस्यैव /
वक्रानुवक्रकालो स्फुटविशेषेण विज्ञेयः //२२//
स्फुटदिनकरान्तरांशाश्चन्द्राटीनां च दर्शने ज्ञेयाः /
विंशतिरूना वसुशिखिमुनिनवरुद्रेन्द्रियैः क्रमशः //२३//
मन्दग्रहान्तरज्या स्वाष्टांशासुतार्किजीवशुक्राणाम् /
सौम्यारयोः षटोना विक्षेपो ऽन्यस्य शीघ्रविधौ //२४//

19a मध्या β पुरो विशोध्य° a, सुरो विशोध्य° β, com. T.-D. 20a °मध्याख्यां a 20c आदिवटासे (न्ये C) aβ, com. T.-D. 20d °मध्याख्योप (प om. β) मयापचय: aβ, com. T.-D. 21a स्फुटा: स्फु (स्फु A)रेवं a, कारेवं (वं om. C) β, com. T.-D. 21b चस्य तु (पु) a, चेक्मंघ्रि β 21c वाम्नं (ग्नं CE, ङ्गं F) β 21d बुधावलयधने aβ 22a सप्तव्यष्टि° aβ, com. T.-D. 22b लिप्ता β स्फुटिकृतस्यैव a, स्फुटितत्त (त्त om. B) स्यैव β, com. T.-D. 22c वक्रानुवक्र° a 23a-b om. C 23a स्फुरदिन° β °करांतरां (सं β)तरां (रा BE, सं F)शा° aβ, com. T.-D. 23b व β दर्शनी a, ट (र्ट F)र्शे β, com. T.-D. 23c विंशति° aβ, com. T.-D. °रूना a 23c-d वसुशिखि-शिखि° aβ, com. Shukla 23d °नवरुद्रेन्द्रि (न्दि a)यै: (गै: β) aβ 24b स्वा (स्व B)ष्टांशासुर्किजीवशुक्राणां β 24c सौम्यान्य (म्य a) यो: aβ षटोनां a, षटन्नां β 24d न्यस्य a

XVI,19. Again (the second corrected apogee) is to be subtracted from the mean (longitude of the planet); (find) the bāhu from that. The arc corresponding to this after it has been reduced (to the bhujaphala) is to be subtracted from, or added to, the mean (longitude of the planet) depending on the argument of the apogee.

XVI,20. Subtract the mean (longitude of the planet) thus corrected from the conjunction (i.e., the longitude of the Sun) according to the previous rule; the arc that is obtained as was the first (śīghra correction) is to be added to, or subtracted from, the corrected mean (longitude of the planet).

XVI,21. All (the planets) thus are corrected. But in the case of Mercury and Venus subtract the Sun's apogee from the conjunction (i.e., the Sun's longitude); reduce the bāhu to the circumference of (the epicycle of) the Sun and subtract (the corresponding arc) from, or add (it) to, (the corrected longitude of) Mercury or Venus.

XVI,22. From Venus, after it has been corrected, 67 minutes are to be subtracted. The time of the first station or of the second station is to be known by means of the difference between velocities.

XVI,23. The degrees of distance between the true (planet) and the Sun (required) for the visibility of the Moon and so on are to be known as 20 diminished in order by 8, 3, 7, 9, 11, and 5 (i.e., Moon 12°, Mars 17°, Mercury 13°, Jupiter 11°, Venus 9°, and Saturn 15°).

XVI,24. For Saturn, Jupiter, and Venus add an eighth to the Sine of the interval between the apogee and the planet; for Mercury and Mars subtract a fourth. There is another latitude in the rule of the conjunction:

गुरुभूतनयास्फुन्नितां पाटोना त्रयमयोस्तु साष्टांशा /
त्रिज्याघ्नी कर्णाप्ता वियोगयोगः स विक्षेपः //२५//
ताराग्रहस्फुटीकरणं षोडशो ऽध्यायः //

25a गुरु (रु F) भूतत (न C) याः β 25b पटोना β त्रयममयोस्तुशांष्टांशाः α
त्रय (प F) मयोस्तुष्टयं (ष्टयं C, ष्ट्यं F) शां β 25d नियोगयो (यो om. E) श α/β

XVI,25. for Jupiter, Mars, and Venus subtract a fourth, and for Mercury and Saturn add an eighth. Multiply (the result) by the radius and divide (the product) by the hypotenuse; the latitude is the difference or sum (of the apogee and conjunction latitudes?).

The sixteenth chapter: the Correction of the Star-planets.

हित्वा मुनिजलमन्द्रार्कान् युगणाद्वेटाष्टभूतहृतलब्धाः /
शुक्रोद्धृत्या गुणांशाः साध्याः पंक्तालिनो भोगः //१//
कन्यांशाः षड्विंशतिमित्वा शुक्रो ऽपरेण यात्युद्धृत्यम् /
उद्धृत्यैकादशभागं दिनेषु दत्वा ततश्चारः //२//
षष्टित्रयेण वेदाग्नियमयुतामंशासप्ततिं भुंक्ते /
अर्धाष्टकविंशत्या विंशत्यंशकाऽस्त्रिभिः सपादांशम् //३//
वक्रमतस्तिथिभिष्टौ पंचभिरेवं ततो ऽपरास्तमितः /
दृश्यभिः प्रागुदितः स्याच्चत्वारिंशज्जलधीन् सितो गत्वा //४//
अनुवक्री परिगत्वा विपरीतं चास्तमेत्यैन्द्र्याम् /
षष्ट्यांशपंचसप्ततिमित्वापरतो भृगुर्दृश्यः //५//
वासिष्ठसिद्धान्ते शुक्रः //
विंशत्युत्त्रिंशद् युगणं नाडीभिस्तावतीभिरपि च गुरोः /
हृत्वा नवनवदहनैरुद्धृत्या लब्धाः स्मरंत्ता दिवसाः //६//

1a मुनिजला° β °चन्द्रा aβ, corr. T.-D. 1b °भूतहत° β 1c शुक्रोद्धृत्या a
गु(ग C)णांशैः aβ 1d साद्धुं a भोगाः aβ 2a षड्विंशति° β 2c उद्धृत्यैकादश° β
°भागान् aβ, corr. T.-D. 2d ततस्तारा: a 3a-b सेसाग्नियम° β
3c अर्धाष्टके (केन a) विंशतां (तिं a, तिः E) aβ 3d विंशात्यैस्त्रिभिः aβ
4a वक्रमतंस्तितिभि° β 4d मिता aβ गता β 5 and वासिष्ठसिद्धान्ते om β
5b विपरीतमस्तमत्यैड्यां (ड्यं D) a 6a विंशत्युत्त्रिंश द्विगुणं aβ, corr. T.-D.
6b गुरुः aβ, corr. T.-D. 6c हृ (हू C) त्वा aβ, corr. T.-D. 6c-7c °नवनवदहनै to
°द्धिते om. β 6c °तुद्धृत्या लब्धास्मि a, corr. T.-D.

Chapter XVII

XVII,1. Subtract 147 from the ahargaṇa and divide (the remainder) by 584; the quotient is the (number of) risings of Venus. Its progress in longitude (during that time) is $5^1/_2$ and $^1/_3$ (degrees) of Scorpio (= 215;50°).

XVII,2. When Venus has travelled to 26° of Virgo it rises in the west. Add $^1/_{11}$th (of a day for every) rising to the days; from this (compute) its motion.

XVII,3. In three (periods) of sixty (days) it travels 70° increased by 4, 3, and 2 (i.e., 74°, 73°, and 72° respectively); in $27^1/_2$ (days) 20°; and in 3 (days) $1^1/_4$°.

XVII,4. Then it retrogrades 2 (degrees) in 15 (days); then it sets in the west in 5 (days) and rises in the east in 10 (days); Venus goes 4 (degrees) in 20 (days).

XVII,5. Proceeding in direct motion, it travels in the opposite direction to setting in the east; proceeding 75° in 60 (days) Venus is (again) visible in the west.

Venus in the Vāsiṣṭhasiddhānta.

XVII,6. For Jupiter subtract from the ahargaṇa 34 (days) and as many nāḍīs and divide (the remainder) by 399; the quotient is (the number of) its risings. The (remaining) days are put down.

उदयनवांशान् दत्वा दिनेषु षड्गैसङ्गुणे हृदये /
एकनवाग्निछिन्ने षट्मिति साष्टादशं शेषम ॥ ७ ॥

द्वि(हित)क्रमशो मध्यः स्फुटस्य खण्डस्तयोश्च विश्लेषात् /
स्फुटहानौ सुषु दत्त्वान्तरम्ऽध्यखण्डे ऽन्यथा हानिः ॥ ८ ॥

रसविषयकृतशशाङ्काः क्षमखण्डे सह्नृतयः षट् यावत् /
विषयरसेना वृद्धौ जीवः स्यात् पंचनवतिशतात् ॥ ९ ॥

षड्सुमनवो हानौ तृतीयखण्डे गुरुस्तु षोडशके /
पंचगुणिते त्वभ्राजिते कलाः पूर्वतो ऽभ्युदेति ॥ १० ॥

नव सार्धाः कन्यांशाः प्रथमे खण्डे द्वितीयखण्डे स्युः /
चक्रार्धं द्विगुणांशा दश सदला देवपूज्यस्य ॥ ११ ॥

दिनषष्ट्यांशा द्वादश सकृतैर्वेदाः कृताब्धिभिर्हृतौ च /
सप्ताष्टकेन वक्री षड्भागाः षष्टितः षट् च ॥ १२ ॥

7a उदयरवांश्च a, com. T.-D. 7b °संगुणैरुदस्य: a, com. T.-D. 7d षट्मिति (ति: β) aβ, com. T.-D. 8a-c द्वि° to स्फु om. C 8a द्वि° om. B पक्ष्य° a 8b खण्डे° aβ °स्तयोश्च a विश्लेषात् aβ, com. T.-D. 8c-d दत्त्वान्तध्य (ध्य om. β) स्त्रौरे aβ 9a रसाविषय° aβ, com. T.-D. °शाशांकाः a 9b-10b सह्नृतयः to तृतीयखण्डे om. β 9b विह्नृतयः a, com. T.-D. 9c विषयरसोना a, com. T.-D. 10c-d त्र्य (अ E) भ्राजिते aβ 10d त्र्युदिते a 11b स्फुः a 11c चक्रार्धे β वगुणांशाः a, च गुणांशाः β 11d दश शकला aβ 12a दिनषष्ट्यंशा aβ, com. T.-D. 12d षड्गैः aβ, com. T.-D. षष्टि β षड् च a, षड्ढ (ध्य C) β, com. T.-D.

XVII,7. Add to (these) days $^1/_9$th (of a day for every) rising. Multiply the (number of) risings by 6^2 (= 36) and divide (the product) by 391; (the remainder) is called the pada. Add 18 to the remainder.

XVII,8. Put down the mean and the true segments, in order, in two places. (Decide) from the difference between them. If the true is less, one should add it to the days; otherwise, if the mean segment (is less), subtract it.

XVII,9. Until the pada (equals) 180, (Jupiter) is in the negative segment 1456; until (it increases by) 195, Jupiter is in the positive (segment) 1265 (or 1456–65 = 1391);

XVII,10. for 16 Jupiter is in the third, negative segment 1486. Multiply by 5 and divide by 8 (or 83); it rises to the east in so many minutes (of arc).

XVII,11. In the first segment of Jupiter they are $9^1/_2{}^\circ$ of Virgo (= 159;30°); in the second segment half a circle (= 180°); (and in the third) $20^1/_2{}^\circ$.

XVII,12. In 60 days (Jupiter) traverses 12°, in 40 (days) 4 (degrees), and in 24 (days) 2 (degrees); (it moves) retrograde 6° in 56 (days) and 6 (degrees) in 60 (days);

अनुबन्धो ऽशीत्यार्काः(र्क) दिनार्धांशतेन नव <च> ततो ऽस्तमितः /
स्थित्वा(त्वै)मेकमासं स्फुटोदयो सम्भवन्ति मासस्य //१३//
बृहस्पतिः //
अध्यर्धांशतं सञ्यंशमपनयेत् सूर्यजस्य दिवसेभ्यः /
वसुमुनिगुणोद्धृतेभ्यः स्थिता दिनाद्यासमस्फुटयात् //१४//
जह्याद्दृत्यदृशांशं स्फुटो नवसङ्गुणान् भजेद्दृत्यान् /
षड्विषयमैः शेषं पटं युतं तन्नवाशीत्या //१५//
षड्रूपवेदपक्षा वृद्धिस्त्रिंशत् पदानि सौरस्य /
नवरूपविषययमला ह्रासः स्वरभास्करपदाख्यः //१६//
प्रचयः स्वराग्निसमया नवनवतिस्त्रिघनभागलिप्तानाम् /
क्षयवृद्धिर्द्विगुणहृतश्चैकगुणघ्नः शनेरुदयः //१७//
षोडश वृषभस्यांशा नवलिप्तावर्जिताः प्रथमखण्डे /
विषयास्त्रिघनास्त्रिंशाश्चतुर्युता मध्यमे खण्डे //१८//

13a अ(य BE, प्र F)नुबन्धो aβ, com. T.-D. शीत्यर्का (र्को EF) aβ, com. T.-D.
13b दी(द्दी a)नार्धांमतेन aβ 13c स्थित्वा सैकं मासं aβ 13d स्फुटोदयाश्चा (श्चां C) न (त्त a, ता BE)रं मास (सं a) मी (मी om. a) aβ 14a-b शत्र्यंशमपनयेत् a, णमपानये β, com. T.-D. 14c °गुणोद्धृतेभ्यः aβ, com. T.-D. 14d स्थितं aβ, com. T.-D. दिनाद्यास्तम° aβ 15a जह्याद्धुटय° aβ, com. T.-D. °दृशांशं β 15b न (नं β) वसंगुणाद्भजे ° aβ 15d पदैर्युतं तत्त्वा° a, पदैः युतं म (भ C) त्त (त C F) वा β, com. T.-D. 16a षड्रू (ड्रु C) पवेद° β 16a-b °पक्षाद्भृ (द्भृ F, द्भृ C, बृ D)द्धि° aβ 16c °यमलो β 17b नवननवतस्त्रि° β 17c क्षयवृद्धिर्द्विगुण° aβ, com. T.-D. 17c-d °यदैरेक° a, °पदैरेक° β, com. T.-D. 17d शनैरुदय: a, शनैरुदयः β, com. T.-D. 18a वृष (श C) भांशा β
18b प्रथमखंडा: aβ, com. T.-D. 18c-d °स्त्रिंश चतुर्युता a C F

XVII,13. in direct motion (it goes) 12 (degrees) in 80 (days); 9 (degrees) in 50 days; then it sets; staying (set it travels) 7 (degrees) in one month (i.e., 30 days); its accurate rising is on the last day of the month (i.e., on the 29th).

Jupiter.

XVII,14. One should subtract $150^{1}/_{3}$ from the days of Saturn (and) divide (the remainder) by 378; put down the days and so on; the quotient is its (number of) risings (i.e., synodic periods).

XVII,15. One should subtract $^{1}/_{10}$th (of a day for every) rising from the days. Multiply the (number) of risings by 9 and divide (the product) by 256; the remainder is the pada. Add to it 89(?).

XVII,16. Saturn's (first) 30 padas are positive 2416; 127 padas are negative 2519;

XVII,17. (and) 99 (padas) are positive 2037. There is a subtraction or addition of 12 degrees and minutes (i.e., 12;12°). Multiply by 31 and divide (the product) by 32 (or: by 32 padas); (the result is) Saturn's rising.

XVII,18. In the first segment are 16° of Taurus diminished by 9 minutes (= 45;51°); in the middle segment are 5 (signs) 27 (degrees) and 34 (minutes) (= 177;34°);

परिहीनाः स्त्रीस्मांशा मनुभिर्लिप्तसाश्वेषुगुणाः सप्त /
षोडशभिश्चाशीतिं कृतोनषष्ट्या हृतिगुणपक्षान् //१९//
वक्री विभूतषष्ट्या त्रीनंशान् षष्टितः कृतान् सौरः /
अनुगो ऽर्कशतेनाष्टौ षट्कृत्वा यास्तगो दहनम् //२०//
शनैश्चरः //
द्युगणात् षड्भैकयमान् विहाय पंचाष्टकं च नाडीनाम् /
गगनाष्टमुनिभिरुद्धृत्या लभ्यन्ते त्राक्ग्रहीनस्य //२१//
उदयगुणिता विनाड्यः स्वरतिथयो ऽब्धिसंहिता दिनक्षेपः /
धृतिगुणितान् त्रिगुणीकृभिरुद्धृत्यान् हृत्वा स्थितो ऽतो ऽस्मात् //२२//
पंचाशीतिं कृत्वा सत्रिराशिं मध्यमः क्रमशः /
राशिप्रमाणतो ऽस्य स्फुटितारं क्रमर्क्षात् कुर्यात् //२३//
स्फुटमध्यमविक्षेपांशकान् क्षिपेन्मध्यमे द्युभ्यः /
मध्यमहानौ जह्याद्गतितो ऽप्याचारमभिधास्ये //२४//

19a षट् (ड् C, ड EF) हृ (हृ C) ताक्त्रीणांशान् *aβ* 19b मनुभिर्लिप्तसाश्वत्गुणाः *aβ*
19d कृतोनषष्ट्यात् (ष्या D, corr. to त् D^2) *a*, कृतोनषष्ट्या (ष्या om. C) श *β*, com. T.-D.
20a विभूत° *β* 20b त्रिनं (न *β*) शान् *aβ* कृतात् *a*, कृतत् *β*, com. T.-D.
20c रुनु (तु F, लु BE) गो *β* कार्कशतैर्नाष्टौ (ष्टौं *β*) *aβ* 20d षट्कृ (कृ E) त्या (सा E) *β* यास्तगे *a*, यास्तमे *β*, com. T.-D. 21a द्युगुणे *aβ*, com. T.-D. षड्भैकयमान् *aβ*
21b नाडी (डि BE) त्वं *β* 21d त्राक् महीनस्य *β* 22b ब्धिसंहिता *a*, ब्धिसंहिता *β*, com. T.-D. 22c °गुणितास्त्र्याम्री (त्री *β*) हृभि° (भि om. *β*) *aβ* 22d हृ (हृ om. C) त्वा *aβ*, com. T.-D. स्माः *aβ*, com. T.-D. 23b त्रितिराक्षं *aβ* मध्यतः *β*
23c स *aβ*, com. T.-D. 23d °यारक्रमं *a*, °यारक्र (क्र F) *β* 24a-b °विक्षेपांशका (का om. *a*) न् *aβ*, com. T.-D. 24d यायाराम° *a*, प्याचारा (र E) म° *β*

XVII,19. (and in the last segment) 0° of Virgo diminished by 14 (degrees) (plus) 7 times 5 minutes (= 136;35°). In 16 (days Saturn traverses) 80 (minutes); in 60 minus 4 (= 56) (days) 232 (minutes);

XVII,20. Saturn (moves) retrograde 3° in 60 minus 5 (= 55) (days) and 4 (degrees) in 60 (days); in direct motion (it proceeds) 8 (degrees) in 112 (days); (and, having gone) 3 (degrees) in 6^2 (= 36) (days), it sets.

Saturn.

XVII,21. Subtract 216 (days) and 40 nāḍīs from the ahargaṇa (and divide the remainder) by 780; the risings of Mars in the east are obtained.

XVII,22. Add to the days 157 plus 4 (= 161) vināḍīs for every rising (i.e., synodic period). Multiply the (number of) risings by 18 and divide (the product) by 133; put down (the remainder) from that.

XVII,23. Calculate 85 (degrees) plus three zodiacal signs (= 175°); (this is), in order, the mean (longitude of Mars); one should compute in order its true motion by means of the measures of the signs (?).

XVII,24. If the mean (is greater), one should add the degrees of difference between the true and mean (segments) to the days; if the mean is less, one should subtract them from the gati. I will describe its motion.

प्रागुदये षट्कृष्टैकमष्टाटश वक्रगस्ततो वक्रः /
गत्यर्धं च ततः शीघ्रात्त्रिघ्नषष्टिं ततो ऽस्तमितः //२५//
समतीत्य टशा त्रिहृतान्> निरंशगस्त्रिंशतिं व्यतीत्य कुजः /
उटयमुपयाति वल्ये गतिचारटिनान्> क्रमर्क्षम्> घातः //२६//
चत्वारिंशच्छतटुयमष्टयमान्वितं विपल्लांशम् /
प्रथमगतौ कुर्याद्दिवसान्> मीनाद्राशिटुयसमान् //२७//
विषयस्वरसप्तर्तून्> तुपंचकार्कान्> टशगुणान् टिुर्तीयगतौ /
सहिताः स्वरैकपक्षर्तुचन्द्रशीतांशुघ्नाः क्रमशः //२८//
शशवृश्चिकाजचापे वक्रे षट्सप्तकेन षड्नागान्> /
टिकृतेन टिगतिवक्रे टिनषष्ट्या षोडशानुगतिः //२९//
गोमिथुनतौलिकन्यासु टशार्हतैः समुटैः स्वरानंशान् /
सकृतैर्टशत्रिषष्ट्या सप्तटशा यथाक्रमं वक्री //३०//

25 ab षट्म(टु EF,ड्ड C)स्तैकमष्टाटश a/β 25b मस्तगस्ततो a/β व(च β)क्रं a/β 25c अत्यर्धं a/β 25c-d शीघ्रास्युना° a, शीघ्राघ्ना° β 25d °षष्टिस्ततो a/β 26a समर्तत्य β 26a-b त्रियुता निरंशातो विंशतिं a/β 26d गतिचा(च F)रा° β °टिनाक्रमं a/β 27a चत्वारिंशच्छिनमध्य° a, चत्वारिंशच्छिनम° β 27b °ष्टयमान्विता विपल्ला च a/β 27c प्रथममतौ a 27c-d कुर्याट्टिवसा a/β 27d मीनट्टो (ट्टा B, ट्टो C) शि° β °समाना: a/β 28a-b °सप्तर्तुपंचकाटशगुणान् a/β 28b टिुवगतौ a, टिुयतगौ β 29a ज्ञ(ज्ञ C, ड्ड F)ष° β 29a-b °ज्ञवापेषु वक्रेषु a, ज्ञपा(या C)चे(ज्ञे B, च्चे C)षु वक्रेषु β 29b षट्ट्र(ड्डस A, ड्ड C, ट्ट B)ग(क्त D)केन a/β, com. T.-D. वब-नागं a, नब-नागा β, com. T.-D. 29c विकृतेन a/β, com. T.-D. टिनगतिवक्री a/β 30a-b °क(कं β)न्यानुबा(ब C)सनैः a/β 30b स्त(स C)रानांशान् a/β, com. T.-D. 30c सकृतै टशा β त्रिषष्टी a/β, com. T.-D. 30d वक्राशा a, चक्रात् β

XVII,25. At rising in the east Mars (traverses) 186 (degrees); then (having traversed) 18 (degrees) in retrogression (it has travelled) half of its course since conjunction; then (traversing) 60 times 3 (= 180) (degrees), it sets;

XVII,26. traversing 10 times 3 (= 30) (degrees) Mars is in conjunction (with the Sun); traversing 30 (degrees) it rises. Now I shall tell the days for the motion of (Mars') gatis in order.

XVII,27. In the first gati 240 plus 28 minus $^1/_2$ (= $267^1/_2$) (days). One should calculate days for every two signs from Pisces:

XVII,28. in the second gati 5, 7, 7, 6, 6, and 5, multiplied by 10 and increased by 7, 1, 2, 6, 1, and 1 in order (i.e., 57, 71, 72, 66, 61, and 51 respectively).

XVII,29. In retrogression (♓→♋) in Pisces, Scorpio, Aries, and Sagittarius (Mars goes) 6 degrees in 6 times 7 (= 42) (days), and in extreme retrogression (♋→♑) 10 (degrees) in 42 (days). It goes 16 (degrees) in 60 days.

XVII,30. In Taurus, Gemini, Libra, and Virgo (it goes) 7 degrees in 4 times 10 (= 40) (days), and 10 (degrees) in 40 (days). It is retrograde in order 17 (degrees) in 63 (days).

कर्कटसिंहयोर्वेटसागरैः सप्त भवान् खार्णवैश्च /
टिबसैः षट्षष्ट्याष्टाटश्च च क्रमात् कुजो वक्रसर्वे तु //३१//
घटमृगयोर्यमदहनैः षड् भागान् नवहुताशनैश्च नव /
मुनिविषयैः पंचटशांशकांश्च तद्वृत्त्रये ऽप्यारः //३२//
वक्रे टिनत्रिभागैर्नवांशयुतैस्तुल्यजिह्मौर्नुकैः /
अतिवक्रे विपरीतं वक्रमतिवक्रं सत्र्यंशम् //३३//
एकेन्द्रियवस्वशिवमनुभवन्निवर्गैर्नृपक्षसंयुक्तम् /
शीघ्रगतौ पंच षष्टिभूनं च शशाङ्ककृतवेदैः //३४//
षष्टि(ष्टी-ए)श्च संयुक्ता अनिलाहर्कैस्त्रिवर्गगुणशून्याः /
टिबसाः सप्तमगत्यां चारो यस्तद्धृटष्टम्याम् //३५//
भौमः //
दत्त्वात् सप्तचतुष्कान् द्युगणे त्र्यंशं च वसुगुणो भाज्यः /
मुनियमनवकैरपि रोधिताः स्युः शोध्यो टिनाष्टांशः //३६//

31b भवान्] सप्त aβ 31c टिबसान् aβ षट्षा (वा D) ष्टया° a, षड्षष्ट्या° β
31d क्रमा a, क्रमान (न् E, म C) β वक्रपू (स CE) र्वास्तु (प्सु EF) aβ 32b भागानवन (वृβ)
हुताशनैरे (र EF) व च aβ 32d तद्धृ aβ, com. T.-D. 33b °युततुल्यजिनै र्नुकैः a,
°युततुल्यजिह्मे (ह्मौ C) र्नुके β 33c अतिचक्रे β 33d वक्रमनुवक्रगस्त्र्यंशं a, वक्रु
(क्रु B, क्रु E) मनुगस्त्र्यंशं β 34b °भवन्निर्गैं° (गं C, र्गै E) β °तु (नु BE) पक्ष° aβ
°शंयुक्तं a 34c पंचाष्टकभूनं aβ 34d शशांकतत्त्ववेदैः β 35a षड्त्रिं (ड्त्रिं D, ड्त्रिं E,
ट्त्रि F) शस्तंयुक्ता aβ 35b द्विकलाहर्कैत्रि° a, द्वि (द्वि C) कलाहा (न्हा C) कैत्रि° β
°वर्गगणशून्यैः aβ 35d चावो a यत्रद्धृट° a, यत (त C) द्धृ (द्धृ C) टं° β, com. T.-D.
36a दत्त्वा a सप्तनु (तु C) क्तान् β 36b द्यु (द्य EF) गणो β त्र्य (त्र्यं F) शच्च aβ
वसुगुणा (ण - B, ण E) β भागः aβ 36c-d रोधितस्य मेष्या टिनाष्टांशाः aβ

XVII,31. In Cancer and Leo (it goes) 7 (degrees) in 44 (days), and 11 (degrees) in 40 (days). Mars in all its retrogression in order (goes) 18 (degrees) in 66 days.

XVII,32. In Aquarius and Capricorn (it goes) 6 degrees in 32 (days), and 9 (degrees) in 39 (days). (It goes) 15 degrees in 57 (days). So Mars is in three (sections).

XVII,33. In retrogression (it goes) for $^1/_3$ with $^1/_9$ (= $^4/_9$) of the days, with the even and odd traversed (?); in extreme retrogression the reverse. The retrogression with $^1/_3$ (i.e., $^4/_3$) is the extreme retrogression.

XVII,34. In the fast gati 5 times 60 (= 300) increased by 1, 5, 8, 11, 14, 11, 3^2 (= 9), 6, and 2, and diminished by 1, 4, and 4 (i.e., 301, 305, 308, 311, 314, 311, 309, 306, 302, 299, 296, and 296 days respectively for the 12 zodiacal signs).

XVII,35. In the seventh gati there are 60 increased by 2, 9, 12, 9, 3, and 0 (i.e., 62, 69, 72, 69, 63, and 60) days; there is the same motion in the eighth (gati).

Mars.

XVII,36. One should add 7 times 4 and $^1/_3$ (= 28;20) to the ahargaṇa; multiply (the sum) by 8 and divide (the product) by 927; (the quotient is the number of) the first visibilities (synodic periods) (of Mercury). Subtract an eighth part of a day (for every synodic period);

हृत्वा चतुर्भिरुदयान् नाड्यः शोध्या बुधस्य दिवसेभ्यः /
<अ>द्विदशयमघ्नानुदयान् पाण्डववर्जितैश्छिन्द्यात् //३७//
नववसुरसैर्मध्यमतो बुधो <ऽष्टां>शा<न्> क्रमा<द्>द्दस्रैश्च /
पंचयुतैस्त्रिंशद्भिस्त्रिंशद्भुक्ते स्फुटानंशान् //३८//
नवकृत्या षष्टिं वसुयुतयाशीत्या शतं स तीक्ष्णांशुम् /
शरैस्त्रिभिरभ्यधिकैस्त्रिंशद्भिस्त्रिंशदेवांशान् //३९//
चतुरधिकेन शतेन त्रिभिरूनं शतमतो ऽर्धसंयुतया /
षड्विंशत्या त्र्यधिकां विंशतिमेवं स्फुटः सौम्यः //४०//
अनयोर्विश्लेषांशा<न्> दिवसेभ्यः शोधयेत् स्फुटाभ्यधिके /
अधिके तु मध्यमें ऽशान् दद्याच्चारः स्फुटबुधाच्च //४१//
मेषे दिनषट्कृत्या खभ्रवस्वरससहीनया भागान् /
पंचत्रिंश<द्> द्विकृतिं त्रिसप्तकं षडङ्कगुणितम् //४२//

37a कृत्वा aβ, corr. T.-D. 37b दुधास्य a, बुधास्या β, corr. T.-D. 37c त्रिद (द om. C) शयम° aβ 37d °यान् रामार्णव° a, °यारुदयां (शां B) रामाणव° β °वर्जितां छिंद्यात् aβ 38a-b नववसुयममध्यमधो: साक्रमांनुदशैश्च a, नववसुमध्यमय-मध्य (यममध्य om. C) मधो: मा (शा BE) क्रमाद् (रु F) दशैश्च β 38d °द्भुक्त aβ, corr. T.-D. 39a नव (व om. C) कृत्यात् aβ, corr. T.-D. षष्टिर्वसु° aβ, corr. T.-D. 39b °युतावशीत्या aβ, corr. T.-D. तीक्ष्णांशो: aβ 39c सर्वैस्त्रिभि° aβ, corr. T.-D. °रभ्यधिकै° a 39d °देवार्का (र्क्का C, र्का F) त् (न् E) aβ, corr. T.-D. 40a चतुरधिकेन् a 40b त्रिभिरुनं aβ, corr. T.-D. र्धसंयुतया aβ, corr. T.-D. 40c षड्त्रिंशत्या a अधिकां aBE 41a °र्विश्लेषांशा aβ, corr. T.-D. 41b शोधये a after 41b repeat 40a–d aβ 41c-d मध्यमे स्यादद्याच्चार aβ, corr. T.-D. 42a-b षट्कृ (ड्कृ a, ड्कृ B, ट्कृ E) त्यां (सा B) शं भ्रवस्वर° aβ 42b भागः aβ, corr. T.-D. 42c पंमत्रिंश aβ, corr. T.-D. 42d षड्व (ड्वय D) गैवगणितं a, षड्व (ड्व F) व (य B) गणित β

XVII,37. divide the (number of) risings by 4 and subtract (so many) nāḍīs from the days of Mercury (i.e., 15 vināḍīs for every synodic period). Multiply the risings by 217 and divide (the product)

XVII,38. by 689 diminished by 5 (= 684); (the result concerns) the mean Mercury. (It) travels in order: 8° in 2 plus 5 (= 7) days, 30 accurate degrees in 30,

XVII,39. 60 (degrees) in 9^2 (= 81), 100 (degrees) in 80 plus 8 (= 88), 12 (degrees) in 14, 30° in 30 plus 3 (= 33),

XVII,40. 100 minus 3 (= 97) (degrees) in 100 plus 4 (= 104), and 20 plus 3 (= 23) (degrees) in 26 plus 5 (= 31); thus (travels) true Mercury.

XVII,41. One should subtract from the days the degrees of difference between these two (i.e., mean and true segments) if the true is greater; but if the mean is greater, one should add the degrees. The motion is known from true Mercury.

XVII,42. In Aries, in 6^2 (= 36) days diminished by 0, 11, 7, and 7 (i.e., 36, 25, 29, and 29) (Mercury travels) 35, 22, 3 times 7 (= 21), and 6 times 9 (= 54) degrees.

गवि वेटयमद्विकृतैर्दिग्द्वैर्विषयाग्निगुणनवाग्न्यधिकैः /
विरसं शतार्धमसरैरूनं च सप्ततिं व्येकाम् ॥४३॥
द्विदृशं सपंचवर्गं खरसत्रिघ्नान्वितं च मिथुने च /
भागार्धशतं ह्रूनं मनवस्त्रिघ्नं च पंचसप्त ॥४४॥
कर्किणि दिग्द्वैः कृतशशिगुणवेदैः सद्विकाष्टशून्यरसैः /
सैकान् दलितान् सेन्दून् पंचकवर्गान्वितांश्चांशान् ॥४५॥
सिंहे गुणेन्दुरामार्गवैर्दिग्द्वैस्तद्या सार्णवर्तुयमविषयैः /
तुल्यां सप्तविहीनां सदृशामधिकां विषयकृत्या ॥४६॥
कन्यायामुत्कृत्याष्टदृशत्रि(त्रिं)त्रिंशत्त्रिकृतैर्न्यूनः /
त्रिघ्ननवपंचसप्तकमष्टशतार्धं च रवियुक्तम् ॥४७॥
विंशतिरेकेन युता न्यूने सप्तान्यतिथिर्द्विसङ्गुणाश्च /
अंशास्त्रिवसुविहीना ह्येकत्रिंशत्सुतास्त्वेव ॥४८॥

43a गाव a, साव β, com. T.-D. वेदे a °द्विकृतो a, द्वितलो β, com. T.-D. 43b द्विद्वै° aβ, com. T.-D. °र्विषयग्नि° a °गण° aβ, corr. T.-D. 43c शतार्धमस (त β) लो aβ 43d रूद्राबध (य C) सप्ताभिर्व्येकां (क a) aβ 44b मिथुनं aβ, com. T.-D. 44c ह्रून a 44d च (च om. C) च (व a CF) सुतश्च (तश्च om. β) aβ 45a–47c कर्किणि to त्रिघ्ननवपंच° om. β 45a कर्किनि a, com. T.-D. दिद्वैः a, com. T.-D. 45b°सून्यरसैः a, com. T.-D. 45c सैकां दलितां सेंदू a, com. T.-D. 46b °विषया: a, com. T.-D. 46c तुल्या a, com. T.-D. 47a-b °मुत्कृत्याष्टत्रिंशत्तया तया च न्यूनः a 47c-d °सप्ताष्टकदृश (श C) तार्धं (र्धं a) aβ 47d च om. β 48a °रेकेण aβ, com. T.-D. 48b व्यन न्यांसांतिथिर्द्वि (द्वि aC) सं (स β) गुणैश्च aβ 48d ह्येक° a, य (य्य CF) क β, com. T.-D. °स्त्रिंशत्सु (फ C) तास्त्वेव β

XVII,43. In Taurus, in 10 multiplied by 4, 2, 2, and 4 and increased by 5, 3, 3, and 9 (i.e., 45, 23, 23, and 49) (days it travels) 50 diminished by 6, 33, and 27 (i.e., 44, 17, and 23) (degrees) and 70 diminished by 1 (= 69).

XVII,44. In Gemini, in 20, increased by 5^2 (= 25), 0, 6, and 3^3 (= 27) (i.e., 45, 20, 26, and 47) (days it travels) 50 diminished by 2 (= 48), 14, 3^3 (= 27), and 75 degrees.

XVII,45. In Cancer, in 10 multiplied by 4, 1, 3, and 4 and increased by 2, 8, 0, and 6 (i.e., 42, 18, 30, and 46) (days it travels these numbers of) degrees increased by 1, halved, and increased by 1 and 5^2 (= 25) (i.e., 43, 9, 31, and 71).

XVII,46. In Leo, in 10 multiplied by 3, 1, 3, and 4 and increased by 4, 6, 2, and 5 (i.e., 34, 16, 32, and 45) (days it travels) an equal (number of degrees), diminished by 7, the same, and increased by 25 (i.e., 34, 9, 32, and 70).

XVII,47. In Virgo, in 26, 18, 33, and 43 (days)—no more—(it travels) 3^3 (= 27), 9, 5 times 7 (= 35), and 58 increased by 12 (= 70) (degrees).

XVII,48. In Libra, (in) 20 increased by 1, 0, and 15, and multiplied by 2 (i.e., 21, 20, 35, and 40) (days it travels these numbers of) degrees diminished by 3 and 8 and increased by 1 and 30 (i.e., 18, 12, 36, and 70).

अलिनि दशघ्नाः शशिरंध्रैकृतदहनाः षट्शरार्णबाष्टसुताः /
तें ऽशा यमसुनीशोना षड्विंशत्या समेताश्च ॥४९॥
धन्विनि दिवसानष्टिं षट्कृतिं षट्सप्तकं दशोनं च /
ते स्युः शशिविषयोनाः सैकास्त्रिंशान्विता भागाः ॥५०॥
मकरे द्विदशं खयुतं मुनियुक्तं धृतिदिवाकराभ्यधिकम् /
अंशा रूपेणोनाः सैकैकाद्योत्कृतियुताश्च ॥५१॥
कुम्भे ऽह्नां त्रिकृत्या युतया हृतभूष्टिनेशदिननाथैः /
द्व्यविंशतिरंशाः पंचवर्गं सुराधिपाः षष्टिः ॥५२॥
मीने त्र्यष्टकमह्नां शशिविषययुतं हुताशसंयुक्तम् /
त्र्यष्टककृतविंशत्याः शाताभ्यमेकोनमंशाः स्युः ॥५३॥
अधोदयान्तरांशा बुधस्य कालांशकास्त्रिगतीनाम् /
दिवसाश्चतुर्थगत्या अनुवक्रमजमीनयोर्मेन्दम् ॥५४॥

49a दशघ्नी a 49a-b शशिकृत(त om. β)दहनाः a/β 49b षड्स्वशर्णबाष्ट° a, षट्स्वरार्णबाष्ट° β 49c तेंशा a, तेंशां (शों C) β, com. T.-D. 49d समेता (ताaBF) च (व a) a/β, com. T.-D. 50a दिवसाधा (या β)ष्टौ a/β 50b षोडश (सa) a/β 50c षड् (ट्षु D)सप्तकं a 50c स्युः a °विषयोनैः a/β, com. T.-D. 50d सैका त्रिंशा° a, सैका त्रिंशा° β 51a द्विदशं a/β, com. T.-D. 51b मुनिहीनं a/β 51c आशा (षा C) β रूपेणोनाः a/β, com. T.-D. 51d °सोत्कृ (कृ C)ति° β 52a ह्ना a त्रिंशत्या a/β 52b द्यु (ग C)नभूष्टि (दि C)नेदिननाथैः a/β 52c° वर्गमधाधिका a/β 53a अष्टक° β 53b हुताशसंशरं a, हुताशस (स om. BE) शरं β, com. T.-D. 53c त्र्यष्टककृति° a, अष्टकृ (क्र E)ति° β 53d °मेकोनमष्टां a/β, com. T.-D. 54a अधोदयां° a/β °तरांशान् a 54b कालांशकां° a/β °स्त्रिगन्सुनात् a, °स्त्रिगन्यूनान् β 54c दिवसा यतुर्थ° β 54d °मीनयोंदं a

XVII,49. In Scorpio, (in) 10 multiplied by 1, 2, 4, and 3 and increased by 6, 5, 4, and 8 (i.e., 16, 25, 44, and 38) (days it travels these numbers of) degrees diminished by 2, 7, and 1 and increased by 26 (i.e., 14, 18, 43, and 64).

XVII,50. In Sagittarius, in 16, 26, 6 times 7 (= 42), and (this) diminished by 10 (= 32) days (it travels these numbers of) degrees diminished by 1 and 5 and increased by 1 and 30 (i.e., 15, 21, 43, and 62).

XVII,51. In Capricorn, in 20 increased by 0, 7, 18, and 12 (i.e., 20, 27, 38, and 32) (days it travels these numbers of) degrees diminished by 1 and increased by 1, 1, and 26 (i.e., 19, 28, 39, and 58).

XVII,52. In Aquarius, in 23 increased by 3, 12, and 12 (i.e., 23, 26, 35, and 35) days (it travels) 22, 5^2 (= 25), 33 and 60 degrees.

XVII,53. In Pisces, in 3 times 8 (= 24) increased by 1, 5, and 3 (i.e., 24, 25, 29, and 27) days (it travels) 3 times 8 (= 24), 24, ⟨24⟩, and 50 diminished by 1 (= 49) degrees.

XVII,54. For the (first) three gatis of Mercury the time-degrees are degrees of ascensional differences (?); for the fourth (gati) days (?). In Aries and Pisces the direct motion is slow.

गतिविश्लेषकृतिघ्नैरंशैर्गतवर्गभाजितैर्लब्धम् /
हित्वा राशिभ्यो भुक्तं प्रथमगतौ वक्रपश्चात् ॥५५॥
वक्रगतौ पूर्वार्धे तृतीयगत्याश्च यातकृतिगुणितैः /
भागैर्गतकृतिभक्तैः फलमनुपाताच्चतुर्थगतौ ॥५६॥
त्र्याविधिविक्षेपघ्नाच्चरकालाट्टम्बराष्टवेदांशम् /
नह्यात् क्षिपेच्च याम्योत्तरे ग्रहे स्वं यथा कल्पम् ॥५७॥
एवं कृते ग्रहार्कान्तरांशकैरस्तटशनं तेषाम् /
चन्द्राटीनां द्वादशमनुरवितिथ्यष्टतिथिसंज्ञैः ॥५८॥
त्रिंशद्विनाडीगुणितैरुदयास्(वि)नाडीप्रमाणहृतैः /
लब्धांशकप्रमाणाद्भुदयो ऽस्तं वा स्फुटं वाच्यम् ॥५९॥
त्रासितारेज्यार्क्ष्मोनाः शशिनः प्रत्युत्तरं रविंशाश्च /
त्रात्वैवं विक्षेपाट्टदेशमनागतं कुर्यात् ॥६०॥

55c–d भुक्तं β 55d प्रथमगतौ a वक्रषश्चाच्चा a, वक्रपश्चाच्चा β 56a वर्गैक्रगतौ a, चक्रगतौ β 56b °गत्या च a β यातकृतं a, याच (च om. CF) तच्चत° β 56c भागैर्गीत° a β, com. T.–D. °कृति–हृत्यै β 56d °पाताच्चतुर्थ–भागागनौ a, °पाच्च चतुर्थ–भागग (ग om. C) तौ β, com. T.–D. 57a–b °विक्षेपघ्ना चर° a β, com. T.–D. 57b °काला (ला om. BE) टिम्बराष्ट° β 57c नह्या a 57c–d यान्मोत्तरं a, याम्यों (म्यों C) तरे β, com. T.–D. 57d यथा कल्पं a 58d °रविति (तिथ C) ष्टतिथि-संज्ञैः β 59a त्रिंशत°a, त्रिंशति° β, com. T.–D. 59a–b °गुणितैश्च (com. to ह्च D²) टशनाडी°a, °गुणितैश्च टशनाडी° β, com. T.–D. 59b °प्रमाणहृतैः a β, com. T.–D. 60a °स्मार्क्षोनाः a, °स्मार्क्षो (क्षों C) नाः β 60b स्वरांशोनाः a β 60d °मनागमत (तत C) त्कुर्यात् β

XVII,55. Multiply the degrees by the square of the difference between the gatis and divide (the product) by the square of what has passed; subtract the quotient from the zodiacal signs; the result is what has been traversed after the first station in the first gati.

XVII,56. In the retrograde gati, in the first half, multiply the degrees by the square of what has passed of the third gati and divide (the product) by the square of what has passed; the result is, by proportion, (what has been traversed) in the fourth gati.

XVII,57. Multiply the time of the ascensional difference by the latitude (of the planet) in the form of a Sine; take a 480th part (of the product); one should subtract or add (the result) according to its orbit as the planet is south or north (of the east-point).

XVII,58. Having done thus, the visibility at setting of the Moon and so on is with 12, 14, 12, 15, 8, and 15 degrees between the planet and the Sun (i.e., Moon 12°, Mars 14°, Mercury 12°, Jupiter 15°, Venus 8°, and Saturn 15°).

XVII,59. Multiply (these degrees) by 300 vināḍīs and divide (the product) by the measure of rising in vināḍīs; from the measure of the obtained degrees the accurate rising or setting (of the planet) is to be declared.

XVII,60. The degrees of the Sun are to be diminished by (the longitude of) Mercury, Venus, Mars, Jupiter, and Saturn; the opposite in the case of the Moon. Thus knowing (the elongation necessary for first visibility) from the latitude, one should compute the future prediction.

आवन्त्यकः समासाच्छिष्यहितार्थं विषद्भस्फुटांशम् /
चक्रे वराहमिहिरस्तारागृहकारिकातन्त्रम् ॥६१॥
प्रद्युम्नभूमितनये जीवे सौरे ऽथवा विजयनन्दिकृते /
बुधो ऽग्नः स्फुटमिदं करणं भजति दृष्टं वराहमिहिरेण ॥६२॥
प्रस्तावे ऽपि न दोषाज्ज्ञानन्नपि वक्ति यः परोक्षस्य /
प्रथयति गुणांश्च तस्मै सुजनाय नमः परहिताय ॥६३॥
अष्टाद्दशभिर्वान्यत्तारागृहतन्त्रमेतदार्याभिः /
वरमिति वराहमिहिरो दद्यात्ति निर्मत्सरः करणम् ॥६४॥
आकरणाद्गतभागा दिवसाद्यारांशका रवौ कार्याः /
अधिका यदा दिनेभ्यो भागा त्रेयास्तदा यक्रात् ॥६५॥
नवयमगुणर्तुहीने कृताहते विषयसप्तखाग्निहृते /
भूयो हृते चतुर्भिर्निरंशदिवसा महीजस्य ॥६६॥

61a आयंतकः β 61a–b समासच्छिष्य° a, समसाः छिसंष्यं β, com. T.–D. 61b तमद्भस्फुटांशं aβ 61c वराहमिहर° aβ, com. T.–D. 62a प्रद्युम्न° a °भुमि° β 62b जी (जि C) वै (वे C) aβ, com. T.–D. शौर a वीजयनंदि° a क्रुतो β 62c बुधेव a, छुधे (ध C) च β नग्ना a, ग्ना – β 62d भजतां aβ वरा (र C) हमिहरेण aβ, com. T.–D. after this verse add सुखप्रबोधं (धां β) aβ 63a दोषा aβ, com. T.–D. 63b जानन्नापि न a, ज्ञानाना (न C) पि न β, com. T.–D. पटोक्षस्य a 63c प्रथयाति β गुणाश्च a, गुणा° β, com. T.–D. °स्तस्मै β 63d सु (स्तु F, स्त C) जनया aβ, com. T.–D. नम a, तमः β, com. T.–D. पर (रि C) हिताया β 64a–b °दशभिर्बैद्यान्यातारा° a, °दशभिर्बै (ब CF) द्यान्यातारा° β 64c वराहमिह (हर E) aβ, com. T.–D. वराहमिहरो β 64d निमत्स (त्स C) रः β 65b दिवसा (सा D, com. to सा D²) द्यारांशका a, दिवसाद्यांश (स C) का β, com. T.–D. 65c अधिकार्यदा दिनेभ्यो aβ, com. T.–D. 65d यक्रात् β 66a °यमगृणार्तु° a, °यमगुणार्तु° β, com. T.–D. 66b कृ (क्रु β) ताहते aβ, com. T.–D. °स्मिन्हृते β 66c हृतो aβ, com. T.–D. 66d °र्विरंस° a, °भि (श्र BE) रंस° β, com. T.–D.

XVII,61. In order to benefit his pupils, Varāhamihira of Avantī has made concisely this tantra of kārikās concerning the star-planets which (gives) the degree of true longitude of the planets.

XVII,62. The wise man who is disturbed at Pradyumna's Mars or at Jupiter or Saturn as computed by Vijayanandin resorts to this accurate karaṇa which has been "seen" by Varāhamihira.

XVII,63. He who, though knowing the faults of one who is absent, does not tell them even when the occasion (presents itself), but recites his good qualities—to that noble benefactor of others, reverence!

XVII,64. Varāhamihira, being free from jealousy, gives this other tantra for the star-planets in 18 āryā (-verses) (thinking): "This is the best karaṇa."

XVII,65. (Take) the degrees of (the longitude of) the Sun at the (last) calculation; convert the days (since then) into degrees of motion for the Sun. When (the degrees) are added to the days, then the degrees (of the Sun's longitude) within the circle (of the zodiac) are to be known.

XVII,66. Diminish (the ahargaṇa) by 6329; multiply (the remainder) by 4, divide (the product) by 3075, and divide (the remainder) again by 4; (the result) is the days of conjunction (with the Sun) of Mars.

षट्त्रिंशैस्तिथ्यंशा दृष्टो वसुधृतिरंशकाः षष्टिः /
अष्टशतेन च षष्टिः समत्या ह्यधिकया नवतिः //६७//
षष्ट्याष्टयुक्तया शतदलं च साब्धिहृदिकैः स्वरा टिघ्नाः /
अस्तमितो ऽतः सप्ताष्टकेन तिथयो निरंशगतिः //६८//
कुजः //
विशशिनसुरसेन्दौ नवयमगुणिते ऽकैरागेगुणाप्ते /
गुणकारहृते लब्धान्यहानि शीतांशुपुत्रस्य //६९//
दशभिर्हृदशहीनः प्रागुदितो मनुभिर्विषयाश्चांशाः /
धृतिभिर्मनवो ऽस्तमितस्त्रिंशद्भिरूनेति स रसांशाः //७०//
अष्टादशभिः शिवः षोडशभिश्चाष्टवर्जितो ऽस्तमितः /
पश्चाद्वसुभिर्नवनवर्जितो निरंशं बुधो ऽपि याति //७१//
बुधः //

67a षड्त्रिंत्सवैस्तिथ्युनो a, षड्भिर्वैस्तिथ्यतो β 67b दृष्टो β °धृतिरंशका ष (च्छ A, छ D)ष्टिः aβ, com. T.-D. 67c व a 67d समध्यधिकया β 68a षष्ट्यो (ष्टो β) ष्ट° aβ, com. T.-D. 68a-b संतदलं a, समदलं β, com. T.-D. 68b साब्धिहृदिकैः β टिघ्नाः aβ, com. T.-D. 68c-d साष्टकेन β 68d निरंगशनिः (निः β) aβ, com. T.-D. 69a विंशशि° a °रसेंद्रे (द्रा EF) aβ 69a-b नवनवगुणिते aβ, com. T.-D. 69b कैरागुणाप्ते (कैः CF) aβ, com. T.-D. 69c °हृते a, °हृते β 69c-d लब्धा (ब्धा C) न्य- (न्यशि.. C) तांशुपुत्रस्य β 70a दशभिर्हृ° a °दशहीनाः aβ, com. T.-D. 70b मनिभीरूनश्चांशाः a, मैनाभीरूनत (भ B) श्चांशाः β 70c °शनवो a, °नवो (वौ) β स्तमितः त्रिं (त्रिं F) शद्° aβ, com. T.-D. 70d स रसाश्चः a, स (स om. C) रसाश्चाः β 71a अष्टादशभिः a, अष्टादशभिः β 71b षोडशभिश्चाष्ट° a 71c पश्चात् वसु° aβ, com. T.-D. 71d निरंश (सa) aβ, com. T.-D. पि (पि om. D, "here a प" in marg. D²) याति a, याति β

XVII,67. In 36 (days) (it comes to the Sun) diminished by 15 (degrees) and becomes visible; in 188 (days) (it travels) 60°; in 108 (days) 60 (degrees); in 70 plus 2 (= 72) (days) 90 (degrees);

XVII,68. in 60 plus 8 (= 68) (days) 50 (degrees); in 240 (days) 7 times 10 (= 70) (degrees); then it sets; in 7 times 8 (= 56) (days) 15 (degrees); then it comes into conjunction (with the Sun).

Mars.

XVII,69. Diminish (the ahargaṇa) by 1681; multiply (the remainder) by 29 and divide (the product) by 3312; divide (the quotient) by the multiplier (29); the result is the days of Mercury.

XVII,70. In 10 (days) it is diminished by 12 (degrees) and rises in the east; in 14 (days) (it is diminished by) 5°; in 18 (days) 14 (degrees); then it sets; in 30 (days) 6° and it rises;

XVII,71. in 18 (days) 14 (degrees); in 16 (days) it is diminished by 8 (degrees) and sets in the west; in 8 (days) Mercury is diminished by 9 (degrees) and comes into conjunction.

Mercury.

रहिते यमशराष्टिभिर्नगाहते द्विनिषयस्वराग्निहृते /
सप्तहृते देवगुरोर्भवन्ति दिवसा निरंशगास्य //७२//
सर्वे ऽर्कात् संशोध्याः षोडशभिर्हृताद्शोदितः प्राच्यां(म्)//
कृतनिषयैः कृतवेदाः सप्तत्या सार्णवा षष्टिः //७३//
नवाष्टभिः शून्यार्काष्टाशीत्या रसस्वरा द्युभिः /
शून्यकृतैर्द्वात्रिंशत्ततो ऽस्तगः षोडशभिरर्कान् //७४//
नीवः //
नयनार्कमहीन्दूने द्विगुणे रूपेन्द्रियेश्वरैर्भक्ते /
शेषं यत्तद्दलितं भृगुतनयनिरंशदिवसाः स्युः //७५//
विषयैर्नवकविहीनः प्रागुदितस्तिथिरेकयमहीनः /
वसुकृत्या तिथ्यूनः कृतघ्नैस्त्रिभिः स <संघास्तगः> //७६//

72a रहिते हृद्वि (हि C, द्वितो F) यम° a/β 72b °नागह (हि E) ते a/β, com. T.-D. द्विनिषयस्वराग्निहृते a, द्विनिषय (यं F) स्व (म्स्व E, मृस्व B, स्व C) राग्निहृते β, com. T.-D. 72c-d देवगुरौ भवन्ति a/β, com. T.-D. 72d तिरांसं गम्याः a, निरंश (शं F) गम्याः β 73a कात् (न् F) a/β, com. T.-D. 73b प्राक्र a, प्राक् β, com. T.-D. 73c कृतनिषयैः om. β कृतवेदाः β 74a नवाष्टभिः β 74c शून्यकृतिर्द्वात्रिंश a, शून (शुC) न्यक्रु (क्र E) तिर्द्वात्रिंश β, com. T.-D. 74d तोत्तु (त्त β) मस्तगा (गात् β) a/β, com. T.-D. °रकां(र्कां C, र्घ्यां F) त् (न् E) a/β, com. T.-D. 75a नयनार्कै (र्क E, र्द्यु F) मितिदूने a/β, com. T.-D. 75b रूपेंद्रियैः स्वरैर्भ (भ C F) क्ते a/β, com. T.-D. 75c यत्त (कृ β) दलितं a/β, com. T.-D. 76b °स्तिथिरेकय (पa) म° a/β, com. T.-D. 76c वसुकृत्या a तिथ्युन a 76d कृ (क्रु EF, क्र B) त्ताष्ट (ष्टा β) भिः स a/β

XVII,72. Diminish (the ahargaṇa) by 1652; multiply (the remainder) by 7 and divide (the product) by 2752; divide (the quotient) by 7; they are the days of Jupiter coming into conjunction (with the Sun).

XVII,73. All are to be subtracted from the Sun. In 16 (days) (it travels) 12 (degrees) and rises in the east; in 54 (days) 44 (degrees); in 70 (days) 60 plus 4 (= 64) (degrees);

XVII,74. in 109 (days) 120 (degrees); in 88 days 76 (degrees); in 40 (days) 32 (degrees); then it sets; and in 16 (days) 12 (degrees).

Jupiter.

XVII,75. Diminish the ahargaṇa by 11 122; divide (the remainder) by 1151; take half of the remainder; these are the days of Venus' conjunctions (with the Sun).

XVII,76. In 5 (days) it is diminished by 9 (degrees) and rises in the east; in 15 (days) diminished by 21 (degrees); in 208 (days) diminished by 15 (degrees); in 3 times 4 (= 12) (days) 5 (degrees) and it sets;

षष्टाष्टकेन स दृशा निरंशगो ऽस्तो विलोमगः पश्चात् /
उदयति निरंशकालान्न याति वास्तं दि⟨न⟩नाद्यगतिः //७७//

शुक्रः //

विधृतिशररसशशाङ्कै त्रिघ्ने धृतिरुद्रभाजिते ऽग्निहृते /
सौरस्य धृतिभिरष्टैः सार्धार्काद्धानिरुदितः प्राक् //७८//
अष्टनवतिभिर्नवतिर्दत्तं च मनुभिस्त्रयोदशविहीनः /
गुणरुद्रैः शून्यार्का द्यूनेन शतेन शशिनवकम् //७९//
अतिजगतिभिरर्का⟨न् सार्धा⟩नस्तमेति नव⟨दशा⟩भिर्निरंशम् /
षोडश सार्धान् सौरश्चरति रवेः सर्वदा हीनः //८०//

शनैश्चरः //

पौलिशसिद्धान्ते ताराग्रहाः //

इत्याचार्यवराहमिहिरकृता पंचसिद्धान्तिका समाप्ता //

77 b निरंसतो तो a, निरंश (स CF) ताती β, corr. T.–D. 77c–d उदयति ति[?] om. CF) थिनिरंशकालोन (ञ β) य (व β) ति aβ 77d विनाद्यगतिः aβ 78a °रसषड्कवर्के (र्कें β) शशांके aβ 78b °भाजिता (त CF) β ग्नि (घ्नि C) हृ (हृ A) ते aβ 78c सौरस्प a धृतिभि (भि om. E) रष्टा (ष्ट C) भि aβ, corr. T.–D. 78d सार्धार्केहानि° a, सार्धार्कें हानि° β 79a अष्टनवतिर्भ्या (र्भ्ये C) नवति° aβ, corr. T.–D. 79b च om. β 79d ह्युनेन a, द्यु (द्यू F) नेन β, corr. T.–D. here ends D शाशिनवकं A 80a–b अतिजग – – र्कारस्तमेत्यंतो A, अतिजगति (ती F) भिर (र om. B) र्का (र्का F) रस्ते मे (मे om. C) त्य (सं CF) न्तो (न्नो E, तो CF) β 80b न (य C) वतिभिर्वि (वि F) रंशं (शंशं C) aβ 80c सार्धात् A, सार्धा β, corr. T.–D. 80d रचे: A col. एवमित्याचार्य° β °वराहमिहर° Aβ, corr. T.–D.

XVII,77. in 6 times 8 (= 48) (days) 10 (degrees) and it comes in conjunction (with the Sun); then it goes in the reverse order in the west. After the time of conjunction it rises, it stands still, it sets, and it comes (in conjunction with) the Sun.

Venus.

XVII,78. Diminish (the ahargaṇa) by 16 518; multiply (the remainder) by 3 and divide (the product) by 1118; divide (the quotient) by 3; (the result is the days) of Saturn. In 18 (days) it is diminished from the Sun $16^1/_2$ (degrees) and rises to the east;

XVII,79. in 98 (days) $90^1/_2$ (degrees); in 14 (days) it is diminished by 13 (degrees); in 113 (days) 120 (degrees); in 100 minus 2 (= 98) (days) 91 (degrees);

XVII,80. in 13 (days) $12^1/_2$ (degrees) and it sets; in 19 (days) Saturn travels $16^1/_2$ (degrees) to conjunction (with the Sun). It is everywhere subtracted from the Sun.

Saturn.

The Star-planets in the Pauliśasiddhānta.

Thus the Pañcasiddhāntikā composed by ācārya Varāhamihira is completed.

4. The Bhūtasaṅkhyā System in the Pañcasiddhāntikā

0. ambara, ākāśa, kha, gagana, bindu, viyat, vyoman, śūnya
1. indu, īśa, ku, candra, jagati, bhū, mahī, rūpa, śaśāṅka, śaśi, śītakara, śītaraśmi, śītāṃśu, himāṃśu
2. akṣi, aśvi, kara, dasra, nayana, pakṣa, yama, yamala
3. agni, anala, guṇa, dahana, rāma, vahni, śikhin, hutabhuj, hutāśa, hutāśana, hotṛ
4. abdhi, arṇava, kṛta, ghana (= ghanada), caraṇa, jala, jaladhi, yuga, lavaṇoda, veda, samudra, sāgara
5. akṣa, artha, indriya, iṣu, pāṇḍava, bāṇa, bhūta, viṣaya, śara
6. ṛtu, rasa
7. adri, aśva, naga, muni, svara
8. tanu, vasu
9. aṅka, anilāhva, randhra
10. āśā, diś
11. īśvara, bhava, rudra, śiva, svargeśa
12. arka, ina, tīkṣṇāṃśu, dinanātha, dinapa, divākara, bhāskara, maṇḍala, ravi
13. atijagati, viśva
14. manu, śarva
15. tithi
16. aṣṭi
18. dhṛti
20. kṛti, nakha
21. mūrchanā
24. jina
26. utkṛti
33. amara, surādhipa
40. naraka
10 000. ayuta

5. Metrological Units in the Pañcasiddhāntikā

Time:

yuga—period in which integer numbers of revolutions of (a) the Sun and Moon or of (b) all the planets occur.

saura measure:

saura year—period in which the Sun travels 360° (normally measured with respect to the fixed stars, i.e., a sidereal year; but cf. the Romakasiddhānta).

saura month—period in which the mean Sun travels 30°.

saura day—period in which the mean Sun travels 1°.

lunar measure:

lunar year—twelve mean synodic months.

lunar month—(a) the mean or (b) the true period between two successive conjunctions (or oppositions) of the Sun and Moon.

lunar day = tithi—a thirtieth of a lunar month. Three varieties of tithi are known: (a) the mean period in which

the elongation of the Sun and Moon increases by 12°; (b) the true period in which the elongation of the Sun and Moon increases by 12°; and (c) the sāvana day which begins during a given tithi.

karaṇa—half a tithi.

omitted tithi = avama or ūnarātra—a tithi which does not contain the beginning of a sāvana day.

sāvana measure:

sāvana year—saura year.

sāvana month—true lunar month.

intercalary month = adhimāsa—the accumulation of 30 tithis from the difference between a saura and a lunar year.

sāvana day—ordinarily the period between two successive sunrises (audayaka), but the period between two successive midnights (ārdharātrika) in the Sūryasiddhānta.

muhūrta—a thirtieth of a sāvana day.

24-hour day—the mean period between two successive midnights or two successive noons.

kṣaṇa—an eighth of a 24-hour day; 3 hours.

nāḍī (nāḍikā) = ghaṭī (ghaṭikā)—a sixtieth of a 24-hour day.

vināḍī (vināḍikā)—a sixtieth of a nāḍī.

Relations in a yuga:

saura years = saura months: 12 = saura days: 360.

lunar years = lunar months: 12 = tithis: 360.

lunar months = saura months + intercalary months.

tithis = sāvana days + omitted tithis.

ahargaṇa—lapsed sāvana days from a given epoch.

Circle:

cakra = bhagaṇa—360°.

cakrārdha = cakradala—180°.

rāśi (rāśika) = bha—30° arcs laid off consecutively from Aries 0°.

nakṣatra = bha—13;20° arcs laid off consecutively from Aries 0°.

aṃśa = bhāga—1°.

kalā = liptā (liptikā) (from λεπτόν)—0;1°.

vikalā = viliptā (viliptikā)—0;0,1°.

tatpara—0;0,0,1°.

Space:

aṅgula—digit.

hasta—hand; 24 aṅgulas.

krośa—4000 hastas.

yojana—4 krośas.

	Nakṣatras	Beginnings		Nakṣatras	Beginnings
1	Aśvinī	0°	15	Svāti	186;40°
2	Bharaṇī	13;20	16	Viśākhā	200
3	Kṛttikā	26;40	17	Anurādhā	213;20
4	Rohiṇī	40	18	Jyeṣṭhā	226;40
5	Mṛgaśiras	53;20	19	Mūla	240
6	Ārdrā	66;40	20	Pūrvāṣāḍhā	253;20
7	Punarvasu	80	21	Uttarāṣāḍhā	266;40
8	Puṣya	93;20	22	Śravaṇa	280
9	Āśleṣā	106;40	23	Dhaniṣṭhā	293;20
10	Maghā	120	24	Śatabhiṣaj	306;40
11	Pūrvaphālgunī	133;20	25	Pūrvabhādrapadā	320
12	Uttaraphālgunī	146;40	26	Uttarabhādrapadā	333;20
13	Hasta	160	27	Revatī	346;40
14	Citrā	173;20			

	Months	Seasons		Months	Seasons
1	Caitra	Vasanta	7	Āśvina	Śarad
2	Vaiśākha		8	Kārttika	
3	Jyaiṣṭha	Grīṣma	9	Mārgaśira	Hemanta
4	Āṣāḍha		10	Pauṣya	
5	Śrāvaṇa	Vārṣa	11	Māgha	Śiśira
6	Bhādrapada		12	Phālguna	

6. Index of Proper Names and Titles

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