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Eclipse Computation Tables in Sanskrit Astronomy: A Critical Edition of the Tables of the Karaṇakesarī of Bhāskara (fl. c. 1681)

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Résumé de l'article

We present here a critical edition of the numerical tables of the Karaṇakesarī, an eclipse-computation table-text authored by Bhāskara in the latter half of the 17th century, and known to us from three manuscripts.

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Eclipse Computation Tables in Sanskrit Astronomy: A Critical Edition of the Tables of the *Karaṇakesarī* of Bhāskara (*fl. c.* 1681)

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1 INTRODUCTION

The *Karaṇakesarī* (epoch 1681 CE) comprises a set of astronomical tables (*sāraṇī* or *koṣṭhaka* in Sanskrit) and accompanying versified text on the subject of eclipse computations, written by Bhāskara, son of Rāma, who flourished in the late seventeenth century.[1] In the corpus of Sanskrit astral-mathematical (*jyotiṣa*) literature, astronomical works exclusively devoted to eclipse-reckoning are rare. Known examples include the *Dhīkoṭida* of Śrīpati from 1039 CE which offers a concise description of lunar and solar eclipse computations within its twenty verses (Majumdar 1934). In the South Indian tradition of astronomy we find some texts dedicated to the theory of eclipses, e.g., the *Grahaṇamaṇḍana* (epoch 1411 CE), *Grahaṇanyāyadīpikā*, and *Grahaṇāṣṭaka* of Parameśvara, and the *Uparāgakriyākrama* and *Uparāgaviṃśati* (both 1593 CE) of Jyeṣṭadeva.[2] But more usually, lunar and solar eclipses are treated in separate chapters of more general *siddhānta*, *tantra*

1 The versified text of this work has been critically edited and analysed in (Montelle and Plofker 2014) and various features of the tabular data were analysed in (Montelle 2014). It should be noted that the author of the *Karaṇakesarī* is different from his better-known namesakes Bhāskara I (*c.* seventh century CE) and Bhāskara II (twelfth century CE). See Pingree 1968: 70–72, 1970–1994: 4.328.

2 The *Dhīkoṭida* of Śrīpati was subsequently commented on by authors like Dinakara in 1608 CE and Harikṛṣṇa in 1715 CE (Pingree 1981: 54). For the south Indian authors, see Pingree 1981: 49–51. Also, see Montelle and Plofker (forthcoming) for additional information about table-texts and the role of eclipse tables within them.

and *karaṇa* texts.[3] Likewise, table-texts or *koṣṭhaka*s often include eclipse tables as a part of a larger collection of astronomical tables: e.g., the *Makarandasāraṇī* of *Makaranda* (epoch 1478 CE), the *Khecaraśīghrasiddhi* (also called *Grahasāraṇī*) of Gaṅgādhara (epoch 1630 CE), or the *Gaṇitarāja* of Kevalarāma Pañcānana (epoch 1728 CE). In some cases, tabular data is verbally encoded in verses in specialised works on eclipse computations: for instance, the numerical data in *Parvadvaya-sādhana* of Mallāri (*c.* 1588 CE) is presented in a mixture of numerical tables and verbal formats.[4]

The text of the *Karaṇakesarī* is organised into two chapters: the lunar eclipse chapter (*candraparvan*) containing thirteen verses and the solar eclipse chapter (*sūryaparvan*) containing the seven verses. There are three known manuscripts, containing a total of 28 tables associated with this text. We present a critical edition of the numerical data contained in these tables, with variant readings and paratextual material[5] associated with the tables noted separately in the critical apparatus. We discuss some of the main problems we encountered in subjecting tabular data to the scholarly practices associated with critical editing and the ways in which we resolved them. A technical summary of the contents of the tables is also provided in Section 4.

2 OVERVIEW OF THE MANUSCRIPTS

In preparing this edition we relied on the following three manuscripts:

Siglum	*Shelfmark*	*Folios*
P_1	Poleman 4946 (Smith Indic MB XIV)	ff. 3–11
P_2	Poleman 4946 (Smith Indic MB XXVII)	ff. 2–3
R_2	Rajasthan Oriental Research Institute (RORI) Jodhpur 12792	ff. 1–8

3 Among the technical genres of Sanskrit astronomy, the *siddhānta* and the *tantra* are typically comprehensive expository works reckoning planetary motions from some distant notional epoch, while *karaṇa*s are abbreviated practical handbooks with epoch dates close to their date of composition (Pingree 1981: 13–14, 48).

4 MS Oxford CS, d.751(10) (catalogued at Pingree 1984: 30). See Pingree 1981: 41–48, 54–55 for information on the Sanskrit astronomical tables.

5 The paratext is the textual content ancillary to the main table-text, sometimes due to later scribes. In our edition, we consider paratext to include any material surrounding the main table, the table headings or the row headers. The basic identification information contained in the table headings and the row headers are indicated separately in the critical apparatus.

The photocopies and digital images of the P manuscripts and R_2 were obtained respectively from the John Hay Library at Brown University (USA) and from the Rajasthan Oriental Research Institute in Jodhpur (India). All three manuscripts are written in Nāgarī script on hand-made paper, with table heading and row header text in Sanskrit and some paratext in an unidentified vernacular, which we have not been able to transliterate or translate with confidence in a consistent manner. Since we have seen only reproductions of the manuscripts, with no details about scale or resolution in the reproduction processes, we cannot vouch for specific data about their physical condition or size: in the individual manuscript descriptions below we have merely quoted this information from published manuscript catalogues. The palæography of Sanskrit scientific manuscripts of this era, especially in northern Indian scripts, is not yet secure enough for us to infer additional conclusions about the date or location of copying, or even the number of scribes contributing to each manuscript, by looking at the characteristics of the scribal hand.[6]

Moreover, the relation between manuscripts of the *Karaṇakesarī* tables and manuscripts of the accompanying versified instructional text edited by Montelle and Plofker (2014) remains unclear. At present we know of no manuscript that has been confirmed to contain both tables and text of the *Karaṇakesarī* (Montelle and Plofker 2014: 2; Pingree 1970–1994: 4.328, 1968: 70).[7] Since these copies, like most Sanskrit manuscripts, consist of loose leaves, we cannot be sure from their present arrangement as preserved in manuscript libraries exactly what their original content and structure would have been during their working lives of use by practising astronomers. In at least one case, as noted below, the existing foliation suggests an incomplete manuscript.

Brief descriptions of the manuscripts P_1, P_2, and R_2 are given below. Note that P_1 and P_2 form part of the so-called 'Miscellaneous Bundle' in Columbia University's Smith Indic manuscript collection, which its original cataloguer described as "a collection of several hundred miscellaneous folios, mostly tables not important enough and not bearing sufficient information to identify at all" (Poleman 1938: 246). These various assorted items consequently may not fully

6 See, for example, Dani 1963; the earlier work by Bühler (1896) treats only sources prior to the mid-second millennium. Recent efforts to extend and update research on manuscriptology and palæography of Sanskrit manuscripts face an immense task (e.g., Tripathi 2010). As noted by Salomon (2007: 75), "the palaeographical development of the modern scripts on the basis of manuscript sources is still virtually an untouched field."

7 A similar bifurcation between copies of verses and tables is apparent in many manuscripts of another *koṣṭhaka* work we have studied, the *Brahmatulyasāraṇī* (Montelle and Plofker 2015; Misra, Montelle, and Plofker forthcoming; Pingree 1968: 36). It should be noted, however, that at least two manuscripts of this work are known to contain both tables and versified instructions together (Pingree 2003: 46–49).

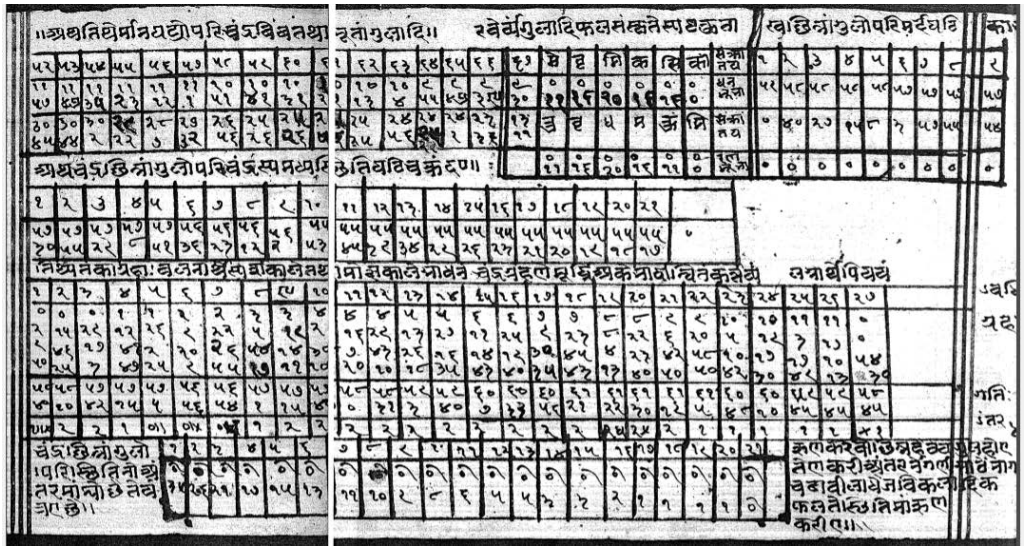


Figure 1: A sample image of MS P_1 f. 4v (reconstructed from two split images on our photocopy of the manuscript) showing the general palæographic layout of the manuscript.

preserve their original form. They were identified and assigned individual shelfmarks by Pingree (1968: 9, 27–34), and later catalogued by him in more detail (Pingree 2007).

MS P_1: POLEMAN 4946 (SMITH INDIC MB XIV), FF. 3–11.

Begins on f. 3r (recto) with Table I (indicating that there were formerly two initial folia which we speculate may have contained the versified *Karaṇakesarī* instructions). 12×27.5 cm (Pingree 2007: 55–56). The black-and-white photocopies available to us contain images of some individual folia split across two sheets. Neatly written with occasional ink blots and smudges, between triple-lined margins. Table grids sometimes include blank cells or extra space, and table content or paratext sometimes spills into the margins; see, e.g., Figure 1.

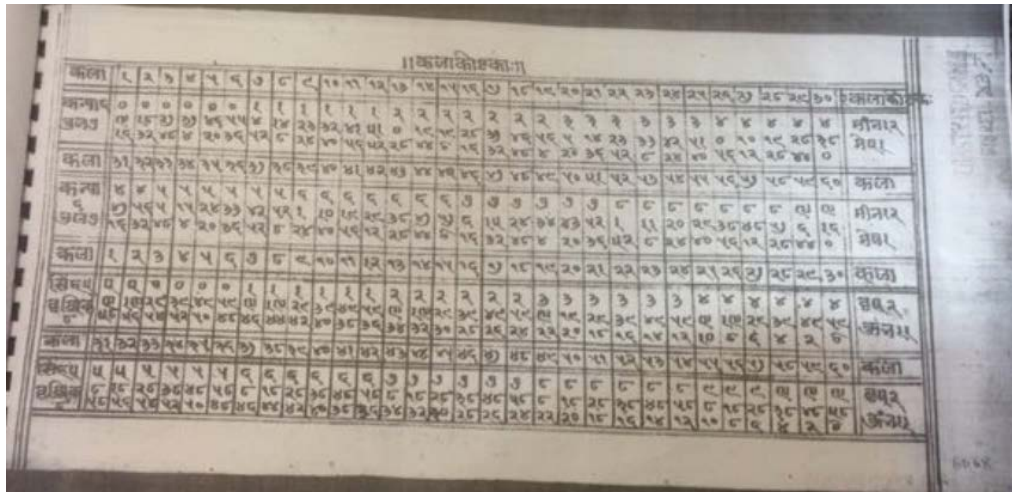


Figure 2: A sample image of MS P_2 f. 2r showing the general palæographic layout of the manuscript.

MS P_2: POLEMAN 4946 (SMITH INDIC MB XXVII), FF. 2–3

Begins on f. 2r with Table XXII (see Schema 1). Folio 3v (verso) is erroneously foliated as '2' in the bottom-right margin (catalogued as '2b' in Pingree 2007: 56); we have corrected it to '3' in our edition. 11.5×26 cm. Black-and-white photocopies. Features similar to MS P_1 (see Figure 2).

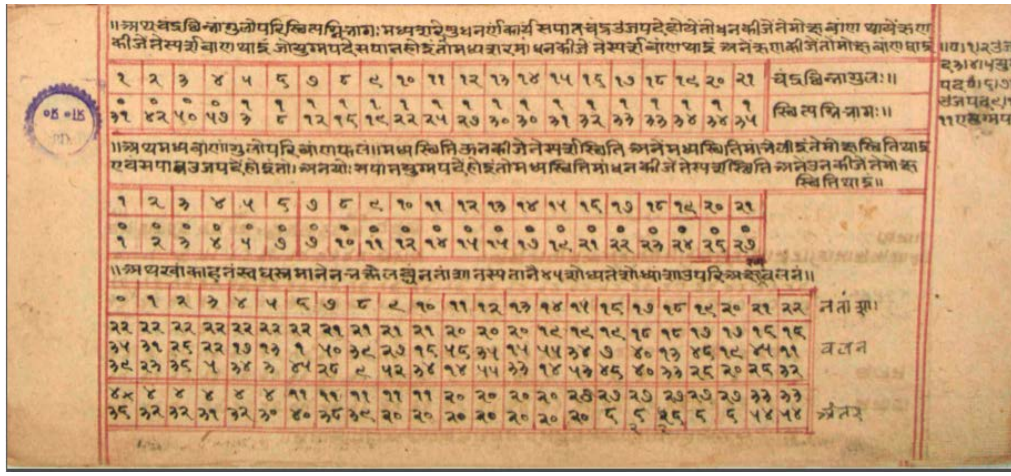


Figure 3: A sample image of MS R_2 f. 3r showing the general palæographic layout of the manuscript.

MS R_2: RAJASTHAN ORIENTAL RESEARCH INSTITUTE (RORI) JODHPUR 12792, FF. 1–8

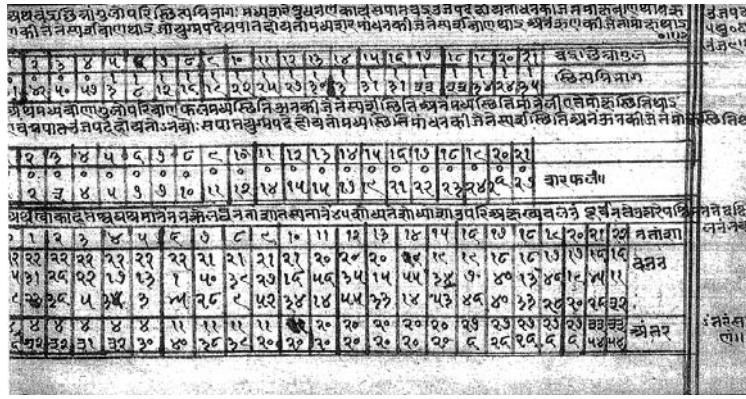
Begins on f. 1r with Table I. 26.2×11.8 cm. Described in catalogue as having 22 lines per page and 31 characters per line (which to us seems inconsistent with its numerical table format), complete, in good condition, dating from the 19th century (Jinavijaya 1968: 422–423). Colour digital images. Neatly written with occasional erasures and corrections, as well as marginal corrections and insertions. Double margin lines and table grids in red ink; features similar to MSS P_1 and P_2 (see Figure 3 and Figure 4).

3 OVERVIEW OF THE TABLES

The *Karaṇakesarī* table-set, as far as we have been able to determine it, consists of the twenty-eight individual tables listed in Schema 1 (p. 10 below). Our identification of their contents and ordering is based not only on the manuscript witnesses P_1, P_2 and R_2, but also on the survey of known *Karaṇakesarī* manuscripts by Pingree (1968: 70–72). Note that the manuscripts do not unanimously agree with all aspects of this identification: see the following list of our main observations about the attested tables, as well as the remarks in Section 6.

1. MS P_2 contains only two tables: Table XXI ff. 3r–3v and Table XXII ff. 2r–2v. While Table XXI is found in all three manuscripts, Table XXII (*ghaṭikā*s of right ascension, see Section 4) is unique to MS P_2.
2. There is surprising uniformity in the layout of the tables in MSS P_1 and R_2. For example, MS P_1 f. 5r and MS R_2 f. 3r (see Figure 4) show the row headers, paratext, and marginal texts along with the tabulated numerical entries similarly positioned. Based on this commonality, one could infer that one of the manuscripts is a direct and faithful descendant of the other, or perhaps they are both copied from the same manuscript.
3. MS R_2 has Table XXVI out of sequence compared to the ordering in MS P_1: it appears in the left margin of f. 7v oriented vertically instead of horizontally, see Figure 5. The table's paratext is wrapped around the table as shown in the figure. This positioning may indicate that the scribe of R_2 considered Table XXVI the final table in the *Karaṇakesarī* and squeezed it into available space on a pre-written page (f. 11r) rather than beginning a new folio for it.

4. MS R_2 omits some of the tables contained in MS P_1 (see Schema 1)3. The omission of Table XI does not significantly affect the tables' use, as it can be easily generated by calculating the differences between successive entries of Table IX.
   However, Table XXVII and Table XXVIII require additional astrological data that could not be recomputed from the other tables. We do not know whether the scribe of R_2 left them out inadvertently or deliberately, or simply did not possess them in the manuscript he was copying. His positioning of Table XXVI (see remark 3 above) suggests that he may have considered it the final table in the work.
5. MS P_1 contains a note on the top right of f. 1r (adjacent to the table title) that reads *śloka* 115 'verse 115'. This suggests that the scribe was tallying up the copied content, presumably for the purpose of computing his fee, in some units equivalent to verses; see Section 6.



(a) MS P_1 f. 5r.

(b) MS R_2 f. 3r.

Figure 4: The similar layout of the Tables XII, XIII, and XIV (partial) of the *Karaṇakesarī* seen in MS P_1 f. 5r and MS R_2 f. 3r.

Figure 5: MS R_2 f. 7v showing vertically oriented tabulated data with the surrounding paratext.

6. MS P_1 marks the break between the material concerning lunar eclipses and that related to solar eclipses by the phrases *iti candraparvādhikāraḥ* 'Thus the chapter on lunar eclipses' at Table XIX and *atha śrīsūryaparvādhikāraḥ* 'Now the chapter on eclipses of the lord Sun' at Table XX.
7. Folio 1v of MS R_2 contains the note *kṣepa* 0|19|21|34 *dhanaṃ* 'additive [quantity] 0|19|21|34 positive' to the right of the title of Table II in what appears to be a different hand. Since this quantity $0^{s}\,19^{\circ}\,21'\,34''$ is the constant difference between successive entries in the table, the note may have been added by a user to help with interpolation calculations; see Section 6.
8. MS R_2 includes a colophonic statement (on f. 8v) that reads:

इति श्रीदैवज्ञरामात्मजभास्करविरचिते कर्णकेशरीग्रन्थे
चन्द्रसूर्यपर्वाधिकारकोष्ठका संपूर्णमिति

Thus, the tables [concerning] the chapters on lunar and solar eclipses, in the book [called] *Karaṇakesarī*, composed by Bhāskara, son of Rāma the astrologer, [are] complete.

THE CONTENTS AND ORGANIZATION OF THE TABLES OF THE *KARAṆAKESARĪ* IN THE THREE MSS P_1, P_2, AND R_2.

Schema 1: Distribution of tables across folia of each of the editing manuscripts

Number	*Type of Table*	*Manuscripts*		
		P_1	P_2	R_2
I	Elongation between the sun and lunar node; argument 1 to 130 periods of 130 years.	f. 3r	–	f. 1r
II	Elongation between the sun and lunar node; argument 0 to 130 single years.	f. 3v	–	f. 1v
III	Elongation between the sun and lunar node; argument 1 to 27 *avadhi*s of 14 days.	f. 4r	–	f. 2r
IV	Digits of lunar latitude; argument 0 to 16 degrees of nodal-lunar elongation.	f. 4r	–	f. 2r
V	Digits of size of apparent solar disk; argument for twenty values (from 59;56 to 64;42) of minutes of daily nodal-solar elongation.	f. 4r	–	f. 2r
VI	Digits of apparent lunar diameter and digits of earth shadow diameter; argument 52 to 67 *ghaṭikā*s in a *tithi*.	f. 4v	–	f. 2v
VII	Digits of increments to apparent shadow diameter; argument zodiacal sign of solar longitude, from Aries to Virgo and from Libra to Pisces.	f. 4v	–	f. 2v

Schema 1 (continued)

Number	*Type of Table*	*Manuscripts*		
		P_1	P_2	R_2
VIII	60-complement of *ghaṭikā*s of half-duration of lunar eclipse totality; argument 1 to 9 digits of excess of earth shadow diameter over lunar disk diameter.	f. 4v	–	f. 2v
IX	60-complement of *ghaṭikā*s of half-duration of lunar eclipse; argument 1 to 21 digits of lunar obscuration.	f. 4v	–	f. 2v
X	Degrees of solar longitude and true daily motion; argument 1 to 27 *avadhi*s of 14 days.	f. 4v	–	f. 2v
XI	Differences between successive entries of Table IX; argument 1 to 21 digits of lunar obscuration.	f. 4v	–	–
XII	Digits of *agnibhāga* 'third part' of the half-duration; argument 1 to 21 digits of lunar obscuration.	f. 5r	–	f. 3r
XIII	Latitude-derived half-duration correction; argument 1 to 21 digits of mid-eclipse lunar latitude.	f. 5r	–	f. 3r
XIV	Degrees of *akṣavalana*; argument 0 to 45 degrees of the 45-complement of half the zenith distance.	ff. 5r–5v	–	ff. 3r–3v
XV	Lords of the *parvans*; argument 9 different intervals of eclipse possibility between 0 and 24 months.	f. 5v	–	f. 3v

Schema 1 (continued)

Number	*Type of Table*	*Manuscripts*		
		P_1	P_2	R_2
XVI	Degrees of *ayanavalana*; argument 0 to 90 degrees of the complement of tropical solar longitude.	f. 6r	–	f. 4r
XVII	Digits of converted total solar *valana*; argument 0 to 47 degrees of combined *valana*.	f. 6v	–	f. 4v
XVIII	Digits of converted total lunar *valana*; argument 0 to 47 degrees of combined *valana*.	f. 6v	–	f. 4v
XIX	*ghaṭikā*s of half-lengths of daylight; argument 0 to 29 degrees of zodiacal sign of tropical solar longitude, from 1/Taurus to 11/Pisces followed by 0/Aries.	f. 7r	–	f. 5r
XX	*ghaṭikā*s of cumulative oblique ascension; argument 0 to 29 degrees of zodiacal sign of tropical solar longitude, from 0/Aries to 11/Pisces.	ff. 7v–8r	–	ff. 5v–6r
XXI	*vighaṭikā*s of oblique ascension; argument 1 to 60 arcminutes of any degree of zodiacal sign of tropical solar longitude, from 1/Aries to 6/Virgo and (decreasing) 12/Pisces to 7/Libra.	ff. 8v–9v	ff. 3r–3v	ff. 6v–7v

Schema 1 (continued)

Number	*Type of Table*	*Manuscripts*		
		P_1	P_2	R_2
XXII	*vighaṭikā*s of right ascension; argument 1 to 60 arcminutes of any degree of zodiacal sign of tropical solar longitude: 1/Aries–3/Gemini and 7/Libra–9/Sagittarius, and (decreasing) 6/Virgo–4/Cancer and 12/Pisces–10/Capricorn.	–	ff. 2r–2v	–
XXIII	*ghaṭikā*s of 'mean' longitudinal parallax; argument 0 to 91 degrees of elongation between ascendant and sun.	f. 9v	–	f. 7v
XXIV	Multiplicative correction to mean longitudinal parallax; argument 0 to 29 degrees of 0 to 11 signs of tropical longitude of ascendant.	f. 10r	–	f. 8r
XXV	Digits of latitudinal parallax; argument 0 to 29 degrees of 0 to 11 signs of tropical longitude of ascendant.	f. 10v	–	f. 8v
XXVI	*ghaṭikā*s of half-duration of solar eclipse; argument 1 to 12 digits of solar obscuration.	f. 11r	–	f. 7v (left margin)
XXVII	Times [?] beginning with days in horoscopy; argument 1 to 60 arcseconds of planets' longitudes [?].	f. 11r	–	–
XXVIII	Birth categories for each of the *nakṣatra*s; argument (1 to 28) *nakṣatra*s.	f. 11v	–	–

4 A TECHNICAL SUMMARY OF THE TABLES IN THE *KARAṆAKESARĪ*

As discussed in Sections 5–6, we do not pretend to full understanding of the *Karaṇakesarī*'s table entries or the means used to produce them. We have noted in Montelle and Plofker (2014) that several of the *Karaṇakesarī* algorithms seem to be closely related to those of the 1183 handbook text *Karaṇakutūhala* by the renowned astronomer Bhāskara II (b. 1114). The following descriptions briefly summarize the individual tables and our inferences, if any, about how they were generated. For further information about their nature and use, see the referenced sections in our 2014 publication (Montelle and Plofker 2014) and those of Pingree (1968: 70–72). These proposed reconstructions of the generating algorithms, along with the edited and variant numerical values presented in Section 5, will facilitate more detailed analysis of the tables in future.

TABLES I–III

Elongation between the sun and lunar node.

See Montelle and Plofker 2014: § 1.2. The first two tables contain linear function values even though the tabulated elongation appears to involve non-linear true longitude, presumably because the argument intervals are long enough that the average elongation increments are sufficiently accurate.

Table I Argument 1 to 130 periods of 130 years.

> अथ सूर्यस्य लब्ध्यपङ्क्तिचक्रं १२ राश्यादि ॥
>
> Now the cyclic [elongation value] of the sun for the quotient number [of integer years after division by 130], [modulo] 12 [in] zodiacal signs, etc.

The constant difference between table entries is -3°; 16, 20.

Table II Argument 0 to 130 single years.

> अथ श्रीकरणकेसरिग्रन्थे सूर्यस्य शेषपङ्क्तिचक्रम् १२।३० ॥
>
> Now, in the book *Karaṇakesarī*, the cyclic [elongation value] of the sun for the remainder number [of integer years after division by 130], [modulo] 12 [zodiacal signs and] 30 [degrees in a sign].

The constant difference between table entries is 19°; 21, 34. The first entry incorporates an epoch offset of 6^s 29°; 24, 36 for the start of Śaka 1603.

Table III Argument 1 to 27 *avadhi*s of 14 days.

अथ करणकेसरिग्रन्थोक्ते सिद्धान्तरहस्ये सूर्येन्द्वोः पर्वानयनार्थे चन्द्रस्य कोष्ठका अवध्योपरि।

Now, [as] stated in the book *Karaṇakesarī*, for the sake of determining eclipses of the sun and moon [as] in the *Siddhāntarahasya* [*Grahalāghava*], table entries of the moon [?] [with] above [argument] *avadhi*s.

See Montelle and Plofker 2014: Tab. 1. The exact algorithms used to generate the table entries are at present unknown, but they appear to represent true solar motion with time corrections, plus mean nodal motion.

Row 1: Non-linear function values of cumulative nodal-solar elongation for each *avadhi*, beginning with $2°;19,55$ at the start of the solar year.

Row 2: Non-linear function values of daily nodal-solar elongation in each *avadhi*, beginning with $61';46$.

Row 3: Signed integer values (all 0, 1 or 2) whose purpose is unclear, though their signs correspond to increase and decrease of successive values in Row 2.

TABLE IV

Digits of lunar latitude, argument 0 to 16 degrees of nodal-lunar elongation.

अथ भुजांशोपरि शराङ्गुलादि॥

Now, digits etc. of [lunar] latitude [with] above [argument] degrees of arc.

See Montelle and Plofker 2014: § 1.3.

Row 1: Function values of digits of lunar latitude β for each degree of nodal-lunar elongation $\Delta\lambda$, from minimum value of 0 for argument 0 to maximum value of $24;45$ for argument 16. The entries for argument values 8 and 16 appear to have been produced by an algorithm close to an attested formula in *Karaṇakutūhala* 4, 5 (Balachandra Rao and Uma 2008: S67–S68) equivalent to the following:

$$\beta\,(\text{digits}) = 90\sin(\Delta\lambda)$$

The remaining entries are derived by linear interpolation.

Row 2: Successive differences between entries in Row 1: the entries for argument values 0 to 8 are either $1;34$ or $1;35$ (average difference $1;34,30$), and the entries for argument values 9 to 16 are $1;30$.

TABLE V

Digits of size of apparent solar disk, argument twenty values (from 59′;56 to 64′;42) of minutes of daily nodal-solar elongation.

> अथ सपातचन्द्रगत्युपरि रविबिम्बाङ्गुलादि ॥
>
> Now, digits etc. of the solar disk [with] above [argument] velocity of the moon plus the node.

See Montelle and Plofker 2014: § 1.3. The exact algorithm used to generate the table entries is at present unknown. The entries vary monotonically from 10;19 digits for the first argument to 11;11 for the last argument. (Note that the given minimum and maximum argument values presumably fall between successive values of daily nodal-solar elongation tabulated in Row 2 of Table III, where the function changes sign.)

TABLE VI

Digits of apparent lunar diameter and digits of earth shadow diameter, argument 52 to 67 *ghaṭikā*s in a *tithi*.

> अथ तिथेर्मानघट्योपरि चन्द्रबिम्बं तथा भूभाङ्गुलादि ॥
>
> Now, the lunar disk, likewise the digits etc. of the earth shadow, [with] above [argument] the measure in *ghaṭikā*s of the *tithi*.

See Montelle and Plofker 2014: § 1.3. The exact algorithms used to generate the table entries are at present unknown, although qualitatively it is clear that the size of both disks varies inversely with the length of the *tithi*.

Row 1: Apparent lunar diameter increases monotonically from 11;57 digits for argument 52 to 9;30 for argument 67.

Row 2: Shadow of the earth likewise increases monotonically from 30;45 digits to 23;11. (The very close values 30;45 and 30;44 in the first two entries probably involve a scribal error somewhere, but without knowing the specific steps used to compute them we have not ventured to emend either of them.)

TABLE VII

Digits of increments to apparent shadow diameter, argument zodiacal signs of solar longitude, from Aries to Virgo and from Libra to Pisces.

रवेर्व्यङ्गुलादिफलसंस्कृते स्पष्टकुभा ॥

Accurate earth shadow when corrected by the result in digit-sixtieths etc. for the sun.

See Montelle and Plofker 2014: § 1.3. It is not clear exactly how these entries were determined, although qualitatively the change in the size of the shadow—positive from Aries to (zero in) Virgo, negative from Libra to (zero in) Pisces—agrees with the change in the sun's longitude and consequently its distance from the earth.

TABLE VIII

60-complement of *ghaṭikā*s of half-duration of lunar eclipse totality, argument 1 to 9 digits of excess of earth shadow diameter over lunar disk diameter.

खच्छिन्नाङ्गुलोपरि मर्दघटिकाचक्रम् ६० ॥

Complement [up to] 60 of the *ghaṭikā*s of half-duration of totality, [with] above [argument] digits of sky-obscuration.

See Montelle and Plofker 2014: § 1.4. These values are to be subtracted from 60 to get the corresponding half-durations; it is unclear why the table compiler did not simply tabulate the half-durations directly. The period of totality is longer when the shadow diameter is much larger than that of the moon's disk, which qualitatively explains the variation of these non-linear function values from 59; 0 *ghaṭikā*s for argument 1 digit (i.e., half-totality 60 – 59; 0 = 1; 0 *ghaṭikā*s) to 57; 45 *ghaṭikā*s for argument 9 digits (half-totality 2; 15 *ghaṭikā*s).

TABLE IX

60-complement of *ghaṭikā*s of half-duration of lunar eclipse, argument 1 to 21 digits of lunar obscuration.

अथ चन्द्रछिन्नाङ्गुलोपरि चन्द्रस्य मध्यस्थितिघटिचक्रम् ६० ॥

> Now, complement [up to] 60 of the *ghaṭikā*s of mean half-duration [of the eclipse] of the moon, [with] above [argument] digits of lunar obscuration.

See Montelle and Plofker 2014: § 1.4. The duration of a lunar eclipse depends on the amount of the moon's disk obscured by the shadow; hence the entries for the half-duration complement decrease from 58; 30 *ghaṭikā*s for argument 1 digit to 55; 17 for argument 21 digits.

These values appear to be based on an algorithm equivalent to the formula in *Karaṇakutūhala* 4.10 (Balachandra Rao and Uma 2008: S73) for computing eclipse half-duration in *ghaṭikā*s. It can be represented by the following equation:

$$\text{half-duration} = 3 \times 60 \times \frac{\sqrt{(r_{\bullet} + r_{\bigcirc})^2 - \beta^2}}{v_{☾} - v_{\odot}}$$

where $r_{\bullet}$ and $r_{\bigcirc}$ are the radii of the disks of the eclipsing and eclipsed bodies respectively (corresponding to the shadow and the moon in the case of a lunar eclipse), while $v_{☾}$ and $v_{\odot}$ are the luminaries' daily velocities and β is the lunar latitude. In this case, the table compiler has only divided by the lunar velocity and not the difference in the luminaries' daily velocities.

Our reconstruction of this algorithm employs the approximate lunar velocity value of 790 arcminutes per day and assumes the sum of the moon and shadow disk radii to be about 21 digits.

TABLE X

Degrees of solar longitude and true daily motion, argument 1 to 27 *avadhi*s of 14 days.

> तिथ्यन्तकालिका ग्रहा वलनार्थे स्पर्शकाले तथा मोक्षकाले साधनं चन्द्रग्रहणे मूर्ध्न्यर्कं भार्धान्वितं कर्तव्यम्। लग्नार्थेऽप्ययम्॥
>
> Planets at the time of the end of a *tithi*: determination for the sake of *valana* at the time of contact, likewise at the time of release, in a lunar eclipse; to the number at the top half the shadow is to be added. This is also for the sake of the ascendant.

See Montelle and Plofker 2014: § 1.4. The algorithms generating these nonlinear function values are not clearly understood, although they seem to represent true

solar longitude with time corrections.[8]

Row 1: Solar longitude; increases from $0^s, 2°; 9, 50$ for argument 1 to $0(=12)^s, 0°; 54, 30$ for argument 27.

Row 2: True solar daily velocity; minimum value $56'; 54$ for argument 7, maximum $61'; 30$ for argument 20.

Row 3: Signed integer values (all 0, 1 or 2) whose purpose is unclear, though their signs correspond to increase and decrease of successive values in Row 2.

TABLE XI

Differences between successive entries of Table IX, argument 1 to 21 digits of lunar obscuration.

> चन्द्रच्छिन्नाङ्गुलोपरि स्थितिनोऽन्तरम्॥
>
> Difference of the half-duration [with] above [argument] digits of lunar obscuration.

See Montelle and Plofker 2014: § 1.4.

TABLE XII

Digits of 'third part' of the half-duration, argument 1 to 21 digits of lunar obscuration.

> अथ चन्द्रछिन्नाङ्गुलोपरि स्थित्यग्निभागः॥
>
> Now, the third part of the half-duration, [with] above [argument] digits of lunar obscuration.

These values of the so-called *agnibhāga* (*lit*. 'third part' [of the half-duration]) represent the difference $\Delta\beta$ in digits between values of the lunar latitude at mid-

8 Note that the description of a hybrid Sanskrit worked example given in the commentary on the edition of the text of the *Karaṇakesarī* (Montelle and Plofker 2014: 22–23) refers to these table values as mean solar longitudes. This appears to be an error arising from a misunderstanding of the example author's use of the term *madhya* 'mean'; what he evidently meant is that each *true* solar longitude in this table is the *average* value for its corresponding *avadhi*.

eclipse and at contact or release,[9] according to an algorithm that can be expressed as follows (see, e.g., *Karaṇakutūhala* 4,17 (Balachandra Rao and Uma 2008: S84–S86)):

$$\Delta\beta \approx \frac{1}{3}\,(\text{half-duration in } \textit{ghaṭikā}\text{s})$$

Qualitatively, the equivalence between the half-duration and the change in latitude during the eclipse is apparent: both quantities are small for short partial eclipses with minimal obscuration and large for total eclipses when the obscuration is great.

Each of the table entries has apparently been calculated as one-third of the 60-complement of the corresponding entry in Table IX. None of the algorithms in the *Karaṇakesarī* text directly invoke this table, but it would be required for the construction of an eclipse diagram as described in (Montelle and Plofker 2014: § 1.10–1.11). The table's vernacular paratext explains how to apply $\Delta\beta$ positively or negatively at contact or release, depending on whether the moon is approaching the node during the eclipse or moving away from it.

TABLE XIII

Latitude-derived half-duration correction, argument 1 to 21 digits of mid-eclipse lunar latitude.

> **अथ मध्यबाणाङ्गुलोपरि बाणफलम्॥**
>
> Now, the latitude-result, [with] above [argument] digits of mid[-eclipse lunar] latitude.

These table entries determine how the half-duration values tabulated in Table IX should be adjusted to produce the 'contact half' and 'release half' of the duration, which are unequal because of the above-mentioned relative motion of the moon and the node during the eclipse.[10] Their computation is more or less based on

9 This is corroborated by a table in the manuscript worked example referred to in the previous note (RORI Jaipur 9597, f. 2v: MS. J in Montelle and Plofker 2014: 2), which includes a mid-eclipse lunar latitude of 12;18 digits and a half-duration of 3;24 *ghaṭikā*s. One-third of this half-duration is 1;8, which when applied negatively and positively to the mid-eclipse latitude produces the tabulated contact and release latitudes of 11;10 and 13;26 digits respectively.

10 Again, we can corroborate this interpretation from the previously-mentioned table in the manuscript worked example (see note 9), in which 1/48 of the stated mid-eclipse lunar latitude of 12;18 digits, i.e., 0;15, 22, 30, has evidently been rounded to 0;15 and applied negatively and positively to the stated mean half-duration of 3;24 *ghaṭikā*s. The results are the tabulated contact and release 'half'-durations of 3;9 and 3;39 *ghaṭikā*s respectively.

an algorithm equivalent to the following equation (see, e.g., *Karaṇakutūhala* 4,11 (Balachandra Rao and Uma 2008: S74–S80)):

$$\Delta \text{half-duration in } \textit{ghaṭikā}\text{s} \approx \frac{1}{48} \times \beta_m$$

where β_m is the mid-eclipse lunar latitude in digits.

The tabulated values in several cases differ from the expected result of dividing the integer digits in the argument by 48, but we cannot determine to what extent the discrepancies are due to computational choices versus scribal errors, so we have left the edited values as attested in the manuscripts. None of the algorithms in the *Karaṇakesarī* text directly invoke this table, although the unequal 'half'-durations are mentioned in the context of parallax corrections as described in (Montelle and Plofker 2014: § 2.5–2.6).

TABLE XIV

Degrees of *akṣavalana*, argument 0 to 45 degrees of the 45-complement of half the zenith distance.

> अथ खाङ्कहृतस्वघश्रमानेन भक्ते लब्धं नतांशास्तस्य ताने ४५ शोध्यते शोध्यांशा उपर्यक्षाख्यवलनम्॥
>
> Now, when [the hour-angle] is divided by the amount of its own day measure [and] multiplied by 90, [there is] obtained the degrees of [half] the zenith distance. Its [amount] is to be subtracted from 45; the degrees from the subtraction are the above [argument of] the *valana* called latitudinal.
>
> नतंशोपरि अक्षाख्यवलनं पूर्वनते उत्तरे पश्चिमनते दक्षिणे वलनम्॥
>
> The *akṣavalana* [with its] above [argument] degrees of [half] the zenith distance. The *valana* [is to be applied] in the north when the zenith distance [is] eastern, in the south when the zenith distance [is] western.

See Montelle and Plofker 2014: § 1.5. The algorithm used is evidently a version of a procedure symbolically represented by the equation:

$$\textit{akṣavalana} = \arcsin(\sin(90^\circ - \zeta) \times \sin \varphi)$$

where ζ is the zenith distance and $\varphi \approx 22^\circ; 35, 39$ is the local terrestrial latitude. It appears that every fifth value is calculated trigonometrically and the intervening ones derived by linear interpolation.

Row 1: Degrees of *akṣavalana* decreasing from 22°; 35, 39 for $\zeta = 90°$ to 0 for $\zeta = 0$.

Row 2: Differences in successive entries of Row 1. The attested and computed differences are not always consistent, but we cannot be sure whether to attribute the inconsistencies to errors in the computation of the Row 1 entries, variations in precision and rounding, scribal errors in Row 1 and/or Row 2 entries, or some combination.

TABLE XV

Lords of *parvans*, argument 9 different intervals of eclipse possibility between 0 and 24 months.

> अथ सपातचन्द्रसूर्यराश्युपरि पर्वेशज्ञानं राशिमां चक्रशोध्या विना॥
>
> Now, [with] above [argument] the zodiacal sign of the sun or moon plus the node, knowledge of the lord of the *parvan* without elimination of the cycle of the zodiacal signs [i.e., not modulo 12].

Non-numerical table assigning a deity or lord of the eclipse to each interval of eclipse possibility (Montelle 2011: 247–248) in the following sequence: 0, 5, 6, 11, 17, 18, 12, 23, and 24 months.

TABLE XVI

Degrees of *ayanavalana*, argument 0 to 90 degrees of the complement of tropical solar longitude.

> अथ स्पर्शकले तथा मोक्षकाले सायनग्रहस्य कोट्यंशोपर्यंशाद्यमयनजं वलनं सायनग्रहकर्कादौ दक्षिणे मकरादावुत्तरे वलनं देयम्॥
>
> Now, [with] above [argument] degrees of the complement of the precession-added [longitude] of the planet at the time of contact, likewise at the time of release, the *ayanavalana* in degrees etc. The *valana* is to be applied to the south when the precession-corrected planet [is] in [the six signs] beginning with Cancer, to the north when in [the six signs] beginning with Capricorn.

See Montelle and Plofker 2014: § 1.6. The algorithm used is evidently closely re-

lated to the following equation:

$$\textit{ayanavalana} = \arcsin(\sin(90^\circ - \lambda) \times \sin 24^\circ)$$

where λ is tropical solar longitude. The tabulated values have been computed in this way at every tenth entry, while the intervening values are linearly interpolated.

Row 1: Degrees of *ayanavalana* increasing from $0;0,3$ for solar longitude 90° to $24;0,1$ for longitude 0°.

Row 2: Differences between successive entries in Row 1 (constant for each set of ten entries).

TABLE XVII

Digits of converted total solar *valana*, argument 0 to 47 degrees of combined *valana*.

> अथ सूर्यस्य वलनं स्पष्टम्। अक्षाख्यं तथायनजं वलनयोर्योगान्तरांशोपर्यङ्गुलाद्यं वलनं स्पष्टं सूर्यस्य। सूर्यस्य ग्रासवलनं पश्चिमे देयम्। मोक्षवलनं पूर्वे देयम्। सूर्यस्य स्पर्शवलनं विपरीतं देयम्। उत्तरे जातं दक्षिणे देयम्। दक्षिणे जातमुत्तरे देयम्॥
>
> Now, the accurate *valana* of the sun. The accurate *valana* of the sun in digits etc., [with] above [argument] degrees of the sum or difference of the two *valana*s, [the one] called latitudinal [and] likewise [the one] produced by the *ayana*. The sun's contact *valana* is to be applied to the west; the release *valana* is to be applied to the east. The sun's contact *valana* is to be applied in reverse: occurring in the north, applied to the south; occurring in the south, applied to the north.

See Montelle and Plofker 2014: § 1.6. The values represent the algebraic sum of *akṣavalana* and *ayanavalana* scaled for solar eclipses, ranging from initial minimum of $0;7$ to final maximum of $8;2$ digits. The exact algorithm used to compute the entries is not known.

TABLE XVIII

Digits of converted total lunar *valana*, argument 0 to 47 degrees of combined *valana*.

अथ चन्द्रस्य वलनं स्पष्टम्। अक्षाख्यवलनं तथायनजं वलनयोर्योगान्तरांशोपर्यङ्गुलाद्यं वलनं स्पष्टं चन्द्रग्रहणे। स्पर्शवलनं पूर्वे देयम्। मोक्षवलनं पश्चिमे देयम्। चन्द्रस्य मोक्षवलनं विपरीतं देयम्। उत्तरे जातं दक्षिणे देयम्। दक्षिणे जातम् उत्तरे देयम्॥

Now, the accurate *valana* of the moon. The accurate *valana* in a lunar eclipse in digits etc., [with] above [argument] degrees of the sum or difference of the two *valana*s, [the one] called latitudinal [and] likewise [the one] produced by the *ayana*. The contact *valana* is to be applied to the east; the release *valana* is to be applied to the west. The moon's release *valana* is to be applied in reverse: occurring in the north, applied to the south; occurring in the south, applied to the north.

See Montelle and Plofker 2014: § 1.6. The values represent the algebraic sum of *akṣavalana* and *ayanavalana* scaled for lunar eclipses, ranging from initial minimum of 0; 4 to final maximum of 13; 51 digits. The exact algorithm used to compute the entries is not known.

TABLE XIX

*ghaṭikā*s of half-lengths of daylight, argument 0 to 29 degrees of zodiacal sign of tropical solar longitude, from 1/Taurus to 11/Pisces followed by 0/Aries.

अथ सायनरविराश्युपरि द्युदलम्॥

Now, the half-day [with] above [argument] the zodiacal sign [and degree] of the precession-corrected [longitude of the] sun.

See Montelle and Plofker 2014: § 1.9 and 2.2. These values of half the duration of daylight during the course of the year are derived from the local ascensional differences of the zodiacal signs. The canonical right ascension values for Aries, Taurus and Libra respectively are $\alpha_1 = 278$, $\alpha_2 = 299$, and $\alpha_3 = 323$ *vighaṭikā*s. The ascensional differences at the text's terrestrial latitude of $\varphi \approx 22^\circ; 36$ were evidently produced by applying the scalar multiples 10, 8, and $\frac{10}{3}$ to an equinoctial shadow length of 5 digits. The resulting ascensional difference values are $\omega_1 = 50$, $\omega_2 = 40$, and $\omega_3 = 17$ *vighaṭikā*s respectively (Montelle and Plofker forthcoming).

The tabulated half-lengths of daylight for each zodiacal sign appear to have been computed by truncation of linearly interpolated values successively differing by 1/30 of the sign's corresponding ascensional difference. They increase from the initial entry of 15; 50 *ghaṭikā*s at Row 1/Taurus 0° to a maximum of 16; 47 *ghaṭikā*s at Row 3/Cancer 0°, decrease to a minimum of 13; 13 *ghaṭikā*s at Row 9/Capricorn

0°, and increase again to the final entry of 15; 48 at Row 0/Aries 29°, implying a longest/shortest day ratio of 33; 34 to 26; 26 *ghaṭikā*s.

TABLE XX

*ghaṭikā*s of cumulative oblique ascension, argument 0 to 29 degrees of zodiacal sign of tropical solar longitude, from 0/Aries to 11/Pisces.

> अथ श्रीसूर्यपर्वाधिकारः तत्र तावत्प्रथमं सायनरविराश्यंशोपरि सायनलग्नं करणीयं सायनरविराश्यंशोपरि लग्नकोष्टकाः ॥
>
> Now, the chapter on eclipse of the lord sun: there, just as previously, [with] above [argument] the sign and degree of the precession-corrected [longitude of the] sun, the precession-corrected [oblique] ascension is to be made. Table entries of the ascension [with] above [argument] the sign and degree of the precession-corrected [longitude of the] sun.

Note: The last sentence is repeated as the heading of the second page of Table XX, see p. 56.

See Montelle and Plofker 2014: § 2.2. The values of cumulative oblique ascension for degree 0 of each zodiacal sign, reproduced in Schema 2, were apparently computed by adding up the appropriate rising times, or right ascensions adjusted by the corresponding ascensional differences determined as in the above description of Table XIX. The cumulative oblique ascension values for the intermediate degrees of each sign seem to have been calculated by linear interpolation: they increase from the initial value of 0; 0, 0 *ghaṭikā*s for 0/Aries 0° to the final value of 59; 52, 24 *ghaṭikā*s for 11/Pisces 29°.

TABLE XXI

*vighaṭikā*s of oblique ascension, argument 1 to 60 arcminutes of any degree of zodiacal sign of tropical solar longitude, from 1/Aries to 6/Virgo and (decreasing) 12/Pisces to 7/Libra.

> अथ लग्नस्य कलाकोष्टकाः ॥
>
> Now, the [oblique] ascension's table entries for arcminutes.

Note: Repeated as the heading of the second page of Table XXI, see p. 58.

Sign (with rising time)		*Oblique ascension* (ρ at 0°, *ghaṭikā*s)	ρ, *vighaṭikā*s
Aries	$(\alpha_1 - \omega_1)$	0 ; 0,0	0
Taurus	$(\alpha_2 - \omega_2)$	3 ; 48,0	228
Gemini	$(\alpha_3 - \omega_3)$	8 ; 7,0	487
Cancer	$(\alpha_3 + \omega_3)$	13 ; 13,0	793
Leo	$(\alpha_2 + \omega_2)$	18 ; 53,0	1133
Virgo	$(\alpha_1 + \omega_1)$	24 ; 32,0	1472
Libra	$(\alpha_1 + \omega_1)$	30 ; 0,0	1800
Scorpio	$(\alpha_2 + \omega_2)$	35 ; 28,0	2128
Sagittarius	$(\alpha_3 + \omega_3)$	41 ; 7,0	2467
Capricorn	$(\alpha_3 - \omega_3)$	46 ; 47,0	2807
Aquarius	$(\alpha_2 - \omega_2)$	51 ; 53,0	3113
Pisces	$(\alpha_1 - \omega_1)$	56 ; 12,0	3372

Schema 2: Cumulative oblique ascensions for the start of each zodiacal sign (Table XX).

See Montelle and Plofker 2014: § 2.2. These entries supply increments to oblique ascension per arcminute of solar longitude. The constant difference between tabulated values of *ghaṭikā*s of oblique ascension for successive degrees of any given zodiacal sign in Table XX is used as the total ascensional difference $\Delta\rho$ for any single degree (60 arcminutes) of the same zodiacal sign in Table XXI; these $\Delta\rho$ values are reproduced in Schema 3. The tabulated individual cumulative ascensional difference values for each arcminute within a single degree of the given sign are computed by linear interpolation.

So the constant difference between entries for successive arcminutes of a single degree of each zodiacal sign in Table XXI is just one-sixtieth of the constant difference $\Delta\rho$ in *vighaṭikā*s between entries for successive degrees of the corresponding sign in Table XX. The two tables used together thus produce values of cumulative oblique ascension precise to arcminutes of the argument.

TABLE XXII

*vighaṭikā*s of right ascension, argument 1 to 60 arcminutes of any degree of zodiacal sign of tropical solar longitude: 1/Aries–3/Gemini and 7/Libra–9/Sagittarius, and (decreasing) 6/Virgo–4/Cancer and 12/Pisces–10/Capricorn.

कलाकोष्ठकाः ॥

Table entries for arcminutes.

See Montelle and Plofker 2014: § 2.2. These values are the right ascension counterparts to the oblique ascension increments tabulated in Table XXI. The total right ascension difference $\Delta\alpha$ in *vighaṭikā*s for any single degree (60 arcminutes) of a given zodiacal sign is taken to be 1/30 of the canonical right ascension value for that sign. These $\Delta\alpha$ values are reproduced in Schema 3. The tabulated individual cumulative right-ascensional difference values for each arcminute within a single degree of the given sign are evidently computed by linear interpolation.

Note: Not every tabulated value in Tables XIX–XXII conforms exactly to our reconstruction of a linear interpolation procedure, but we do not know enough about the details of the computation techniques used to feel secure in emending any of the attested entries.

Signs	*Oblique ascension difference per degree* ($\Delta\rho$, *vighaṭikā*s)	*Right ascension difference per degree* ($\Delta\alpha$, *vighaṭikā*s)
Aries/Pisces	7;36,0	9;16,0
Taurus/Aquarius	8;38,0	9;58,0
Gemini/Capricorn	10;12,0	10;46,0
Cancer/Sagittarius	11;20,0	10;46,0
Leo/Scorpio	11;18,0	9;58,0
Virgo/Libra	10;56,0	9;16,0

Schema 3: Oblique ascension and right ascension differences for a single degree of a given zodiacal sign (Tables XXI and XXII).

TABLE XXIII

*ghaṭikā*s of 'mean' longitudinal parallax, argument 0 to 91 degrees of elongation between ascendant and sun.

> अथ दर्शान्तलग्नार्कयोर्विवरबाहुभागप्रमिते कोष्ठके मध्यमलम्बनं घटिकादि ॥
>
> Now, in [each] table entry commensurate with the degree of the difference-arc [between the longitudes] of the sun and the ascendant at the end of the *tithi* [i.e., at mid-eclipse], the mid[-eclipse] longitudinal parallax in *ghaṭikā*s etc.

See Montelle and Plofker 2014: Secs. 2.3–2.4. The longitudinal parallax of the moon, which affects the perceived time and appearance of a solar eclipse when the moon crosses the sun, in Indian astronomy is qualitatively taken to vary as the sine of the ecliptic arc of elongation between the sun and the nonagesimal, which is the point of the ecliptic 90° west of the ascendant, on or near the meridian. This parallax component is usually assumed to be zero when the elongation arc is zero, i.e., when the sun is at the nonagesimal, and to attain its conventional maximum of 4 *ghaṭikā*s when the sun is on the horizon with elongation 90°. It is denoted 'mean' because it does not take into account the depression of the nonagesimal from the zenith, where total parallax is zero.

These tabulated values of 'mean' longitudinal parallax are based on nine values stated at 11° intervals of argument in *Karaṇakutūhala* 5.4–5.5 (Balachandra Rao and Uma 2008: S95–S96), which are modified from the above-mentioned simple sinusoidal interpolation by an adjustment whose nature and purpose are not entirely clear to us. The nine base values, listed in Schema 4, are reversed in the *Karaṇakesarī* table by changing their argument to the elongation between the sun and the ascendant rather than between the sun and the nonagesimal. The remaining table entries appear to have been computed by linear interpolation, increasing from 3;40 *ghaṭikā*s at argument 0° to the maximum value of 4 *ghaṭikā*s at 24° and subsequently decreasing to 0;1 *ghaṭikā*s at argument 90° and 91°.

TABLE XXIV

Multiplicative correction to mean longitudinal parallax, argument 0 to 29 degrees of 0 to 11 signs of tropical longitude of ascendant.

> अथ सायनलग्नराश्यंशोपरि लम्बनस्पष्टगुणकाः ॥

Degree of sun-ascendant elongation, Karaṇakesarī	*Mean longitudinal parallax* (*ghaṭikā*s)	*Degree of sun-nonagesimal elongation, Karaṇakutūhala*
	3;20	99
2	3;44	88
13	3;56	77
24	4;00	66
35	3;55	55
46	3;39	44
57	3;08	33
68	2;21	22
79	1;17	11
90	0;01	

Schema 4: Mean longitudinal parallax values in the *Karaṇakesarī* derived from the *Karaṇakutūhala* (Table XXIII).

> Now, the multipliers for correcting longitudinal parallax [with] above [argument] the sign and degree of the precession-corrected ascendant.

See Montelle and Plofker 2014: Secs. 2.3–2.4. The mean longitudinal parallax values are adjusted to true ones in *Karaṇakutūhala* 5.2–5.3 by multiplying them by the cosine of the zenith distance of the nonagesimal, which is approximated as the difference between the local latitude φ and the ecliptic declination δ_N of the nonagesimal point (Balachandra Rao and Uma 2008: S92). Qualitatively, this means that as the nonagesimal approaches the zenith the correction factor will tend to zero, so when the nonagesimal coincides with the zenith there will be no longitudinal parallax.

The *Karaṇakesarī*'s tabulated values of this correction factor were apparently calculated such that

$$\text{factor} = 40\cos(\varphi - \delta_N)$$

where φ as usual is the text's local latitude of approximately $22°;35,39$ and δ_N equals $\arcsin(\sin 24° \sin(\lambda_A - 90°))$ with λ_A being the tropical longitude of the ascendant in the table argument. For reasons unknown, each table entry is 40 times larger than the required correction, so the accompanying verse instructs

the user to divide the tabulated correction factor by 40 before applying it to the previously determined mean longitudinal parallax. The entries cycle from 27;22 at the initial argument 0/Aries 0°to the maximum value of 39;59 at 5/Virgo 9–12°, followed by a dip to 39;54 at 5/Virgo 29°and a return to the maximum at 6/Libra 16–21°, decreasing to the minimum value of 27;22 at the final argument 11/Pisces 29°.

TABLE XXV

Digits of latitudinal parallax, argument 0 to 29 degrees of 0 to 11 signs of tropical longitude of ascendant.

> अथ सायनलग्नराश्यंशोपरि नत्यङ्गुलादि ॥
>
> Now, the digits etc. of latitudinal parallax [with] above [argument] the sign and degree of the precession-corrected ascendant.

See Montelle and Plofker 2014: § 2.4. These entries are evidently derived via a formula in *Karaṇakutūhala* 5.2–5.3 (Balachandra Rao and Uma 2008: S92–S93). It can be represented symbolically as follows:[11]

$$\text{latitudinal parallax} = \frac{1}{8} \times \frac{13}{12} \times 120 \sin(\delta_N - \varphi)$$

where δ_N as before is the ecliptic declination of the nonagesimal. The table entries decrease from the maximum value of 11;46 digits at Aries 0° to the minimum value of 0;1 digits at Virgo 12°, increase to 0;24 at Virgo 29°, decrease to the minimum value again at Libra 18°, and continue increasing to the maximum value at Pisces 19°. They appear to have been computed by the above algorithm at 15° intervals with the intermediate values linearly interpolated.

TABLE XXVI

*ghaṭikā*s of half-duration of solar eclipse, argument from 1 to 12 digits of solar obscuration.

> अथ रविछन्नाङ्गुलाद्यध्यस्थितिघटिकादि ॥

11 Note that in the equivalent formula stated by Montelle and Plofker (2014: 44), the expression for δ_N is erroneously rendered as $\arcsin(\sin 24° \sin(\lambda_A + 90°))$ instead of the correct $\arcsin(\sin 24° \sin(\lambda_A - 90°))$.

> Now, the *ghaṭikā*s etc. of the mean half-duration with respect to the digits of solar obscuration.

These values appear to derive from the same algorithm employed in Table IX, except in this case the eclipsing body with disk radius $r_{\bullet}$ is the moon and $r_{\bigcirc}$ is the radius of the disk of the Sun.

Our reconstruction of this algorithm employs the approximate lunar and solar mean velocity values of 790 and 59 arcminutes per day and assumes the sum of their disk radii to be about 11 digits or 33 arcminutes, which is also the maximum lunar latitude β at which an eclipse is possible. The amount of obscuration at mid-eclipse is thus $11 - \beta$ digits, which ought to produce table argument values from 0 to 11.

The actual table contains values increasing monotonically from 1;7 *ghaṭikā*s at the initial argument 1 to 2;42 *ghaṭikā*s at argument 11, all of which are correctly reproduced by the above formula with the stated parameters (with truncated rather than rounded results) except for the value at argument 10, which should be 2;41 rather than 2;40. However, the table compiler or scribe has also included a half-duration value of 0;0 *ghaṭikā*s for a final argument value of 12 digits of obscuration, which as far as we can tell makes no sense astronomically.

TABLE XXVII

Times [?] beginning with days in horoscopy, argument 1 to 60 arcseconds in the second fractional place of planets' longitudes [?].

> अथ जातके ग्रहाणां विकलानां कोष्ठका दिनादि॥
>
> Now in horoscopy, the table entries [are] days etc. [as a function] of the arcseconds [of the longitudes] of the planets.

See Pingree 1968:72. These tabulated values, whose nature and purpose in genethlialogy are not at all clear to us, appear to assign a time or time-interval in days, *ghaṭikā*s etc., to each of the 60 possible values of the arcseconds place in a planetary longitude. They increase with a common difference of $0;1,48$ days or 108 *vighaṭikā*s from their minimum value of $0;1,48$ at argument 1 to the maximum of $1;46,12$ at argument 59. The entry for argument 60 (or arcsecond 0 of the following arcminute) is $0;0,0$.

TABLE XXVIII

Birth categories for each of the *nakṣatra*s, argument (1 to 28) *nakṣatra*s.

अथ नक्षत्राणां योनिविचारः ॥

Now, the various birth categories of the *nakṣatra*s.

See Pingree 1968: 72. This table lists the various members of three genethlialogical categories pertaining to each of the *nakṣatra*s or lunar mansions associated with the birth of the native.

Row 1: *yoni* or animal assigned to the *nakṣatra*.

Row 2: Order of being or 'world' (divine, demonic or human).

Row 3: Altitude (high, middle or low).

5 EDITION OF THE NUMERICAL TABLES

Various challenges, standards and practices concerning the preparation of a critical edition of tabular data have been explored by Misra, Montelle, and Plofker (forthcoming). Following the guidelines developed in that study, our edition of the numerical tables of the *Karaṇakesarī* considers an individual table rather than a page to be its fundamental unit element or object. Consequently, we have presented each edited table separately with any paratext and marginalia pertaining to it, accompanied by its own critical apparatus including numerical and textual variants and notes.

We have attempted to reproduce as far as possible in the edition the tables' original layout features such as vertical stacking of sexagesimal digits, placement of row headers, row breaks, and (for tables that extend over multiple pages in the manuscripts) page breaks. However, accompanying marginalia and paratext other than table headings are recorded only in the critical apparatus.

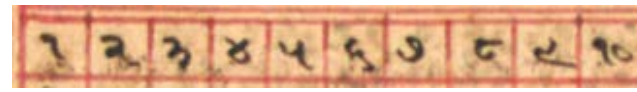
The morphology of the individual Sanskrit words or phrases used as row headers in the tables varies inconsistently between inflected and stem forms. For example, the row header *kalāḥ* in Table XXI is written *kalā* in MSS P_1 (f.8v) and P_2 (f.2r) whereas MS R_2 has *kalā* or *ka* ∘ as the row headers on the same folio (f.6v). Likewise, the word *aṃśaḥ* (degree) in Table XIX appears as *aṃ* in MS P_1 (f.7r) and *'ṃśa* in MS R_2 (f.5r). In our edition we have chosen to represent these words in

their inflected forms; e.g., *gatiḥ* in Table III or *valanaṃ* in Table XIV.

We have been much less draconian in regularizing the numerical content of the table entries. Since discrepancies between attested and recomputed values of tabulated quantities may be caused by different computation techniques as well as by outright errors in copying or calculating (see Section 6), we have resisted emending apparently incorrect values except in very unambiguous cases. For example, where a sequence of table entries forms a clearly identifiable and consistent linear progression except for one anomalous number, we have edited the outlier to conform to the rest of the sequence. E.g., the value (in *ghaṭikā*s and *vighaṭikā*s) of the mean longitudinal parallax for 24° of elongation between ascendant and the Sun is taken as 4;0 in Table XXIII instead of 3;0 seen in both MSS P_1 and R_2: see Table XXIII description in Section 4. However, in any case where doubts about the compiler's choice of computational algorithm, approximation technique, rounding practices, etc., render it somewhat uncertain what the recorded number was intended to be, we have retained the attested value, no matter how mathematically improbable it may appear. Where the manuscripts disagree, we have tended to follow the witness that appears more mathematically correct as well as textually faithful. E.g., the value of the daily nodal-solar elongation (*gatiḥ*, denoted S) corresponding to the 12^{th} *avadhi* is taken as 61;42 following MS R_2 instead of 62;42 seen in MS P_1, in order to form the consistent monotonically increasing sequence S(11): 61;11, S(12): 61;42, and S(13): 62;14.

In the edited tables and in our introductory commentary, we employ the following additional conventions:

1. All Nāgarī text is transcribed in Roman script using the IAST transliteration. Decimal place-value Nāgarī numerals are represented by their modern Indo-Arabic equivalents; see Schema 5 for some typical examples of the Nāgarī numerals in our manuscripts.
2. Vernacular and/or hybrid Sanskrit text has been converted to Roman script to the best of our ability, but we make no pretence to reliable consistency or accuracy in transcribing it. Consequently, we've accompanied all such transcriptions with images of these passages in the manuscripts; a complete set of images of all these manuscript pages is provided in Section 7.
3. Square brackets [ ] indicate an editorial addition or proposed reconstruction of missing text.
4. Angle brackets < > indicate manuscript readings that we discard as incorrect.
5. Scribal variants of Nāgarī orthography which are emended silently and not noted in the critical apparatus (except where the meaning of the ori-

Manuscript	*Folio*	*Excerpt showing handwritten numbers from 1 to 10*
P_1	f. 4r	
P_2	f. 3r	
R_2	f. 6v	

Schema 5: A sample of the handwritten numbers: 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 (१, २, ३, ४, ५, ६, ७, ८, ९, and १० in Devanāgarī) from the manuscripts MSS P_1, P_2 and R_2.

ginal reading may be ambiguous) include the following: *virāma*, *avagraha*, misplaced *daṇḍa*s, reversed conjunct consonants (e.g., *ladhba* for *labdha*), conjunct consonants that we cannot reproduce in our Nāgarī typesetting, doubled consonants after *r* or across a *pāda* break, routinely confused consonant pairs (e.g., *ba* for *va*, *ṣa* for *kha*), and all forms of *koṣṭa* for *koṣṭha* 'table entry'. However, the *anusvāra* (for a conjoined nasals) and omitted *visarga* have been noted explicitly in the critical apparatus.

6. Fragments of Sanskrit words or compounds in Nāgarī are indicated with a small circle ० at the breakpoint.
7. In the critical apparatus, text followed by a single square close-bracket ⌉ indicates the edited version of the manuscript reading that follows it.
8. The symbol *x* within Nāgarī text indicates an *akṣara* (syllable) that is illegible in the manuscript.
9. Numerals in sexagesimal or base-60 place-value notation in our commentary are shown with a semicolon separating their integer and fractional parts, and commas separating their successive sexagesimal digits. The superscripts ˢ, °, ′, and ″ indicate zodiacal signs (i.e., 30-degree arcs of longitude), degree, minute, and second of arc, respectively.
10. A few technical Latin terms (abbreviated at times) are used to express the peculiarities of the variants when compared to the base text. Their meanings with examples are as follow:

***om.* (*omisit*):** omitted.
Example from Table XX: MS P_1: first column of signs: …ma 9 ⌉ om.

This means that the entry ma 9 is omitted in MS P_1.

***prius*:** earlier (of the two).

Example from Table XXI: kalaḥ ⌋ …prius ka∘ in row II, alibi kalā R_2

This means that the first entry is ka ∘ in row II, while everywhere else in row II it is kalā in MS R_2.

***alibi*:** elsewhere.

***alterum*:** the other.

Example from Table XXI: dhanus 9 ⌋ …alterum dhanaḥ 9 P_2

This means that the other entry (not the first) is dhanaḥ 9 in MS P_2.

***transposuit*:** transposed

Example from Table XXI: alterum $\boxed{\begin{matrix}\text{tula } 7\\ \text{kanyā } 6\end{matrix}}$ transposuit $\boxed{\begin{matrix}\text{kanyā } 6\\ \text{tula } 7\end{matrix}}$ in P_2

This means that the second entry $\boxed{\begin{matrix}\text{tula } 7\\ \text{kanyā } 6\end{matrix}}$ is transposed in its word ordering to $\boxed{\begin{matrix}\text{kanyā } 6\\ \text{tula } 7\end{matrix}}$ in MS P_2.

Table I

| | atha sūryasya labdhapaṅkticakraṃ 12 rāśyādi | |																																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
11	11	11	11	11	11	11	11	11	10	10	10	10	10	10	10	10	10	9	9	9	9	9	9	9	9	9	8	8	8	8	8		rā	EL.z
26	23	20	16	13	10	7	3	0	27	24	20	17	14	10	7	4	1	27	24	21	18	14	11	8	4	1	28	25	21	18	15		aṃ	EL.d
43	27	11	54	38	22	5	49	33	16	0	44	27	11	55	38	22	6	49	33	17	0	44	28	11	55	39	22	6	50	33	17		ka	EL.m
40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20		vi	EL.s
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64			
8	8	8	8	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5		rā	EL.z
12	8	5	2	28	25	22	19	15	12	9	6	2	29	26	22	19	16	13	9	6	3	0	26	23	20	16	13	10	7	3	0		aṃ	EL.d
1	44	28	12	55	39	23	6	50	34	17	1	45	28	12	56	39	23	7	50	34	18	1	45	29	12	56	40	23	7	51	34		ka	EL.m
0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40		vi	EL.s
65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96			
4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1		rā	EL.z
27	24	20	17	14	10	7	4	1	27	24	21	18	14	11	8	4	1	28	25	21	18	15	12	8	5	2	28	25	22	19	15		aṃ	EL.d
18	2	45	29	13	56	40	24	7	51	35	18	2	46	29	13	57	40	24	8	51	35	19	2	46	30	13	57	41	24	8	52		ka	EL.m
20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0		vi	EL.s
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	
1	1	1	1	0	0	0	0	0	0	0	0	0	0	11	11	11	11	11	11	11	11	11	10	10	10	10	10	10	10	10	10	9	9	EL.z
12	9	6	2	29	26	22	19	16	13	9	6	3	0	26	23	20	16	13	10	7	3	0	27	24	20	17	14	10	7	4	1	27	24	EL.d
35	19	3	46	30	14	57	41	25	8	52	36	19	3	47	30	14	58	41	25	9	52	36	20	3	47	31	14	58	42	25	9	53	36	EL.m
40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	20	0	40	EL.s

∘paṃktiḥ cakraṃ∘ R_2

P_1: EL.s(2) 19; EL.m(3) 21, EL.s(3) 1; EL.d(4) 13, EL.m(4) 38, EL.s(4) 20; EL.m(8) 59; EL.d(17) 40; EL.s(25) 20; EL.s(33) 40; EL.d(41) 25; EL.d(68) 7; EL.m(75) 31; EL.m(86) 33; EL.d(97) 15, EL.m(97) 33; EL.s(106) 45; EL.d(115) 15; EL.s(122) 28.

R_2: EL.s(2) 19; EL.m(3) 21, EL.s(3) 1; EL.d(5) 23, EL.m(5) 38; EL.m(8) 59; EL.s(33) 40.

MS P_1 does not have row headers. It has the words śloka 115 is written in a different handwriting to the left of the title.

MS R_2 has ṭṃ instead of aṃ in the row header for EL.d.

MS P_2 does not contain this table.

Table II

|| atha śrīkaraṇakesarigranthe sūryasya śeṣapaṅkticakram 12 | 30 ||																																					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33					
6	7	8	8	9	10	10	11	0	0	1	2	2	3	4	4	5	5	6	7	7	8	9	9	10	11	11	0	1	1	2	2	3	4	EL.z				
29	18	8	27	16	6	25	14	4	23	13	2	21	11	0	19	9	28	17	7	26	15	5	24	14	3	22	12	1	20	10	29	18	8	EL.d				
24	46	7	29	50	12	34	55	17	38	0	21	43	4	26	48	9	31	52	14	35	57	19	40	2	23	45	6	28	50	11	33	54	16	EL.m				
36	10	44	18	52	26	0	34	8	42	16	50	24	58	32	6	40	14	48	22	56	30	4	38	12	46	20	54	28	2	36	10	44	18	EL.s				
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67					
4	5	6	6	7	8	8	9	10	10	11	0	0	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	10	11	0	0	1	2	EL.z				
27	16	6	25	15	4	23	13	2	21	11	0	19	9	28	18	7	26	16	5	24	14	3	22	12	1	20	10	29	19	8	27	17	6	EL.d				
37	59	21	42	4	25	47	8	30	51	13	35	56	18	39	1	22	44	6	27	49	10	32	53	15	37	58	20	41	3	24	46	8	29	EL.m				
52	26	0	34	8	42	16	50	24	58	32	6	40	14	48	22	56	30	4	38	12	46	20	54	28	2	36	10	44	18	52	26	0	34	EL.s				
68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101					
2	3	4	4	5	6	6	7	8	8	9	9	10	11	11	0	1	1	2	3	3	4	5	5	6	6	7	8	8	9	10	10	11	0	EL.z				
25	15	4	23	13	2	22	11	0	20	9	28	18	7	26	16	5	24	14	3	23	12	1	21	10	29	19	8	27	17	6	25	15	4	EL.d				
51	12	34	55	17	38	0	22	43	5	26	48	9	31	53	14	36	57	19	40	2	24	45	7	28	50	11	33	55	16	38	59	21	42	EL.m				
8	42	16	50	24	58	32	6	40	14	48	22	56	30	4	38	12	46	20	54	28	2	36	10	44	18	52	26	0	34	8	42	16	50	EL.s				
102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130										
0	1	2	2	3	4	4	5	5	6	7	7	8	9	9	10	11	11	0	1	1	2	2	3	4	4	5	6	6						EL.z				
24	13	2	22	11	0	20	9	28	18	7	27	16	5	25	14	3	23	12	1	21	20	19	10	8	28	17	6	29						EL.d				
4	25	47	9	30	52	13	35	56	18	40	1	23	44	6	27	49	11	32	54	15	37	58	20	42	3	25	46	2						EL.m				
24	58	32	6	40	14	48	22	56	30	4	38	12	46	20	54	28	2	36	10	44	18	52	26	0	34	8	42	16						EL.s				

∘keśarigraṃthe∘…∘ paṃkti∘ cakraṃ∘ P_1 • ∘ karṇakeśarīgraṃtheḥ∘…∘ paṃkticakra∘ R_2

P_1: EL.s(1) 11; EL.s(21) 31; EL.d(27) 17; EL.m(35) 56; EL.s(38) 7; EL.s(40) 13; EL.s(41) 48; EL.d(44) 12, EL.s(44) 31; EL.m(59) 27; EL.s(64) 58; EL.s(73) 52; EL.m(79) 56, EL.s(79) 26; EL.s(80) 59; EL.m(81) 21; EL.s(85) 47; EL.m(107) 42; EL.m(109) 33; EL.s(116) 24; EL.s(117) 59; EL.s(121) 50; EL.s(122) 44; EL.d(124) 29; EL.s(127) 40; EL.s(130) 10.

R_2: EL.s(1) 11; EL.s(21) 31; EL.m(29) 51; EL.z(31) 3; EL.m(35) 56; EL.s(38) 7; EL.s(40) 13; EL.s(41) 48; EL.s(44) 31; EL.s(73) 52; EL.m(79) 46; EL.s(116) 24; EL.s(117) 59; EL.s(121) 20; EL.d(124) 29, EL.d(125) 19; EL.s(127) 40.

MS P_1 has the entries corresponding to argument 38, i.e., | 38 | 7 15 4 8 | repeated twice in adjacent columns.

MS R_2 has scribal corrections for entries of arguments 29 and 79 written in the top and bottom margins respectively. Also, MS R_2 does not have an entry corresponding to argument 130.

kṣepa 0 | 19 | 21 | 34 dhanaṃ is written in a different handwriting to the right of the title in MS R_2.

MS P_2 does not contain this table.

Table III

	|| atha karaṇakesarigranthokte siddhāntarahasye sūryendvoḥ parvānayanārthe candrasya koṣṭhakā avadhyopari ||																									avadhayaḥ	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
	0	0	1	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	0	0	EL.z
	2	16	0	15	29	13	27	11	25	9	23	8	22	7	21	6	21	6	21	6	21	6	21	6	21	5	20	EL.d
	19	41	56	5	10	12	14	16	20	28	42	3	30	5	48	37	33	33	35	39	43	43	46	31	16	53	22	EL.m
	55	1	10	26	35	50	8	1	26	57	48	0	39	27	7	34	11	34	47	40	21	21	16	35	25	20	9	EL.s
	61	61	60	60	60	60	60	60	60	60	61	61	62	62	63	63	64	64	64	64	64	64	63	63	62	62	61	gatiḥ S.a
	46	21	53	26	16	7	5	13	26	53	11	42	14	51	18	44	7	31	33	41	30	16	59	21	56	26	56	S.b
	1 ॥ ×	2	2	1	0 ॥	0 ॥ ×	1 dha	1	1	2	2	2	2	2	2	2	2	0 । dha	0 । dha	0 । ×	1	1	1	1 |	2	2	1×	gatyantaram SD

∘ graṃthokte siddhāṃta ∘…∘ sūryedvoḥ parvana ∘…∘ caṃdrasya koṣṭakā avadhyopari ॥ śrī P_1 • atha ∘…∘ keśarigraṃthokte siddhāṃta ∘…∘ sūryeṃdvauḥ parvanayanārthe sapātacaṃdrasya koṣṭakāḥ tātkālika avadhyopariḥ ॥ R_2

avadhayaḥ ⌋ vadhaya R_2 ∾ gatiḥ ⌋ gati R_2 ∾ gatyantaram ⌋ gatyaṃtara R_2

P_1: S.a(12) 62; EL.d(13) 2; S.a(23) 64.

R_2: EL.s(22) 53, EL.m(23) 40, S.a(23) 64.

MS R_2 has the right marginal column entry (vertically written): pa ma 8 0 | da |

MS P_2 does not contain this table.

Table IV

	|| atha bhujāṃśopari śarāṅgulādi ||																	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	bhujāṃśaḥ
	0	1	3	4	6	7	9	11	12	14	15	17	18	20	21	23	24	śarāṅgulādi
	0	34	9	43	18	52	27	1	36	10	46	15	45	15	45	15	45	
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	śarāntaraḥ
	34	34	35	34	34	34	34	35	34	30	30	30	30	30	30	30	30	

LL.a
LL.b
LD.a
LD.b

°rāṃgulādi] || *omitted* P_1 • °rāṃgulādi | śarāṃtara āveṃtebhujakalāvikalāgomūtrayādiguṇya || R_2

śarāṅgulādi] śarāṃgulāḥ P_1; śarāṃgulādi R_2 ∾ śarāṅtaraḥ] ṃtaraśadā dhanaṃ || P_1; śarāṃtaraḥ R_2

P_1: LL.b(0) 10.

R_2: LL.b(0) 10; LD.(9) 34.

MS P_1 has left marginal entry: || tasya bhujāṃśopari śarāṃgulādi aṃtaraṃ sadā dhanaṃ śaragolopari digjñānaṃ meṣādyāv uttaro golas tulādau dakṣiṇaḥ smṛta ||

MS P_2 does not contain this table.

Table V

॥ atha sapātacandragatyupari ravibimbāṅgulādi ॥																			
59	60	60	60	60	60	61	61	62	62	62	62	63	63	63	64	64	64	64	64	sapātasya gatiḥ	
56	6	12	26	39	59	19	46	6	19	32	52	19	39	59	12	26	32	39	42		
10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	11	11	11	11	11	ravibimbaḥ	SD.a
19	21	22	24	27	31	34	39	42	45	47	51	56	59	2	5	8	9	10	11		SD.b

∘ caṃdra ∘ biṃbāṃgulādi ॥ P_1 and R_2

P_1: Argument 63;59 is 53;59.

R_2: Argument 59;56 is 59;59 and Argument 64;26 is 64;16.

P_1 has additional row headers placed to the right of the table in the margin as seen below:

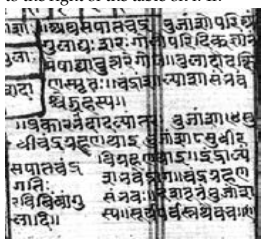
sapātasyagatiḥ	sapātacaṃdragatiḥ
ravibiṃbaḥ	ravibiṃbāṃgulādi ॥

MS P_1 has the following text typeset to the right of the table on the folio: atha sapātacaṃdrabhujāṃśopari aṃgulādyaḥ śaraḥ golopari dikjñānaṃ meṣādyāv uttare gola ॥ tulādau dakṣiṇa smṛtaḥ । caṃdrāṃśālpāśā saṃbhavaś ced grahasya ॥
prakārabhedād alpāṃtaraḥ bhujāṃśā 14 sudhīcaṃdragrahaṇa thāi bhujāṃśā 8 sudhīravigrahaṇa thāi ॥
iṃdrālpaṃśabhaved bhāga ॥ caṃdragrahaṇa saṃbhavaḥ ॥ daśanūnaṃ bhujāṃśasya ॥ sūryaparvas tathaiva ca ॥ 1 ॥

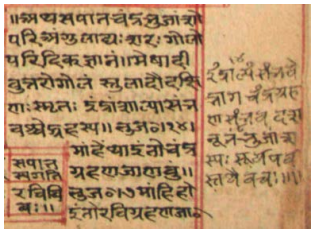
MS R_2 has the following text typeset to the right of the table on the folio: ॥ atha sapātacaṃdrabhujāṃśopari aṃgulādyaḥ śaraḥ golopari dikjñānaṃ ॥ meṣādīvuttaro golaṃstulādau dakṣiṇaḥ smṛtaḥ iṃdrāṃśālpāsaṃbhavaś ced grahasya ॥ bhuja 0 । 14 । māṃheṃthā iṃto caṃdragrahaṇajāṇavuṃ ॥ bhuja 0 । 7 māṃhi ho iṃto ravigrahaṇajā 0 ॥

Additionally, the right margin of R_2 contains the following emendation (in a different handwriting): iṃdrālpaṃ^{14} saṃbhaved bhāga candragrahaṇasaṃbhava daśanū naṃ^{8} bhujāṃśasyaḥ sūryaparvastathaiva caḥ ॥

MS P_1 has the following text (vernacular mixed with Sanskrit) to the right of the table on f. 4r:



MS R_2 has the following text (vernacular) to the right of the table on f. 2v:



MS P_2 does not contain this table.

Table VI

|| atha tither mānaghaṭyopari candrabimbaṃ tathā bhūbhāṅgulādi ||															
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	9
57	47	35	23	12	1	51	41	31	21	13	4	55	47	39	30
30	30	30	29	28	28	27	26	26	25	25	24	24	24	23	23
45	44	2	22	44	7	32	56	26	52	25	56	25	2	36	11

LD.a
LD.b
ES.a
ES.b

∘ tithīr ∘…∘ caṃdrabiṃbaṃ tathā bhūtāṃgu ∘ P_1 • ∘ caṃdrabiṃbatathā ∘ R_2

P_1: ES.b(56) 7; ES.a(57) 27, ES.b(57) 32; ES.a(58) 26, ES.b(58) 56; ES.a(59) 25, ES.b(59) 26; ES.a(60) 25; ES.b(65) 1; ES.a(67) 13.
R_2: LD.a(58) 11; ES.a(60) 25.

MS P_2 does not contain this table.

Table VII

	|| raver vyaṅgulādiphalasaṃskṛte spaṣṭakubhā ||						
	me [ꣻ]	vṛ [꣼]	mi [ꣽ]	ka [ꣾ]	siṃ [ꣿ]	kaṃ [ꣻ]	saṃkrāntayaḥ
AD.a	0	0	0	0	0	0	dhanabhūbhā
AD.b	11	16	20	16	11	0	
	tu [ꣻ]	vṛ [ꣻ]	dha [ꣻ]	ma [ꣻ]	kuṃ [ꣻ]	mī [ꣻ]	saṃkrāntayaḥ
AD.a	0	0	0	0	0	0	ṛṇabhūbhā
AD.b	11	16	20	16	11	0	

∘ vyaṃgulā ∘…∘ spaṣṭakutā P_1 • ∘ vyaṃgulā ∘ R_2

ṛṇa bhūbhā ⌋ raṇa bhūbhā P_1

P_1: Argument kaṃ is kāṃ and Argument mī is mi; AD.b(siṃ) 16.

R_2: Argument ka is rka [perhaps kī]; AD.b(kaṃ) 16; AD.b(mī) 16.

MS R_2 has seventh column entries as

saṃ ∘	dhanaṃ	saṃkrāṃta	ṛṇa

MS P_2 does not contain this table.

Table VIII

	|| khacchinnāṅgulopari mardaghaṭikācakram	60 ||								
	1	2	3	4	5	6	7	8	9	
	59	58	58	58	58	58	57	57	57	HD.a
	0	40	27	15	8	3	57	55	54	HD.b
	0	0	0	0	0	0	0	0	0	HD.c

khacchinnāṃgu ∘…∘ cakraṃ ∘ P_1 and R_2

P_1: HD.a(6) 57.

MS P_2 does not contain this table.

Table IX

	|| atha candrachinnāṅgulopari candrasya madhyasthitighaṭicakram 60 ||																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	58	57	57	57	56	56	56	56	56	55	55	55	55	55	55	55	55	55	55	55	55
	30	55	29	8	51	36	23	12	2	53	45	39	34	29	26	23	21	20	19	18	17

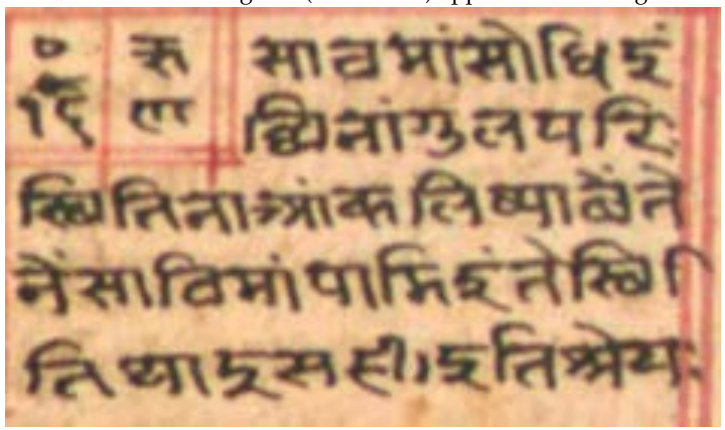
HD.a
HD.b

∘ caṃdrachinnāṃgulopari caṃdra ∘…∘ cakraṃ ∘ P_1 • ∘ caṃdrachinnāṃgulopari caṃdra ∘…∘ ghaṭikādicakraṃ 60 R_2

P_1: HD.a(1) 57; HD.a(5) 57.

R_2: HD.a(1) 57.

MS R_2 has the following text (vernacular) appended to the right of the table on f. 2v:



MS P_2 does not contain this table.

Table X

	|| tithyantakālikā grahā valanārthe sparśakāle tathā mokṣakāle sādhanaṃ candragrahaṇe mūrdhny aṅke bhārdhānvitaṃ kartavyam | lagnārthe ṗy ayaṃ ||																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	avadhiḥ		
0	0	0	1	1	2	2	3	3	4	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	0		SL.z	
2	15	29	12	26	9	22	5	19	2	16	29	13	27	11	25	9	23	8	22	6	20	5	19	3	17	0	grahaḥ	SL.d	
9	46	17	41	2	20	26	54	14	38	7	43	26	16	14	19	30	45	4	23	42	58	10	17	17	10	54		SL.m	
50	25	3	47	25	9	55	17	11	10	20	10	18	35	43	40	35	43	13	40	50	50	42	30	49	13	30		SL.s	
58	58	57	57	57	56	56	57	57	57	58	58	59	59	60	60	60	61	61	61	61	61	60	60	59	59	58	gatiḥ	DM.a	
40	10	42	15	5	56	54	1	15	40	0	31	3	40	7	33	56	21	22	30	19	5	48	10	45	45	45		DM.b	
1 ||×	2	2	1	0 ||	0 |×	0 | dha	1	2	2	2	2	2	2	2	2	2	2	2 dha	2×	2	1	1	1	1	1	1 ×	antaraṃ	DF.a	

tithyataṃkāgrahāḥ ◦…◦ caṃdra ◦…◦ dhri aṃke bhārddhā ◦…◦ karttavyaṃ lagnārthepiyayaṃ P_1 • ◦ tithyāṃtakālikāgrahāḥ ◦…◦ caṃdragrahaṇeṃ mūdhni aṃke ◦…◦ karttavyaṃ ◦ R_2 lagnārthe ṗi yayaṃ *om.* R_2

avadhiḥ] vadhi P_1 ∞ antaraḥ] ṃtara P_1

P_1: DF.a(27)×1.

R_2: SL.s(18) 53.

MS R_2 has ∨ kāli ∨ (in a different handwriting) in the left margin as a correction to the table title on f. 2v. Also, the row headers: avadhiḥ, grahaḥ, gatiḥ, and antaraṃ are absent in MS R_2

MS R_2 has a correction for entry DM.b(26) as $\boxed{\begin{matrix}59\\ 15\\ 4\end{matrix}}$

MS P_2 does not contain this table.

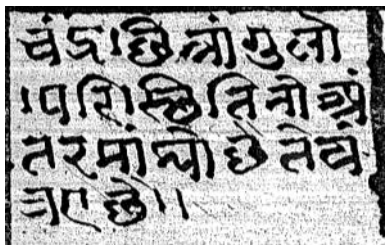
Table XI

	candracchinnāṅgulopari sthitino 'ntaram																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	35	26	21	17	15	13	11	10	9	8	6	5	5	3	3	2	1	1	1	1	0

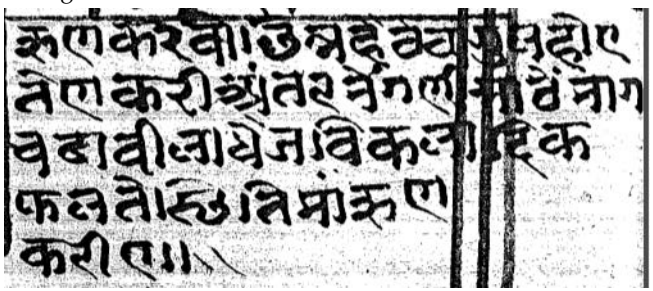
DF.a
DF.b

MS P_1 has the following marginal texts alongside the table:
Left Margin: caṃdracchinnāṃguloparisthitino aṃtaramāṃmyo chaiteyaṃ tra e che || and
Right Margin: ṛṇakaravochinnahavaivagulaho eteneṇakarī aṃtaraneṃgaṇaṃ māṭheṃ bhāga cabāvīlādhaija vikalādikaphalatosthitimāṃ ṛṇa karīe ||

MS P_1 has some vernacular text (transcribed above) to the left of the table on f. 4v:



MS P_1 has the some vernacular text (transcribed above) to the right of the table on f. 4v:



MSS P_2 and R_2 do not contain this table.

Table XII

	|| atha candrachinnāṅgulopari sthityagnibhāgaḥ ||																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	candrachinnāṅgulaḥ
	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	sthityagnibhāgaḥ
	31	42	50	57	3	8	12	16	19	22	25	27	30	30	31	31	33	33	34	34	35	

AB.a
AB.b

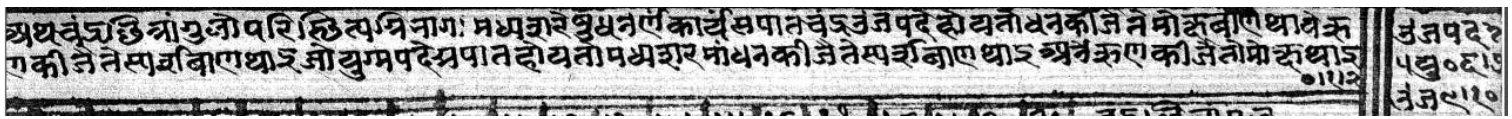
atha caṃdrachinnāṃgulopari sthityagnibhāgaḥ madhyaśareṣu dhanarṇaṃ kāryaṃ sapātacaṃdra ojapade ho yato dhanā kījai te mokṣabāṇa thāyṛ ṛṇa kījai te sparśabāṇa thāijo yugmapade sapāta ho yato madhyaśaramāṃ dhana kījai te sparṣabāṇathāi aneṃ ṛṇa kījai to mokṣa thāi || 0 | 1| 2 ojapada 3 |4 | 5 yu 6 | 7 | 8 oja 9 | 10 | 11 yu || P_1
|| atha caṃdrachinnāṃgulopari sthityagnibhāgaḥ madhyaśareṣu dhanarṇaṃ kāryaṃ sapātacaṃdra ojapade ho yeṃto dhana kījeṃte mokṣabāṃṇa thāyeṃ ṛṇakījeṃte sparśabāṇathāiṃ jo yugmapade sapāta ho iṃto madhyaśaramāṃ dhana kījeṃ te sparṣabāṃṇathāiṃ aneṃ ṛṇa kījeṃto mokṣabāṃṇathāiṃ || 0 | 1| 2 ojapada 3 | 4 | 5 yugmapada ~~e~~ 6 | 7 | 8 | ojapada 9 | 10 | 11 e yugmapada || R_2

candrachinnāṅgulaḥ] caṃdrachinnāṃgula P_1 • caṃdrachinnāgulaḥ R_2

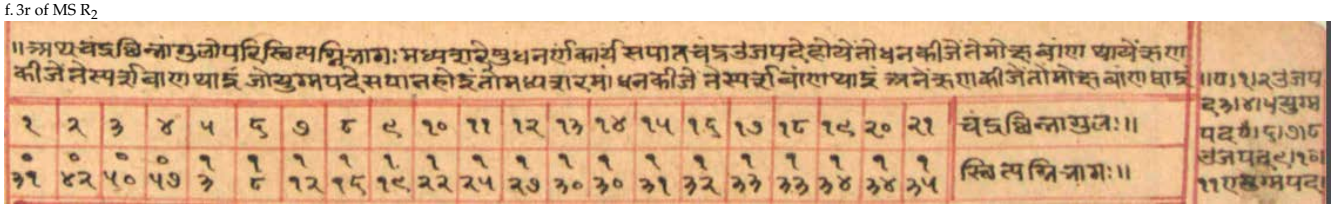
P_1: AB.b(14) 3; AB.b(20) 24.

R_2: AB.b(16) 32.

The table titles in MSS P_1 and R_2 appear to be in a vernacular language (transcribed above), the images of which are shown below:
f. 5r of MS P_1



f. 3r of MS R_2



MS P_2 does not contain this table.

Table XIII

	|| atha madhyabāṇāṅgulopari bāṇaphalam ||																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	śaraphalaṃ
	1	2	3	4	5	7	7	10	11	12	14	15	15	17	19	21	22	23	24	26	27	

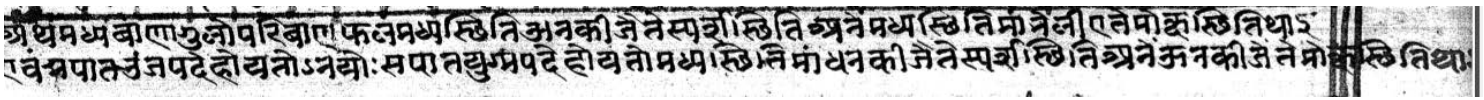
LR.a
LR.b

atha madhyabāṇāṃgulopari bāṇaphalamadhyasthiti ūnakī jai te sparśasthiti aneṃ madhyasthiti māṃ bhelī ete mokṣasthiti thāi evaṃ sapāta ojapade ho yato 'nayoḥ sapātayugmapade ho yato madhyasthiti māṃ dhana kījaite sparśasthiti aneṃ ūnakījaite mokṣasthiti thāi || P_1
|| atha madhyabāṃṇāṃgulopari bāṃṇaphalaṃ || madhyasthiti ūnakījete sparśasthiti aneṃ madhyasthitimāṃ bhelī iṃte mokṣa sthiti thāi evaṃ sapāta ojapadeṃ ho iṃto | anayoḥ sapātayugmapadeṃ ho iṃto madhyasthitimāṃ dhanakījeṃte sparśasthiti aneṃ unakījeṃte mokṣasthiti thāiṃ|| R_2

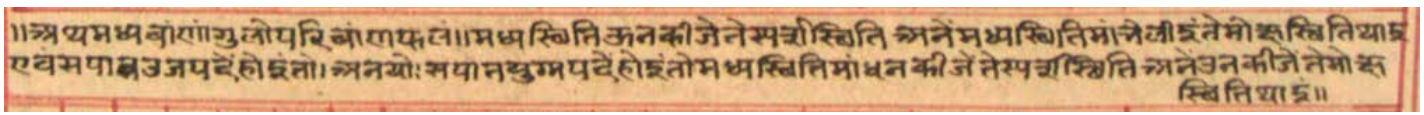
śaraphalaṃ *om.* R_2

The table titles in MSS P_1 and R_2 appear to be in a vernacular language (transcribed above), the images of which are shown below:

f. 5r of MS P_1



f. 3r of MS R_2



MS P_2 does not contain this table.

Table XIV

|| atha khāṅkahataśvaghaśramānena bhakte labdhaṃ natāṃśās tasya tāne 45 śodhyate śodhyāṃśā upary akṣākhyavalanaṃ || nataṃśopari akṣākhyavalanaṃ pūrvanate uttare paścimanate dakṣiṇe valanaṃ ||																							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	natāṃśāḥ	
22	22	22	22	22	22	22	21	21	21	21	20	20	20	19	19	19	18	18	17	17	16	16		VL.d
35	31	26	22	17	13	1	50	39	27	16	56	35	15	55	34	7	40	13	46	19	45	11	valanaṃ	VL.m
39	23	36	5	34	3	45	28	9	52	34	14	55	33	14	53	46	40	33	28	20	26	32		VL.s
$4_{\times}$	4	4	4	4	4	11	11	11	11	11	20	20	20	20	20	27	27	27	27	27	33	33	antaraṃ	DF.m
36	32	32	31	32	30	40	38	39	20	20	20	20	20	20	20	6	26	26	6	6	54	54		DF.s
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	natāṃśāḥ	
15	15	14	13	13	12	11	11	10	9	9	8	7	6	6	5	4	3	3	2	1	0	0		VL.d
37	3	29	51	13	34	56	17	34	51	9	26	43	57	12	27	42	57	9	22	34	47	0	valanaṃ	VL.m
39	45	53	30	3	39	14	49	54	57	2	4	10	59	48	36	25	14	27	21	33	26	3		VL.s
$33_{\times}$	33	33	38	38	38	38	38	42	42	42	42	42	45	45	45	45	45	47	47	47	47		antaraṃ	DF.m
44	54	53	24	24	26	26	26	56	56	56	56	56	12	12	12	12	12	26	27	26	27			DF.s

atha khāṃkāhataṃ śva ∘…∘ labhdanatāṃśātasya ∘…∘ upari akṣakhyavalanaṃ pūrvanate uttare paścimanate dakṣiṇe valanaṃ bhavati \|\| <f. 5r> \|\| natāṃśo ∘…∘ valanaṃ \|\| <f. 5v> P_1 ∘hataṃsca ∘…∘ natāṃśā tasya tānai ∘…∘ upari akṣa $\overset{\text{khya}}{\wedge}$ valanaṃ <f. 3r> \|\| natāṃśo ∘…∘ valanaṃ \|\| <f. 3v> R_2

natāṃśāḥ ⌋ natāṃśā <f. 5r>, natāṃśa \|\| <f. 5v> P_1; natāṃśa <f. 3v> R_2 ∾ valanaṃ ⌋ valana P_1 and R_2 ∾ antaraṃ ⌋ aṃtara <f. 5r>, ṃtaraṃsadā[r]ṇaṃ <f. 5v> P_1; aṃtara <f. 3r> aṃtaraṃ$_{\times}$ <f. 3v> R_2

MS P_1: VL.m(33) 2.

MS R_2: VL.s(19) 26; DF.s(23) 54; DF.s(41) 27; DF.s(42) 26; DF.s(43) 27.

MS R_2 has additional entries DF.m(45) 47$_{\times}$ and DF.s(45) 26. Also, in MSR_2 the original values for DF.m(30) 42 and DF.s(30) 38 are corrected 56 to 26 respectively, and in the bottom margin DF.m(35) 45 and DF.s(35) 12 are corrected to 42 and 56 respectively; and DF.m(40) 47 and DF.s(40) 26 are corrected to 45 and 12 respectively.

MSS P_1 and R_2 run over two folia, with MS P_1 having cells 1 to 22 on f. 5r and 23 to 23 to 45 on f. 5v, and MS R_2 having cells 1 to 22 on f. 3r and 23 to 23 to 45 on f. 3v.

MS P_1 has a right marginal comment on <f. 5r> next to the row entries for difference (aṃtaraṃ) that reads ṃtaraṃsadā [r]ṇaṃ

MS P_2 does not contain this table.

Table XV

	|| atha sapātacandrasūryarāśyupari parveśajñānaṃ rāśīnāṃ cakrasodhyā vinā ||									
	0	5	6	11	17	18	12	23	24	rāśayaḥ
	varuṇa	śaśi	indra	yama	varuṇa	agni	brahmā	indra	kubera	parveśāḥ

P

∘ caṃdra ∘…∘ rāśyuṃ ∘…∘ parveśaṃ ∘…∘ rāśimāṃ ∘ P_1 • ∘ sapātasūrya ∘, –caṃdra– *om.* R_2

MS P_1: P(6) iṃdra; P(12) brāhma; P(23) iṃdra.

MS R_2: P(6) iṃdra; P(23) iṃdra.

MS R_2 has the table heading placed to the right of the table.

MS P_2 does not contain this table.

Table XVI

	|| atha sparśakale tathā mokṣakāle sāyanagrahasya koṭyaṃśopary aṃśādyam ayanajaṃ valanaṃ sāyanagrahakarkādau dakṣiṇe makarādāv uttare valanaṃ deyam ||																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
	0	0	0	1	1	2	2	2	3	3	4	4	5	5	5	6	6	7	7	7	8	8	8	9	9	10	10	10	11	11	12		VL.d
	0	25	50	15	40	6	31	56	21	46	12	36	0	24	48	12	36	0	24	48	12	34	56	20	43	6	28	51	14	37	0		VL.m
	3	13	24	36	48	1	12	24	36	48	1	0	0	0	0	0	0	0	0	0	0	46	36	24	12	0	48	36	24	12	0		VL.s
	25	25	25	25	25	25	25	25	25	25	25	24	24	24	24	24	24	24	24	24	24	22	22	22	22	22	22	22	22	22	20	dhanam	DF.m
	12	12	12	12	12	12	12	12	12	12	12	0	0	0	0	0	0	0	0	0	0	48	48	48	48	48	48	48	48	48	24		DF.s
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60			
	12	12	13	13	13	14	14	14	15	15	15	16	16	16	16	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20			VL.d
	20	40	1	21	42	2	22	43	3	24	42	0	18	36	54	12	30	48	6	24	36	52	7	20	36	50	4	19	33	48			VL.m
	24	48	12	36	1	24	48	12	36	0	0	0	0	0	0	0	0	0	0	0	24	48	12	39	0	24	48	12	36	0			VL.s
	20	20	20	20	20	20	20	20	20	20	20	18	18	18	18	18	18	18	18	18	14	14	14	14	14	14	14	14	14	14		dhanam	DF.m
	24	24	24	24	24	24	24	24	24	24	24	0	0	0	0	0	0	0	0	0	24	24	24	24	24	24	24	24	24	24			DF.s
	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90			
	20	21	21	21	21	21	22	22	22	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	24			VL.d
	58	9	20	31	42	52	3	14	25	36	42	48	54	0	6	12	18	24	30	36	38	40	43	45	48	50	52	55	57	0			VL.m
	48	36	24	11	0	48	36	24	12	0	0	0	0	0	0	0	0	0	0	0	24	48	12	36	0	24	48	12	36	1			VL.s
	10	10	10	10	10	10	10	10	10	10	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	0		dhanam	DF.m
	48	48	48	48	48	48	48	48	48	48	0	0	0	0	0	0	0	0	0	0	24	24	24	24	24	24	24	24	24	0			DF.s

∘ koṭyaṃśopari aṃśādyaṃ āyanajaṃ ∘…∘ sāyanasahakarkādau dakṣiṇe makarādau uttare ∘ P_1 • ∘ koṭyāṃśopari aṃśādyaṃ āyanajaṃ ∘…∘ karkādau dakṣiṇeṃ makarādau uttare valano deyaṃ || R_2 dhanam ⌋ dhanaṃ P_1 and R_2 for DF entries corresponding to 0 to 30 and 31 to 60, *om.* for P_1 and R_2 for DF entries corresponding to 61 to 90.

MS P_1: VL.s(23) 34; VL.d(48) 18.

MS R_2: DF.s(0) 12 dha; VL.s(23) 24; DF.s(30) 24^{dha}; Vl.s(39) 0; VL.d(41) 16; VL.d(48) 18; DF.m(51) 18, DF.s(51) 0; DF.s(60) $^{\text{dha}}24$; DF.m(90) 2.

MS P_1 has the left marginal entries: dha∘ adjacent to the row of DF entries corresponding to the values 0 to 30 and dhana adjacent to the row of DF entries corresponding to the values 31 to 60. It also has a right marginal entry dhanaṃ additional to the row header dhanaṃ for DF entries corresponding to the values 0 to 30.

MS P_2 does not contain this table.

Table XVII

	|| atha sūryasya valanaṃ spaṣṭam | akṣākhyaṃ tathāyanajaṃ valanayor yogāntarāṃśopary aṅgulādyaṃ valanaṃ spaṣṭaṃ sūryasya | sūryasya grāsavalanaṃ paścime deyam | mokṣavalanaṃ pūrve deyam| sūryasya sparśavalanaṃ viparītaṃ deyam | uttare jātaṃ dakṣiṇe deyam | dakṣiṇe jātam uttare deyam ||																								
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
0	0	0	0	0	0	1	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	4	4	SF.a	
7	14	24	34	46	59	8	21	33	44	56	12	27	39	49	0	1	11	23	35	45	57	7	16	SF.b	
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47		
4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	SF.a	
27	39	50	0	9	21	30	39	50	0	6	18	26	35	45	55	3	12	20	26	36	45	53	2	SF.b	

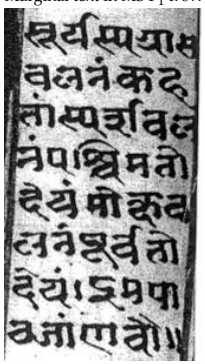
° spaṣṭaṃ | ākṣākhyaṃ tathā āyanajaṃ °…° āyanajaṃ °…° yogāṃtarāṃśo | pari aṃgulā °…° grāśa °…° paścime deyaṃ | °…° pūrve deyaṃ | °…° viparītaṃ deyaṃ | °…° dakṣiṇe jatāṃ uttare deyaṃ P_1 • ° spaṣṭaṃ akṣākhyaṃ °…° tathā āyanayaṃ valanayoryogāṃtarāṃśopari aṃgulā °…° sūryasya sūryasya grāsavalanaṃ pāścime deyaṃ mokṣa °…° deyaṃ sūryasya °…° viparītaṃ deyaṃ$^{\vee}$ dakṣiṇe jātaṃ uttare deyaṃ $\vee$ uttare jātaṃ $\vee$ *right marginal insertion* on f. 4v R_2

MS P_1: SF.b(29) 26.

MS R_2: SF.b(5) 49; SF.b(7) 12.

MS P_1 has sūryasya grāsavalanaṃkahatāṃ sparśavalanaṃ paścimato deyaṃ mokṣavalanaṃ pūrvato deyaṃ | imapāṭhajāṃṇavau || in the left margin of f. 6v.

Marginal text in MS P_1 f. 6v:



MS P_2 does not contain this table.

Table XVIII

	|| atha candrasya valanaṃ spaṣṭam | akṣākhyavalanaṃ tathāyanajaṃ valanayor yogāntarāṃśopary aṅgulādyaṃ valanaṃ spaṣṭam | candragrahaṇe sparśavalanaṃ pūrve deyam | mokṣavalanaṃ paścime deyam | candrasya mokṣavalanaṃ viparītaṃ deyam | uttare jātaṃ dakṣiṇe deyam | dakṣiṇe jātam uttare deyam ||																							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
0	0	0	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5	6	6	6	7	7	SF.a
4	21	40	1	20	40	1	19	40	5	19	39	58	17	40	55	19	22	33	0	40	47	8	24	SF.b
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
7	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	12	13	13	13	13	SF.a
42	3	21	38	0	19	46	59	3	16	35	53	6	20	37	55	10	27	41	53	7	24	35	51	SF.b

∘ caṃdra ∘…∘ spaṣṭaṃ akṣākhya ∘…∘ tathā āyanajaṃ valanayo | ryogāṃtarāṃśopari aṃgulādyaṃ ∘…∘ spaṣṭaṃ caṃdra ∘…∘ purvadeyaṃ mokṣa ∘…∘ paścime deyaṃ caṃdrasya ∘…∘ viparītaṃ deyam uttare ∘…∘ dakṣiṇe deyaṃ | ∘ P_1 • ∘ caṃdra ∘…∘ spaṣṭaṃ akṣākhya ∘…∘ tathā āyanajaṃ valanayoryogāṃtarāśopari aṃgulādyaṃ ∘…∘ spaṣṭaṃ caṃdragrahaṇe ∘…∘ purvadeyaṃ mokṣa ∘…∘ paścime deyaṃ caṃdrasya ∘…∘ viparītaṃ deyam uttare ∘…∘ dakṣiṇe deyaṃ dakṣiṇe ∘ R_2

MS P_1: SF.b(17) 33; SF.b(18) 22; SF.a(35) 11.

MS R_2: SF.b(17) 33; SF.b(18) 22.

MS P_1 has double entries for arguments 29 and 30: the correct ones are as seen above, the incorrect ones are SF.a(29) 9, SF.b(29) 46 and SF.a(30) 9, SF.b(30) 59.

MS P_2 does not contain this table.

Table XIX

		atha sāyanaravirāśyupari dyudalam																													
aṃśaḥ	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	aṃśaḥ
1	15	15	15	15	15	15	15	15	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	vṛ [ʊ]
	50	51	51	53	55	56	58	59	0	2	3	4	6	7	8	10	16	12	14	17	17	19	19	21	21	23	24	26	27	28	
2	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	mi [II]
	30	31	31	31	32	32	34	34	35	35	35	36	36	37	38	38	39	39	40	40	41	42	42	43	43	44	44	45	46	46	
3	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	ka [ꣀ]
	47	46	45	45	44	44	43	43	42	42	41	41	40	40	39	39	38	37	36	36	35	35	34	34	32	32	31	31	31	30	
4	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	15	siṃ [ꣂ]
	30	28	27	26	24	23	22	20	19	18	17	15	14	12	11	10	8	7	6	4	3	2	0	59	58	56	55	54	52	51	
5	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	kaṃ [꣄]
	50	48	46	45	43	41	40	38	36	35	33	31	30	28	26	25	23	21	20	18	16	15	13	11	10	8	6	5	3	1	
6	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	tu [Ω]
	0	58	56	55	53	51	50	48	46	45	43	41	40	38	36	35	33	31	30	28	26	25	23	21	20	18	16	15	13	11	
7	14	14	14	14	14	14	14	14	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	vṛ [꣆]
	10	8	7	6	4	3	2	0	59	58	56	55	54	52	51	50	48	47	46	44	43	42	40	39	38	36	35	34	32	31	
8	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	dha [꣇]
	30	29	29	28	27	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18	17	17	16	15	16	17	14	14	14	13	
9	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	ma [꣈]
	13	13	14	14	15	15	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	26	26	27	27	28	28	29	
10	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	8	kuṃ [꣊]
	30	31	32	34	35	36	38	39	40	42	43	44	46	47	48	50	51	52	54	55	56	56	59	0	2	3	4	5	7	8	
11	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	mī [꣋]
	10	11	13	15	16	18	20	21	23	25	26	28	30	31	33	35	36	38	40	41	43	45	46	49	50	51	52	54	55	57	
0	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	me [ꣃ]
	0	1	3	5	6	8	10	11	13	15	16	18	20	21	23	25	26	28	30	31	32	35	36	38	40	41	43	45	46	48	

HL.g
HL.v

∘ rāśyopari dyudalaṃ P_1; iti caṃdraparvādhikāraḥ added to the left of the title in P_1

aṃśaḥ] aṃ P_1; ꣋mśa R_2

MS P_1: HL.v(1,5) 58; HL.v(1,9) 3; HL.v(1,22) 29; HL.v(2,11) 35; HL.v(2,12) 35; HL.v(3, 17) 38; HL.v(3,24) 33; HL.v(7,29) 36; HL.v(8, 22) 18; HL.g(10,23) 13.
MS R_2: HL.g(1,8) 15; HL.v(2, 17) 19; HL.v(4, 23) 49; HL.v(6, 27) 5.

MS P_2 does not contain this table.

The abbreviated zodiacal signs in the last column of the table stand for the following zodiacal constellations, only seem in MS R_2:

1	vṛ [ʊ]	vṛṣabha	4	siṃ [ꣂ]	siṃha	7	vṛ [꣆]	vṛścika	10	kuṃ [꣊]	kumbha
2	mi [II]	mithuna	5	kaṃ [꣄]	kanyā	8	dha [꣇]	dhanuṣa	11	mī [꣋]	mīna
3	ka [ꣀ]	karkaṭa	6	tu [Ω]	tulā	9	ma [꣈]	makara	0	me [ꣃ]	meṣa

Table XX

	|| atha śrīsūryaparvādhikāraḥ tatra tāvatprathamaṃ sāyanaravirāśyaṃśopari sāyanalagnaṃ karaṇīyaṃ sāyanaravirāśyaṃśopari lagnakoṣṭhakāḥ ||																															
	aṃśaḥ	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	aṃśaḥ	
[♈]	me 0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	me 0	OA.g
		0	7	15	22	30	38	45	53	0	8	16	23	31	38	46	54	1	9	16	24	32	39	47	54	2	10	17	25	32	40		OA.v
		0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24		OA.l
[♉]	vṛ 1	3	3	4	4	4	4	4	4	4	5	5	5	5	5	5	5	6	6	6	6	6	6	6	7	7	7	7	7	7	7	vṛ 1	OA.g
		48	56	5	13	22	31	39	48	57	5	14	22	31	40	48	57	6	14	23	32	40	49	57	6	15	23	32	41	49	58		OA.v
		0	38	16	54	32	10	48	26	4	42	20	58	36	14	52	30	8	46	24	2	40	18	56	34	12	50	28	6	44	22		OA.l
[♊]	mi 2	8	8	8	8	8	8	9	9	9	9	9	9	10	10	10	10	10	11	11	11	11	11	11	12	12	12	12	12	12	13	mi 2	OA.g
		7	17	27	37	47	58	8	18	28	38	49	59	9	19	29	40	50	0	10	20	31	41	51	1	11	22	32	42	52	2		OA.v
		0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48		OA.l
[♋]	ka 3	13	13	13	13	13	14	14	14	14	14	15	15	15	15	15	16	16	16	16	16	16	17	17	17	17	17	18	18	18	18	ka 3	OA.g
		13	24	35	47	58	9	21	32	43	55	6	17	29	40	51	3	14	25	37	48	59	11	22	33	45	56	7	19	30	41		OA.v
		0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40		OA.l
[♌]	siṃ 4	18	19	19	19	19	19	20	20	20	20	20	20	21	21	21	21	21	22	22	22	22	22	23	23	23	23	23	23	24	24	siṃ 4	OA.g
		53	4	15	26	38	49	0	12	23	34	46	57	8	19	31	42	53	5	16	27	39	50	1	12	24	35	46	58	9	20		OA.v
		0	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42		OA.l
[♍]	kaṃ 5	24	24	24	25	25	25	25	25	25	26	26	26	26	26	27	27	27	27	27	27	28	28	28	28	28	28	29	29	29	29	kaṃ 5	OA.g
		32	42	53	4	15	26	37	48	59	10	21	32	43	54	5	16	26	37	48	59	10	12	21	32	43	54	5	16	27	28		OA.v
		0	56	12	48	44	40	36	32	28	24	20	16	12	8	4	0	56	32	48	44	40	36	36	32	28	24	20	16	12	8		OA.l

∘ lagnakoṣṭakāḥ || P_1 • ∘ śopari lagnaṃ kara ∘…∘ lagnakoṣṭakāḥ R_2

MS P_1: first column of signs: aṃśaḥ ⌋ aṃ; me 0 ⌋ rāśi 0; vṛ 1 ⌋ 1; mi 2 ⌋ 2; ka 3 ⌋ 3; siṃ 4 ⌋ 4; kaṃ 5 ⌋ 5 last column of signs: *omitted*

MS R_2: first column of signs: aṃśaḥ ⌋ aṃḥ; ka 3 ⌋ kar 3 last column of signs: aṃśaḥ ⌋ ṁ

MS P_1: OA.g(3,3) 23; OA.l(3,14) 50; OA.v(3,24) [-]5 OA.l(5,5) 4[-]; OA.l(5,6) [-]6; OA.v(5,21) 21; OA.v(5,22) 32, OA.l(5,22) 32; OA.v(5,23) 43, OA,l(5,23) [–]; OA.v(5,24) 54, OA.l(5,24) 24; OA.v(5,25) 5, OA.l(5,25) 24; OA.v(5,26) 16, OA.l(5,26) 16; OA.v(5,27) 27, OA.l(5,27) 1[-]; OA.v(5,28) 38; OA.v(5,29) 49, OA.l(5,29) 4.

MS R_2: OA.l(0,2) 22; OA.v(2,10) 48; OA.v(2,11) 58; OA.l(2,28) 56; OA.v(3, 8) 53; OA.l(5,2) 52.

MS P_1 has the following entries (or part thereof) illegibly smudged: OA.v(3,24), OA.l(5,5), OA.l(5,6), OA.l(5,23), and OA.l(5,27).

MS P_2 does not contain this table.

Table XX

	sāyanaravirāśyaṃśopari lagnakoṣṭhakāḥ | |																																
	aṃśaḥ	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	aṃśaḥ	
[Ω]	tu 6	30	30	30	30	30	30	31	31	31	31	31	32	32	32	32	32	32	33	33	33	33	34	34	34	34	34	34	34	35	35	tu 6	OA.g
		0	10	21	32	43	54	5	16	27	38	49	0	11	22	33	44	54	5	16	27	38	49	0	11	22	33	44	55	6	17		OA.v
		0	56	52	48	44	40	36	32	28	24	20	16	12	8	4	0	56	52	48	44	40	36	32	28	24	20	16	12	8	4		OA.l
[♏]	vṛ 7	35	35	35	36	36	36	36	36	36	37	37	37	37	37	38	38	38	38	38	39	39	39	39	39	39	40	40	40	40	40	vṛ 7	OA.g
		28	39	50	1	13	24	35	47	58	9	21	32	43	54	6	17	28	40	51	2	14	25	36	47	59	10	21	33	44	55		OA.v
		0	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42		OA.l
[♐]	dha 8	41	41	41	41	41	42	42	42	42	42	43	43	43	43	43	43	44	44	44	44	44	44	45	45	45	45	46	46	46	46	dha 8	OA.g
		7	18	29	41	52	3	15	26	37	49	0	11	23	34	45	57	8	19	31	42	53	5	16	27	39	50	1	13	24	35		OA.v
		0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40		OA.l
[♉]	ma 9	46	46	47	47	47	47	47	47	48	48	48	48	48	48	49	49	49	49	49	50	50	50	50	50	50	51	51	51	51	51	ma 9	OA.g
		47	57	7	17	27	38	48	58	8	18	29	39	49	59	9	20	30	40	50	0	11	21	31	41	51	2	12	22	32	42		OA.v
		0	12	24	36	38	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48		OA.l
[♓]	kuṃ 10	51	52	52	52	52	52	52	52	53	53	53	53	53	53	53	54	54	54	54	54	54	54	55	55	55	55	55	55	56	56	kuṃ 10	OA.g
		53	1	10	18	27	36	44	53	2	10	19	27	36	45	53	2	11	19	28	37	45	54	2	11	20	28	37	46	54	3		OA.v
		0	38	16	54	32	10	48	26	4	42	20	58	36	14	52	30	8	46	24	2	40	18	56	34	12	50	38	6	44	22		OA.l
[♈]	mī 11	56	56	56	56	56	56	56	57	57	57	57	57	57	57	57	58	58	58	58	58	58	58	58	59	59	59	59	59	59	59	mī 11	OA.g
		12	19	27	34	42	50	57	5	12	20	28	36	43	50	58	6	13	21	28	36	44	51	59	6	14	22	29	37	44	52		OA.v
		0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24		OA.l

∘ rāśyaṃśyopari ∘ P_1 • ∘ lagnakoṣṭakāḥ \| \| P_1 and R_2

MS P_1: first column of signs: aṃśaḥ ⌋ aṃ; tu 6 ⌋ rā 6; vṛ 7 ⌋ 7; dha 8 ⌋ 8; ma 9 ⌋ 9; kuṃ 10 ⌋ 10; mī 11 ⌋ 11 last column of signs: aṃśaḥ ⌋ aṃ; tu 6 ⌋ rā 6; vṛ 7 ⌋ 7; dha 8 ⌋ 8; ma 9 ⌋ *om.*; kuṃ 10 ⌋ *om.*; mī 11 ⌋ *om.*

MS R_2: first column of signs: aṃśaḥ ⌋ aṃśa; tu 6 ⌋ tula 6; vṛ 7 ⌋ vṛści 7; dha 8 ⌋ dhana 8; ma 9 ⌋ ma ∘ 9; kuṃ 10 ⌋ kuṃ ∘ 10; mī 11 ⌋ mī ∘ 11 last column of signs: *omitted*

MS P_1: OA.g(6,2) 31; OA.g(6, 25) 33; OA.l(8, 5) 4; OA.l(8, 17) 20; OA.v(9,2) 17; OA.l(9,23) 48; OA.g(10, 3) 58; OA.v(11,26) 26.

MS R_2: OA.l(6,25) 26; OA.v(9,1) 47; OA.l(9,2) 14; OA.l(9,23) 48; OA.g(9, 25) 50; OA.l(9, 28) 46; OA.v(10, 2) 17; OA.l(10, 23) 24; OA.l(10,26) 28; OA.l(11,3) 38; OA.l(11,14) 22.

MS P_2 does not contain this table.

The abbreviated names of the zodiacal signs are described in full in the critical apparatus of Table XIX.

Table XXI

|| atha lagnasya kalākoṣṭhakāḥ ||

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalāḥ	
	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	mīna 12	OA.g
I	7	15	22	30	38	45	53	0	8	16	23	31	38	46	54	1	9	16	24	32	39	47	54	2	10	17	25	32	40	48	meṣa 1	OA.v
	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0		OA.l
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
	3	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	7	7	7	7	7	mīna 12	OA.g
I	55	3	10	18	26	33	41	48	56	4	11	19	26	34	42	49	57	4	12	20	27	35	42	50	58	5	13	20	28	36	meṣa 1	OA.v
	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0	36	12	48	24	0		OA.l

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalāḥ	
	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4	vṛṣa 2	OA.g
II	8	17	25	34	43	51	0	9	17	26	34	43	52	0	9	18	26	35	44	52	1	9	18	27	35	44	53	1	10	19	kumbha 11	OA.v
	38	16	56	32	10	48	26	4	42	20	58	36	14	52	30	8	46	14	2	40	18	56	34	12	50	28	6	44	22	0		OA.l
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
	4	4	4	4	5	5	5	5	5	5	5	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	8	8	8	8	vṛṣa 2	OA.g
II	27	36	44	53	2	10	19	28	36	45	53	2	11	19	28	37	45	54	3	11	20	28	37	46	54	3	12	20	29	38	kumbha 11	OA.v
	38	16	54	32	10	48	26	4	42	20	58	36	14	52	30	8	6	24	2	40	18	56	34	12	50	28	6	44	22	0		OA.l

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalāḥ	
	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5	mithuna 3	OA.g
III	10	20	30	40	51	1	11	21	31	42	52	2	12	22	33	43	53	3	13	24	34	44	54	4	15	25	35	45	55	6	makara 10	OA.v
	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0		OA.l
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8	8	9	9	9	9	9	9	10	10	mithuna 3	OA.g
III	16	26	36	46	57	7	17	27	37	48	58	8	18	28	39	49	59	9	19	30	40	50	0	10	21	31	42	52	1	12	makara 10	OA.v
	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0	12	24	36	48	0		OA.l

∘ koṣṭakā || P_1 and P_2 • atha *om*. P_2

kalāḥ ⌋ kalā P_1; kalā P_2; *prius* ka ∘ in row II, *alibi* kalā R_2 ∾ kumbha ⌋ kuṃbha P_1, P_2, and R_2

MS P_1: OA.g(I,23) 3; OA.l(II,16) 18; OA.v(II,17) 16; .

MS P_2: OA.v(II,24) 17, OA.l(II,24) 14; OA.g(III, 11) 2, OA.l(III,11) 0.

MS R_2: OA.l(I,12) 32; OA.v(I,13) 31; OA.l(I,29) 14; OA.l(I,52) 15; OA.l(I 57) 22; OA.l(II,26) 8; OA.v(II,42) 12; OA.l(II,45) 34; OA.l(III,53) 26.

MS P_2 has 60 kalāḥ entries corresponding to each pair of zodiacal signs tabulated in two unequal successive rows of 31 columns (1 to 31) and 29 columns (32 to 60).

MS R_2 has no table title.

Table XXI

	|| atha lagnasya kalākoṣṭhakāḥ ||																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalāḥ	
IV	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	karka 4	OA.g
	11	22	34	45	56	8	19	30	42	53	4	16	27	38	50	1	12	24	35	46	58	9	20	32	43	54	6	17	28	40	dhanus 9	OA.v
	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0		OA.l
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
IV	5	6	6	6	6	6	6	7	7	7	7	7	8	8	8	8	8	9	9	9	9	9	10	10	10	10	10	10	11	11	karka 4	OA.g
	51	2	14	25	36	48	59	10	22	33	44	56	7	18	30	41	52	4	15	26	38	49	0	12	23	34	46	57	8	20	dhanus 9	OA.v
	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0	20	40	0		OA.l
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalāḥ	
V	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	siṃha 5	OA.g
	11	22	33	45	56	7	19	30	41	53	4	15	26	38	49	0	12	23	34	46	57	8	19	31	42	53	5	16	27	39	vṛścika 8	OA.v
	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42	0		OA.l
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
V	5	6	6	6	6	6	6	7	7	7	7	7	8	8	8	8	8	9	9	9	9	9	9	10	10	10	10	10	11	11	siṃha 5	OA.g
	50	1	12	24	35	46	58	9	20	32	43	54	5	17	28	39	51	2	13	25	36	47	58	10	21	32	44	55	6	18	vṛścika 8	OA.v
	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42	0	18	36	54	12	30	48	6	24	42	0		OA.l
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalāḥ	
VI	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	tula 7	OA.g
	10	21	32	43	54	5	16	27	38	49	0	11	22	33	44	54	5	16	27	38	49	0	11	22	33	44	55	6	17	28	kanyā 6	OA.v
	56	52	48	44	40	36	32	28	24	20	16	12	8	4	0	56	52	48	44	40	36	32	28	24	20	16	12	8	4	0		OA.l
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
VI	5	5	6	6	6	6	6	6	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9	10	10	10	10	10	10	tula 7	OA.g
	38	49	0	11	22	33	44	55	6	17	28	39	50	1	12	22	33	44	55	6	17	28	39	50	1	12	23	34	45	56	kanyā 6	OA.v
	56	52	48	44	40	36	32	28	24	20	16	12	8	4	0	56	52	48	44	40	36	32	28	24	20	16	12	8	4	0		OA.l

∘ koṣṭakāḥ || P_1 and P_2 • atha *om.* P_2

kalāḥ] kalā P_1, P_2, and R_2 ∾ dhanus 9] dhana 9 P_1; *prius* dhana 9, *alterum* dhanaḥ 9 P_2; dhana 9 R_2 ∾ tula 7] *prius* tulā 7 P_1; kanyā 6] *alterum* kanyā 6 6 || R_2

alterum [tula 7 / kanyā 6] *transposuit* [kanyā 6 / tula 7] in P_2

MS P_1: OA.l(V,47) 3; OA.l(VI, 7) 38; OA.l(VI, 21) 35; OA.l(VI, 57) 13.

MS R_2: OA.l(IV, 19) 40; OA.g(IV, 38) 6, OA.v(IV, 38) 59, OA.l(IV, 38) 20; OA.v(V, 15) 59; OA.l(VI, 11) 26; OA.l(VI, 19) 24; OA.l(VI, 34) 34.

MS P_2 has entries for OA.v(4,55), OA.l(4,55), OA.v(5,25), OA.l(5,54) illegibly smudged.

MS R_2 has no table title.

Table XXII

	| | kalākoṣṭhakāḥ | |																																
	kalāḥ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalākoṣṭhakāḥ	
	kanyā 6	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	mīna 12	OA.g
I	tula 7	9	18	27	37	46	55	4	14	23	32	41	51	0	9	19	28	37	46	56	5	14	23	33	42	51	0	10	19	28	38	meṣa 1	OA.v
		16	32	48	4	20	36	52	8	24	40	56	52	28	44	0	16	32	48	4	20	36	52	8	24	40	56	12	28	44	0		OA.l
	kalāḥ	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
	kanyā 6	4	4	5	5	5	5	5	5	6	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8	8	8	8	9	9	mīna 12	OA.g
I	tula 7	47	56	5	15	24	33	42	52	1	10	19	29	38	47	57	6	15	24	34	43	52	1	11	20	29	38	48	57	6	16	meṣa 1	OA.v
		16	32	48	4	20	36	52	8	24	40	56	12	28	44	0	16	32	48	4	20	36	52	8	24	40	56	12	28	44	0		OA.l
	kalāḥ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalāḥ	
	siṃha 5	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	vṛṣa 2	OA.g
II	vṛścika 8	9	19	29	39	49	59	9	19	29	39	49	59	9	19	29	39	49	59	9	19	29	39	49	59	9	19	29	39	49	59	kumbha 11	OA.v
		58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2	0		OA.l
	kalāḥ	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
	siṃha 5	5	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9	9	vṛṣa 2	OA.g
II	vṛścika 8	8	18	28	38	48	58	8	18	28	38	48	58	8	18	28	38	48	58	8	18	28	38	48	58	8	18	28	38	48	58	kumbha 11	OA.v
		58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2	0		OA.l
	kalāḥ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	kalākoṣṭhakāḥ	
	karka 4	0	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	5	5	5	mithuna 3	OA.g
III	dhanus 9	10	21	32	43	53	4	15	26	36	47	58	9	19	30	41	52	3	13	24	35	46	56	7	18	29	39	50	1	12	23	makara 10	OA.v
		46	32	18	4	50	36	22	8	54	40	26	12	58	44	31	16	2	48	34	20	6	52	38	24	10	56	42	28	14	0		OA.l
	kalāḥ	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	kalāḥ	
	karka 4	5	5	5	6	6	6	6	6	6	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9	10	10	10	10	10	mithuna 3	OA.g
III	dhanus 9	33	44	55	6	16	27	38	49	59	11	22	32	43	53	4	15	26	36	47	58	9	19	30	41	52	20	13	24	35	46	makara 10	OA.v
		46	32	18	4	50	36	22	8	54	40	26	12	58	44	30	16	2	48	34	20	6	52	38	24	10	56	42	28	14	0		OA.l

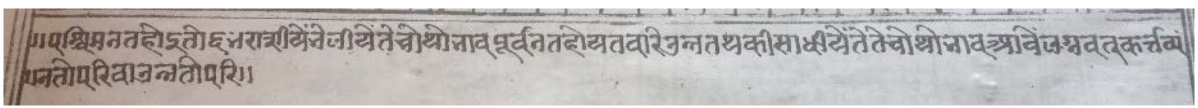
∘ koṣṭakāḥ | | <ff. 3rv>P_2

kalāḥ] kalā P_2; kalākoṣṭhakāḥ] *prius* kalākoṣṭakāḥ on f. 3r, *alterum* kalākoṣṭa on f. 3v P_2 ∾ kumbha 11] kuṃbha 11 P_2 ∾ dhanus 9] dhana 9 P_2

MS P_2: OA.v(I,14) 19; OA.g(III, 39) 7

MS P_2 includes this table on two folia: f. 3r with two blocks of kalās values corresponding to twin pairs of zodiacal signs and f. 3v with one block of kalās values corresponding to twin pairs of zodiacal signs.

MS P_2 has the the following (vernacular) text at the bottom of the table on f. 3v: paścimanata ho i to dvabharāśīyeṃ melīyeṃ te cothobhāva pūrvanata hoyatavāre unnatathakī sādhīyeṃ tete cothobhāva āveṃ lagnavada karttavyaṃ ṇnatoparivā unnatopari | |



MSS P_1 and R_2 do not contain this table.

Table XXIII

	|| atha darśāntalagnārkayor vivarabāhubhāgapramite koṣṭhake madhyamalambanaṃ ghaṭikādi ||																														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	LP.g
	40	42	44	45	46	47	48	49	52	53	54	55	56	56	56	56	57	57	58	58	58	59	59	59	0	59	59	58	58	58	57	LP.v
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	LP.g
	57	56	56	55	55	53	52	50	49	47	46	44	43	42	42	39	36	33	30	27	25	23	19	16	13	11	8	4	59	55	56	LP.v
	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91		
	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		LP.g
	56	42	38	34	29	25	21	15	9	4	58	52	46	40	40	29	23	17	10	3	56	49	42	35	28	21	14	7	1	1		LP.v

∘ darśāṃta ∘…∘ koṣṭake ∘…∘ laṃbaṃnaṃ ∘ P_1

- ∘ darśāṃta ∘…∘ yor vi [x] ra vāhu ∘…∘ koṣṭake∘…∘ maṃ laṃbanaṃ ∘ R_2

MS P_1: LP.g(24) 3; LP.v(37) 53; LP.v(59) 59; LP.v(61) 59.

MS R_2: LP.v(8) 50; LP.v(9) 52; LP.v(10) 53; LP.v(11) 54; LP.v(12) 55; LP.v(15) 57; LP.g(24) 3; LP.v(45) 40; LP.v(59) 59; LP.v(64) 39.

MS P_1 has LP.v(46), LP.v(48), LP.v(49), and LP.v(50) illegibly smudged.

MS P_1 repeats the argument 55 twice instead of 55 and 56.

MS P_2 does not contain this table.

Table XXIV

|| atha sāyanalagnarāśyaṃśopari lambanaspaṣṭaguṇakāḥ ||																														
aṃśa	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
0 [♈]	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	28	28	28	28	28	28	28	28	28	28	28	28	SF.a
	22	24	26	27	29	31	32	34	36	38	39	41	43	45	46	48	53	58	3	8	13	18	23	28	33	38	43	48	53	58	SF.b
1 [♉]	29	29	29	29	29	29	29	29	30	30	30	30	30	30	30	31	31	31	31	31	31	31	31	32	32	32	32	32	32	32	SF.a
	3	11	19	27	35	43	50	58	5	13	22	30	38	47	54	1	5	13	21	29	37	45	53	1	9	17	25	33	41	50	SF.b
2 [♊]	32	33	33	33	33	33	33	34	34	34	34	34	34	34	35	35	35	35	35	35	35	35	35	36	36	36	36	36	36	36	SF.a
	57	6	15	24	32	42	51	0	9	18	27	38	45	54	0	5	12	19	26	33	41	48	56	3	10	17	24	31	39	48	SF.b
3 [♋]	36	37	37	37	37	37	37	37	37	37	37	37	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	39	39	39	SF.a
	54	1	8	16	24	31	36	45	51	52	54	58	2	6	10	14	17	21	24	26	33	40	41	42	48	48	49	0	4	7	SF.b
4 [♌]	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	SF.a
	11	15	18	22	24	28	24	26	27	28	30	31	32	34	35	36	36	38	38	40	42	43	44	46	47	48	49	49	50	51	SF.b
5 [♍]	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	SF.a
	52	53	53	54	55	56	56	57	58	59	59	59	59	58	57	57	57	57	57	57	57	57	56	56	56	55	55	55	55	54	SF.b
6 [♎]	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	SF.a
	54	55	55	55	55	56	56	56	57	57	57	57	57	57	58	58	58	59	59	59	59	58	57	56	55	55	54	53	52	52	SF.b
7 [♏]	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	SF.a
	52	51	50	49	48	47	46	45	44	42	42	41	40	39	39	38	36	35	33	32	30	28	26	25	23	21	19	17	15	14	SF.b
8 [♐]	39	39	39	39	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	37	37	37	37	37	37	37	37	37	37	37	SF.a
	11	9	7	1	56	52	48	44	40	36	33	29	25	21	17	13	9	6	2	58	54	50	46	42	37	33	34	15	8	0	SF.b
9 [♑]	36	36	36	36	36	36	36	36	35	35	35	35	35	35	35	35	34	34	34	34	34	34	34	34	33	33	33	33	33	33	SF.a
	54	46	39	21	25	17	10	3	55	48	40	33	27	19	13	5	58	54	46	37	27	16	10	0	51	42	33	34	15	6	SF.b
10 [♒]	32	32	32	32	32	32	32	32	31	31	31	31	31	31	31	31	30	30	30	30	30	30	30	29	29	29	29	29	29	29	SF.a
	56	48	40	32	25	20	9	1	52	43	36	29	21	13	5	1	53	46	37	30	22	13	6	58	50	52	35	27	18	11	SF.b
11 [♓]	29	28	28	28	28	28	28	28	28	28	28	28	28	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	SF.a
	3	58	53	48	43	38	33	28	23	18	13	28	3	59	53	48	46	44	43	41	39	39	39	38	37	31	29	27	24	21	SF.b

∘ śāyana ∘…∘ laṃbana ∘ P_1 • atha yal laṃbanaṃ sve guṇake guṇyamitiṃ jñeyam || R_2

MS P_1: SF.b(0, 12) 46; SF.b(0, 22) 28; SF.b(2, 19) 23; SF.b(4, 16) 38; SF.b(5,1) 53 *om.*; SF.b(6, 5) 55; SF.b(6, 16) 59; SF.b(6, 21) 59; SF.b(6, 22) 58; SF.b(6, 23) 57; SF.b(6, 24) 56; SF.b(6, 27) 54; SF.b(8, 16) 59; SF.a(9, 1) 32; SF.b(9, 6) 16; SF.b(9, 13) 29; SF.b(9,15) 5 *om.*; SF.b(10, 3) 33; SF.b(10, 8) 42; SF.b(11, 23) 34.

MS R_2: SF.b(7, 7) 44; SF.a(8, 4) 39; SF.b(9, 19) 46; SF.b(11, 14) 3.

MS P_1 has entries for SF.b(5,1) and SF.b(9, 15) blank.

MS P_2 does not contain this table.

Table XXV

	|| atha sāyanalagnarāśyaṃśopari natyaṅgulādi ||																														
aṃśaḥ	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
0 [♈]	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	SF.a
	46	46	45	44	44	43	42	41	41	40	39	39	38	37	37	36	35	33	29	27	25	23	21	19	17	15	13	11	9	7	SF.b
1 [♉]	11	11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	9	9	9	9	9	9	9	9	9	9	SF.a
	5	2	58	55	52	49	45	42	39	36	33	29	26	23	19	16	11	6	2	57	53	48	44	39	34	30	25	20	16	11	SF.b
2 [♊]	9	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	SF.a
	7	2	58	57	46	41	35	30	25	20	14	9	4	58	52	46	40	34	28	21	15	9	2	56	50	44	38	32	27	19	SF.b
3 [♋]	6	6	6	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	SF.a
	13	7	1	54	48	42	36	29	23	16	10	3	57	50	43	37	31	25	19	13	6	0	54	48	42	35	29	23	17	12	SF.b
4 [♌]	3	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	SF.a
	5	59	54	48	43	37	31	26	20	14	9	3	57	52	46	40	36	31	27	22	18	13	9	4	0	56	51	47	42	38	SF.b
5 [♍]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	SF.a
	33	30	27	24	22	19	16	13	10	7	5	2 u	1	3	6	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	SF.b
6 [♎]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 da	0	0	0	0	0	0	0	0	0	SF.a
	24	23	22	21	20	19	18	17	16	15	14	13	12	11	11	9	6	3	1	2 u	5 kṣa	7	10	13	16	19	22	24	27	30	SF.b
7 [♏]	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	SF.a
	33	38	42	47	51	56	0	4	9	13	18	22	27	31	36	40	46	52	57	3	10	14	20	26	31	37	43	48	54	59	SF.b
8 [♐]	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	6	6	SF.a
	5	11	17	23	29	35	42	48	54	0	6	13	19	25	31	37	43	50	57	5	10	16	27	26	39	46	48	54	1	7	SF.b
9 [♑]	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	9	SF.a
	13	19	25	32	38	44	50	56	2	9	15	21	25	28	34	40	49	52	58	4	9	24	20	25	30	35	41	42	59	2	SF.b
10 [♒]	9	9	9	9	9	9	9	9	9	9	9	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	SF.a
	7	11	16	20	25	30	34	39	44	48	53	57	3	6	11	16	19	23	26	29	33	36	39	42	45	49	52	55	58	2	SF.b
11 [♓]	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	SF.a
	5	7	9	13	15	17	19	21	23	25	27	29	35	36	37	37	38	37	38	39	39	40	41	41	42	42	44	44	45	46	SF.b

∘ sāyanaṃ ∘…∘ nati aṃgulādi kanyānānā aṃśa 11 tha kī tulanā aṃśa 19 lagnai uttare anyathā sarvadakṣiṇe || P_1 • ∘ natiaṃgulādi kaṃnyāṃnām aṃśa 11 tha kī te tulanā ṃśa 19 lageṃ uttareṃ ṇyathā sarvadakṣiṇeṃ R_2

aṃśaḥ] aṃ P_1; ṃśa R_2.

MS P_1: SF.b(0, 23) 17; SF.b(0, 24) 15; SF.b(0, 25) 13; SF.b(2, 2) 56; SF.b(2, 28) 25; SF.b(3, 8) 33; SF.b(3, 23) 44; SF.b(3, 29) 11; SF.b(4, 28) 43; SF.b(5, 11) u- *om.*; SF.b(6, 19) u- *om.*; SF.a(6, 20) 0- *om.*, SF.b(6, 20) da and kṣa *om.*; SF.b(9, 7) 50; SF.b(9, 12) 11; SF.a(10, 12) 0.

MS R_2: SF.b(3, 7) 39; SF.b(7, 18) 27; SF.b(7, 25) 39.

MS P_1 has da ∘ at the end of the table to the right of SF entry for (11,29) in a right-adjacent cell.

MS R_2 has the following text in the bottom margin: || iti śrīdaivajñarāmātmajabhāskaravіracite karṇakeśarīgraṃthe caṃdrasūryaparvādhikārakoṣṭakā saṃpūrṇam iti ||

MS P_1 has entry for SF.b(0,22) illegibly smudged.

MS P_2 does not contain this table.

Table XXVI

	|| atha ravichannāṅgulād madhyasthitighaṭikādi ||												
	1	2	3	4	5	6	7	8	9	10	11	12	śrīḥ	
	1	1	1	2	2	2	2	2	2	2	2	0	śrīḥ	FD.a
	7	33	51	5	16	24	31	36	39	40	42	0		FD.b

laṃbanaspaṣṭaṃ guṇakena 2 guṇitaṃ pūrṇanigamair bhakte labdhaṃ spaṣṭalaṃbanaṃ sa tatsaṃ laṃbanaṃ gaṇitā gatadarśe dhanaṃ ṛṇaṃ karttavyaṃ yadā sūryalagnayor vivaratribhāto trirāśito hīnas tadā darśaghaṭīpaleṣu laṃbanaṃ ṛṇaṃ karttavyaṃ yadā trirāśito aṃtaram adhikaṃs tadā darśaghaṭīṣu laṃbanaṃ dhanaṃ kāryam evaṃ kṛte spaṣṭamadhyakālo bhavati || ityādi ||

∘ raviḥ cchannāṃgulāt ∘…∘ ghaṭikādi raver madhyasthitisparśakāle gaṇitā gatakāle darśe hīnaṃ mokṣakāle yutaṃ paścā laṃbanaṃ deyaṃ || śrī || P_1 • ∘ raviḥ channaṃgulāt ∘…∘ ghaṭikādi ravimadhyasthitisparśakāle gaṇītagatakāle darśe hīnaṃ mokṣakāle yutaṃ | paścāl laṃbanaṃ deyaṃ || R_2

∘ spaṣṭaguṇakena guṇakena guṇitaṃ pūrṇaniga[*xx*]kte labdhaṃ ∘…∘ sa tatlaṃbanaṃ gaṇitā gatada[*xxx*]ṛṇaṃ ∘…∘ sūryalagnayor vivaratribhato ∘…∘ trirāśito aṃtaram aṃtaraṃ adhikas tadā ∘…∘ kāryaṃmevaṃ ∘…∘ bhavati || P_1; ityādi || *om.* P_1

∘ṛṇaṃ karttavyaṃḥ yadā trirāśito aṃtaram aṃtaraṃ adhikastadā∘ R_2

śrīḥ *om.* R_2; column header 12 ⌋ 0 R_2

MS R_2 has the table written in the left margin of <f. 7v>, with heading text wrapping in-line along the table to the right and further extending below the table.

MS P_1 has the marginal text to the right of the table, whereas MS R_2 has the marginal text to the right margin on f. 7v.

MS P_2 does not contain this table.

Table XXVII

	|| atha jātake grahāṇāṃ vikalānāṃ koṣṭhakā dinādi ||																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	AS.a
	1	3	5	7	9	10	12	14	16	18	19	21	23	25	27	28	30	32	34	36	37	39	41	43	45	46	48	50	52	54	AS.b
	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0	AS.c
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	AS.a
	55	57	59	1	3	4	6	8	10	12	13	15	17	19	21	22	24	26	28	30	31	33	35	37	39	40	42	44	46	0	AS.b
	48	36	24	12	12	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0	48	36	24	12	0	AS.c

∘ koṣṭakā ∘ P_1

MSP_1: AS.c(32) 37; AS.b(53) 25.

MSS P_2 and R_2 do not contain this table.

Table XXVIII

	|| atha nakṣatrāṇāṃ yonivicāraḥ ||												
i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii	xiii	xiv	
a	bha	kṛ	ro	mṛ	ā	pu	pu	ā	ma	pū	u	ha	ci	nakṣatra
aśva	gaja	chāga	sarpa	sarpa	śvāna	mārjāra	chāga	mārjāra	mūṣaka	dhenu	mahiṣa	vyāghra	mahiṣa	A
devagaṇa	mānava	rākṣasa	mānava	devagaṇa	mānava	devagaṇa	devagaṇa	rākṣasa	rākṣasa	mānava	mānava	devagaṇa	rākṣasa	B
adhama	madhyama	ūrdhva	ūrdhva	madhyama	adhama	adhama	madhyama	ūrdhva	ūrdhva	madhyama	adhama	adhama	madhyama	C
xv	xvi	xvii	xviii	xix	xx	xxi	xxii	xxiii	xxiv	xxv	xxvi	xxvii	xxviii	
sva	vi	a	jye	mū	pū	u	a	śra	dha	śa	pū	u	re	nakṣatra
vyāghra	mṛga	mṛga	śvāna	vānara	nakula	nakula	vānara	siṃha	aśva	siṃha	siṃha	chāga	hāthī	A
devagaṇa	rākṣasa	devagaṇa	rākṣasa	rākṣasa	mānava	devagaṇa	mānava	devagaṇa	rākṣasa	rākṣasa	mānava	mānava	devagaṇa	B
ūrdhva	ūrdhva	madhyama	adhama	adhama	madhyama	ūrdhva	ūrdhva	ūrdhva	madhyama	adhama	adhama	madhyama	ūrdhva	C

MS P_1 has the following text at the bottom of the table: || atha paḍivānau caṃdradeṣā i vānadeṣāyate ūparijñānaṃ || naṃdā 9 digī 10 śa 11 manuṃ 14 ṣoḍaśa 16 nāgacaṃdrā 18 | caṃdrārkabhāgavivare yadi cāṃśakāḥ syuḥ dṛśyas tadā bhavati śītamayūkhamālī || meṣādike dinakare ghaṭabhādvilomaṃ || 1 || śrīḥ ||

MS P_1: B(iv) māṃnava; B(vi) māṃnava, C(vi) ṭhama; A(vii) māṃjara, C(vii) ṭhama; nakṣatra(ix) a; A(ix) māṃjara, B(ix) rākṣa, C(ix) urdhva; B(x) rākṣa; B(xi) māṃnava; B(xii) māṃnava, C(xii) ṭhama; B(xiii) deva, C(xiii) ṭhama; B(xiv) rākṣa; nakṣatra(xv) śvā, B(xv) deva; B(xvi) rākṣa; B(xvii) deva; B(xviii) rākṣa, C(xviii) ṭhama; B(xix) rākṣa, C(xix) ṭhama; B(xx) māṃnava; B(xxi) deva; B(xxiii) deva; A(xxiv) ṣva, B(xxiv) rākṣava; B(xxv) rākṣa, C(xxv) ṭhama; B(xxvi) māṃnava, C(xxvi) ṭhama; B(xxvii) māṃnava.

MSS P_2 and R_2 do not contain this table.

The abbreviated nakṣatra names in the table stand for the following constellations:

i	a	aśvinī	vii	pu	punarvasuaśvini	xiii	ha	hasta	ix	mū	mūla	xv	śa	śatabhiṣaj
ii	bha	bharaṇī	viii	pu	puṣya	xiv	ci	citrā	xx	pū	pūrvāṣādhā	xvi	pū	pūrvabhādrapadā
iii	kṛ	kṛttikā	ix	ā	āśleṣā	xv	sva	svāti	xxi	u	uttarāṣādhā	xvii	u	uttarabhādrapadā
iv	ro	rohiṇī	x	ma	maghā	xvi	vi	viśakhā	xxii	a	abhijit	xviii	re	revatī
v	mṛ	mṛgaśiras	xi	pū	pūrvaphālgunī	xvii	a	anurādhā	xxiii	śra	śravaṇa			
vi	ā	ārdrā	xii	u	uttaraphālgunī	xviii	jye	jyeṣṭhā	xiv	dha	dhaniṣṭhā			

6 CONCLUDING REMARKS

Astronomical table-texts complicate still further the already contentious issue of the nature and goals of critical editions in Sanskrit textual scholarship (Csernel and Patte 2009; Phillips-Rodriguez 2007; Witzel 2014). It is well understood that even the most conscientious critical edition cannot replicate 'the original' form of a text, even though it may successfully restore 'an earlier' version of the textual tradition. Naively, we might expect that a table-text consisting mostly of numerical data would simplify this issue somewhat, as the algorithms used to produce the data provide an independent check on what they are 'supposed' to be. The following list of questions that we have formulated in our analysis of the *Karaṇakesarī* tables reveals the folly of any such expectation, and shows us how much remains to be done in gaining a better understanding of the long-neglected Sanskrit *koṣṭhaka/sāraṇī* genre.

QUESTIONS

How were attested table entries generated, and how should editors decide whether and when to correct apparently erroneous entries or to select one variant reading over another?

As illustrated in our brief analysis of individual tables in Section 4, it is not always clear from the numbers in a table exactly what computations the original compiler performed to produce them, nor are the computational techniques always consistent: e.g., a few key values may be determined by a trigonometric formula and the intervening values filled in by linear interpolation. Even if the generating algorithm is confidently identified, it may be impossible to determine what rounding (or truncating) practices or arithmetic methods the compiler used and how they affected the end result. Finally, the table compiler may have simply miscalculated in carrying out the procedures: should the 'authoritative' value be the one that was actually produced or the one that was presumably intended?

Checking table entries by recomputing them from the generating algorithm is not always a straightforward process, even if the algorithm is known. Differences in accuracy and precision between historical and modern trigonometric procedures, or between sexagesimal numbers and decimal approximations, can often introduce more confusion into the analysis of attested values. Table reconstruction must be carefully designed and documented if it is to serve as a justification for emending the tabulated values.

What was the role of scribes in producing or incorporating additional table data?

We have described in Section 3 the inclusion of various tables in some of the *Karaṇakesarī* manuscripts but not in others. What choices are scribes and/or their patrons making about the selection of tables that constitute a particular text? Are scribes sometimes responsible for adding new content to existing tables, e.g., writing the differences between successive table entries in a separate row? How do specifically astrological tables, such as the ones in MS P_1 of the *Karaṇakesarī*, fit into these practices? We might speculate that the selection and inclusion of such specialized tables may have been part of a process of 'customizing' a table-text for individual users.

How is table paratext determined and distributed?

The authorship of paratextual content in and around tables—table headings and row headers, notes, etc.—is not always easy to determine. Are table headings, for example, passed down along with the versified user instructions as composed by the original compiler of the tables? Or are they sometimes amplified or modified by scribes, along the lines of the brief chapter or subject introductions interspersed throughout verse texts (and generally beginning, like table headings, with the standard transition *atha* 'Now')?

We have seen in Section 3 that some paratextual notes in a vernacular language are recorded in both our manuscripts of the *Karaṇakesarī* tables. Did they originate with the tables themselves or were they contributed by an earlier scribe, or user, and subsequently absorbed into the manuscript tradition? Does the placement of paratext, e.g., in headings as opposed to margins, signify anything about its authorship?

What is the impact of the table-text genre on Sanskrit technical vocabulary?

The use of standard technical terms like *upari* for 'argument', *koṣṭhaka* for 'table entry' or 'table cell', *pramita* 'measured by', 'commensurate with' to indicate the dependence of the tabulated value on the argument, etc., deserves further scrutiny (and is discussed in more depth in (Montelle and Plofker forthcoming)). When did these particular meanings of these terms emerge in scientific Sanskrit, and are there variations in their use that shed light on the evolution of this genre?

How were scribal copying practices adjusted to accommodate tabular data?

Palæographic study of manuscripts of Sanskrit versified texts reveals the fundamentally linear nature of the standard copying process (Murthy 2012): the suc-

cessive syllables of the verses stream across lines and pages, punctuated by vertical bars (*daṇḍa*s) where appropriate. Spaces may be left for rubricated chapter introductions, diagrams, displayed mathematics, etc., but these are just temporary interruptions of the continuous flow of characters. The *koṣṭhaka* form, on the other hand, creates a graphical structure that the scribe must fit the content into, and at present we know very little about the details of the process (Montelle and Plofker forthcoming).

It is clear that scribes would begin the task of reproducing a table by laying out the table grid, but did they then fill in the numbers by individual argument value, or by copying streams of digits all the way across a row or down a column, or some combination? Can we reconstruct from scribal errors the details of these scribal practices?

And how was table content quantified for the purpose of determining scribes' fees? Typically, a manuscript copyist would be paid according to the number of some standard textual units transcribed: the unit might be a line or a page, but typically a verse (*śloka*). As noted in Section 3, one of the *Karaṇakesarī* manuscripts contains the note '*śloka* 115', suggesting that the scribe had copied 115 of some table-content units considered equivalent to a verse. We can only suppose that scribes adopted some convention of assigning to tabular content a *śloka* amount to create a common unit of copying for their payments.

What do *koṣṭhaka* manuscripts reveal about the professional activities of their users?

We remarked in Section 3 the presence of a marginal note in one of the *Karaṇakesarī* manuscripts, in what appears to be a different hand from the copyist's, recording the common difference between entries in the accompanying table. It may be that this was added by a user to facilitate interpolating linearly between table entries in an astronomical calculation.

All of these open questions make the endeavour to produce a critical edition of *koṣṭhaka* tables a rather ambitious project, and we cannot claim to have established a version of the *Karaṇakesarī* tables content that is in any way definitive. They do, however, reveal the importance of such texts for understanding the evolution of second-millennium Sanskrit astronomy, and the vast amount of that evolution that took place within the *koṣṭhaka*/*sāraṇī* genre.

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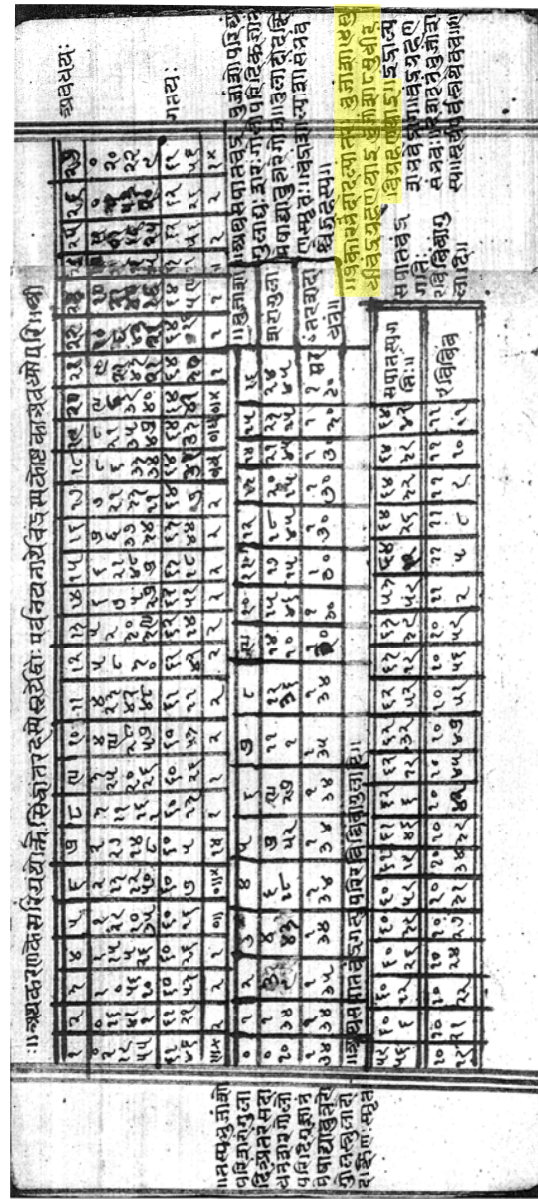
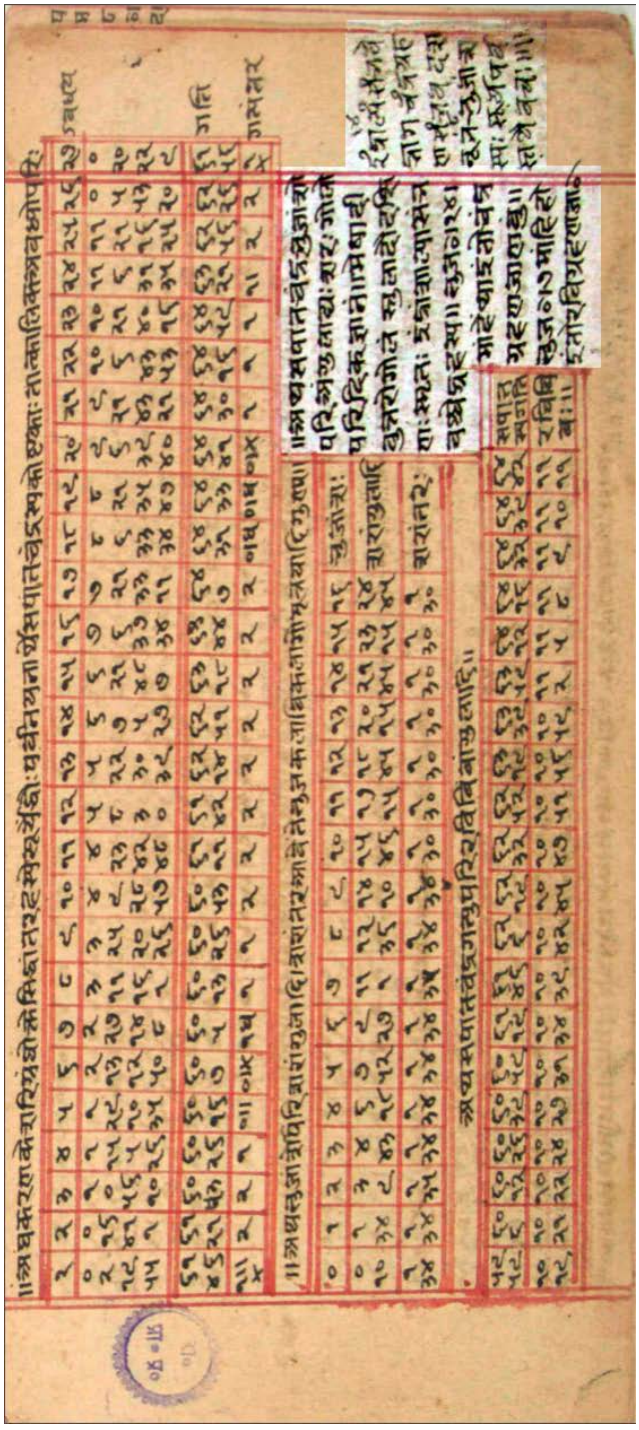
7 APPENDIX

We present here images of certain folia from the manuscripts that contain paratextual information in an unidentified vernacular language written in Nāgarī.

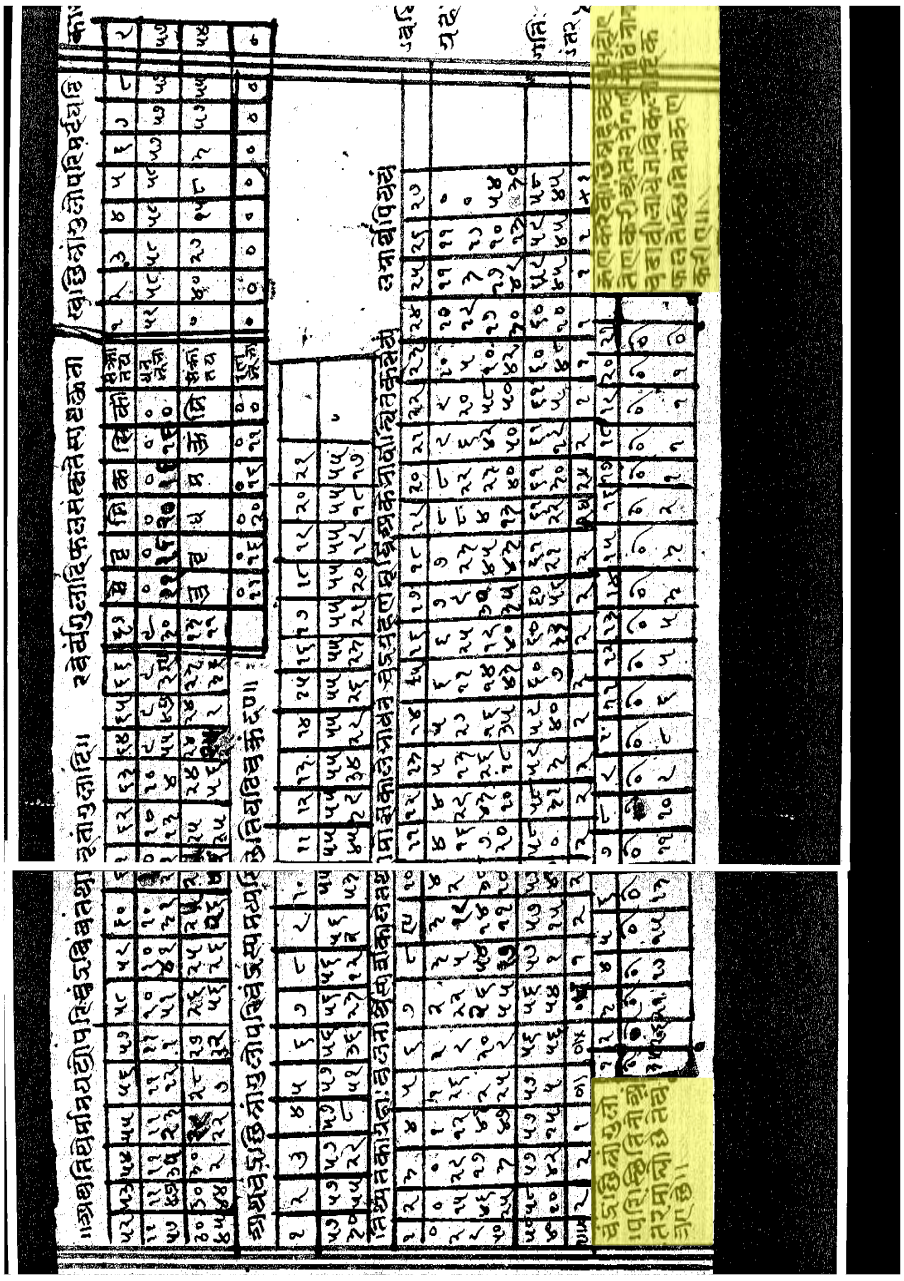


f. 4r of MS P_1 with Table V and associated vernacular paratext.

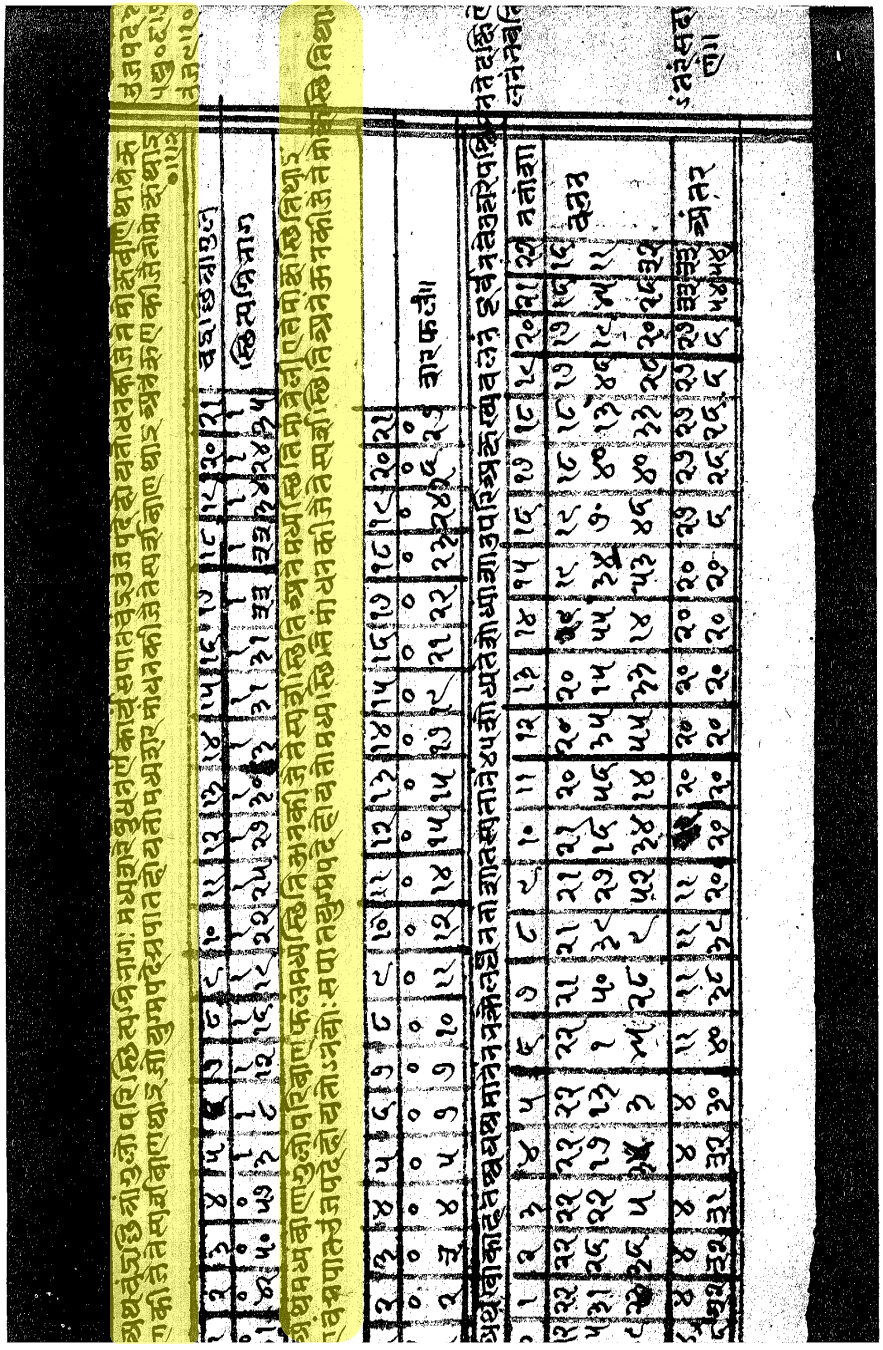


f. 2r of MS R_2 with Table V and associated vernacular paratext.

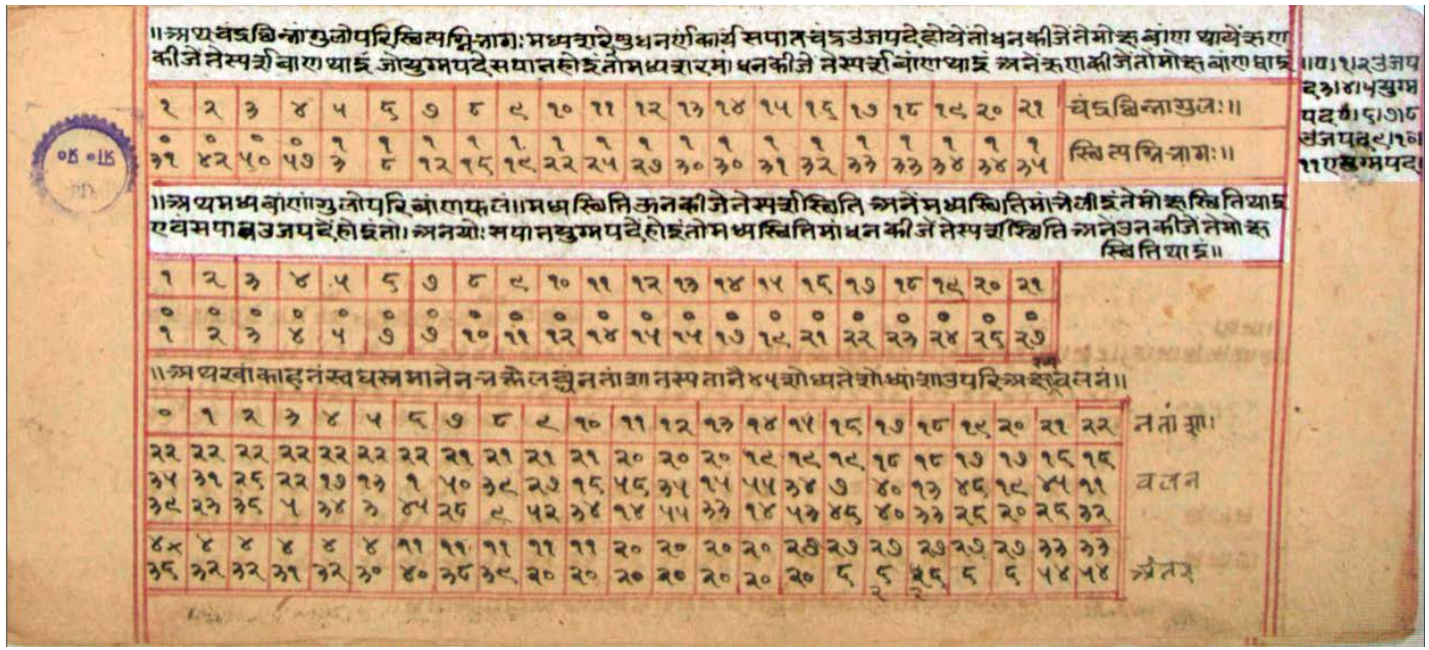
f. 2v of MS R_2 with Table IX and associated vernacular paratext.



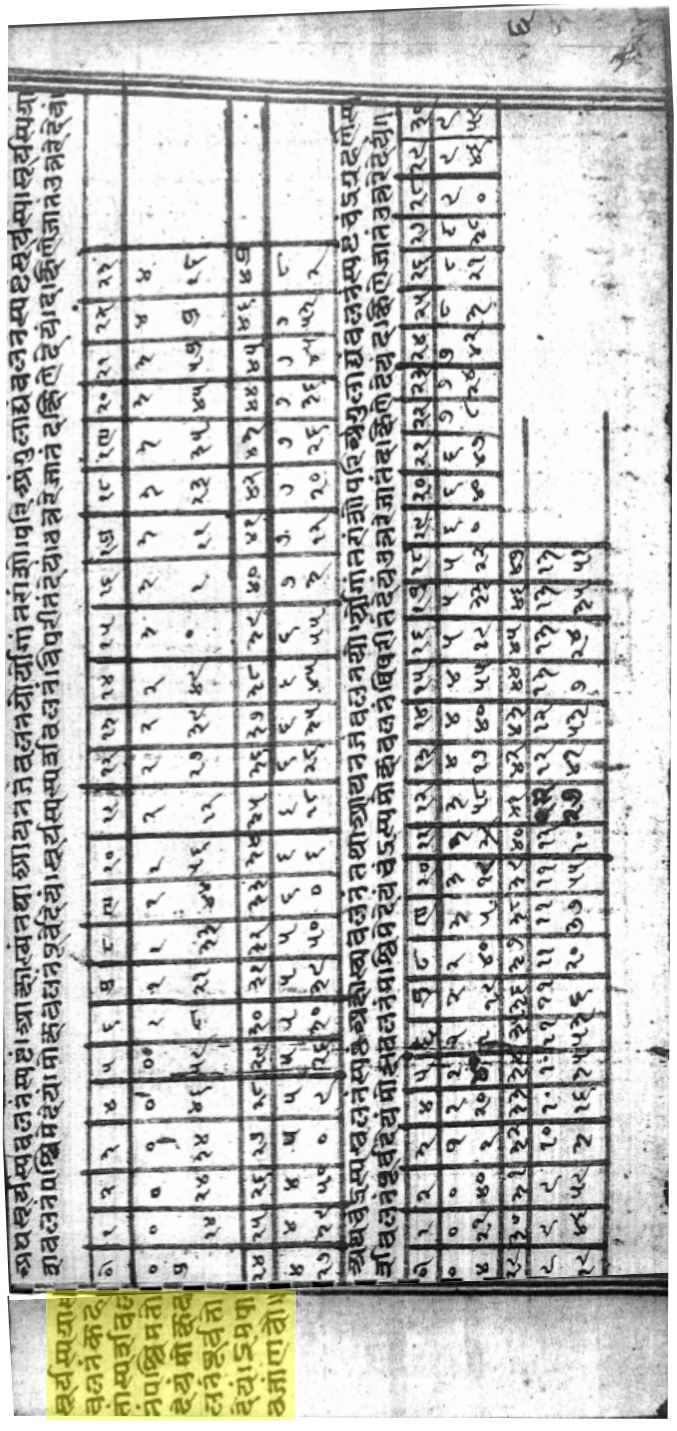
f. 4v of MS P_1 with Table XI and associated vernacular paratext.



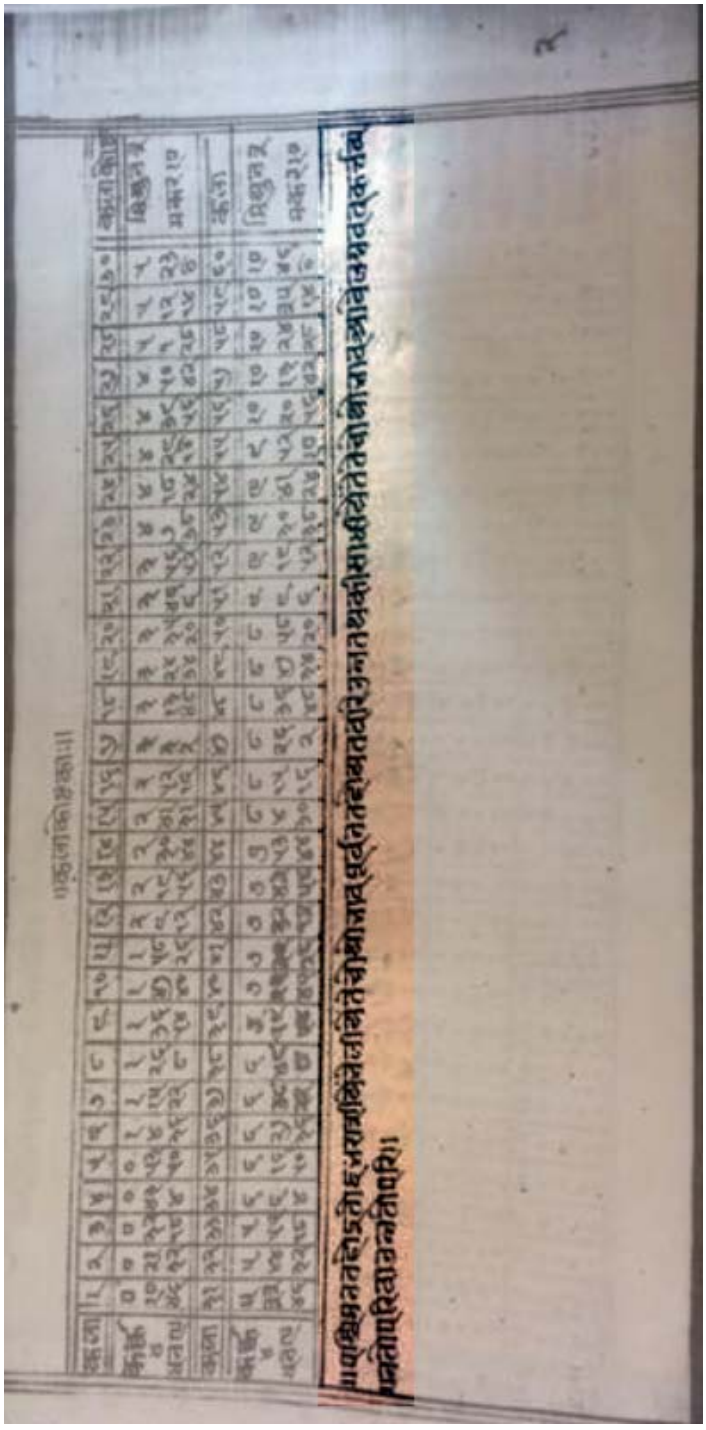
f. 5r of MS P_1 with Table XII and XIII along with their associated vernacular paratext.



f. 3r of MS R_2 with Table XII and XIII along with their associated vernacular paratext.



f. 6v of MS P_1 with Table XVII and associated vernacular marginal text.



f. 3v of MS P_2 with Table XII and associated vernacular paratext.

Please write to ⟨wujastyk@ualberta.ca⟩ to file bugs/problem reports, feature requests and to get involved.
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