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ŚRĪDHARA'S  
LAGHUKHECARASIDDHI

*Edited by*  
**David Pingree,**  
Ph.D.



**Oriental Institute**  
**BARODA**  
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*General Editor*

**A. N. Jani,**

M.A., Ph.D., D.Litt.,  
Kāvyaīrtha,

Director, Oriental Institute, BARODA.

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*Edited by*

**David Pingree,**

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Professor of the History of Mathematics,

Brown University,

U.S.A.





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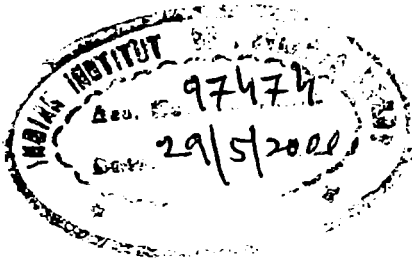
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## FOREWORD

It is a matter of considerable pleasure that *Śrīdhara's Laghukhecarasiddhi*, edited by Dr. David Pingree, Professor of History of Mathematics, Brown University, U.S.A., is being published here as No. 11 in the M. S. University Oriental Series. Some of our readers perhaps remember that it was first printed in the Journal of the Oriental Institute, and is now being brought out separately.

The *Lāghukhecarasiddhi* is a small treatise of the thirteenth century on astronomy, dealing with calculations regarding the movements of the planets.

The Institute is particularly proud in publishing this work, not only because it is a valuable contribution of Gujarat in the field of astronomy, but also on account of the fact that the present work is based on two manuscripts, one from our own collection and the other from that of the India Office Library in London. The latter manuscript, it is especially gratifying to record, is one of those 507 manuscripts ( mostly in Sanskrit ) which were presented in 1809 A.D. to the East India Company by the then Baroda ruler Anandarao Gaekwad ( 1800-1819 ).

It is therefore a happy event that the work returns home after a long absence of one hundred sixtyseven years and that it now sees the light of day in the printed form.

It is hoped students and scholars of astronomy, will welcome the present publication.

Oriental Institute,  
Baroda  
January 27, 1976

A. N. JANI  
Director



## INTRODUCTION

In A.D. 1809 the then Gaekwad of Baroda, Ānandarāja (1800-1819), presented to the East India Company a collection of 507 manuscripts, mostly in Sanskrit. This splendid library of the early nineteenth century is still preserved intact in the India Office Library in London; descriptions of its contents are scattered throughout the pages of the several volumes of part I of that library's *Catalogue of the Sanskrit Manuscripts* (1887-1904).

Nearly a fifth of the Gaekwad's collection—95 manuscripts in all—contain texts on *Jyotiḥśāstra*; they are listed in Appendix A. They range in date from A.D. 1398 (2528 c) to A.D. 1795 (2528 e), and form an invaluable aid to the reconstruction of the history of *jyotiḥśāstra* in Gujarat and the surrounding regions. In particular, they allow us to trace the history of a Gujarātī family of *jyotiḥśāstrīs*, the Girinārāyaṇajñātī, who were active at Jūnāgaḍha and Rājakoṭa between the early fifteenth century and the middle of the eighteenth, and who copied or owned at least 16 of the *jyotiḥśāstra* manuscripts in the collection.<sup>1</sup>

The astronomical texts included in the Gaekwad's collection belong either to the *Brāhmapakṣa*<sup>2</sup> or to the *Gaṇeśapakṣa*.<sup>3</sup> This is precisely what one

1 Pingree D., *Sanskrit Astronomical Tables in England* (hereafter *SATE*), Madras 1973, pp. 186-188.

2 On the characteristics of the *pakṣas* see Pingree D., "On the Classification of Indian Planetary Tables", *Journal for the History of Astronomy* (hereafter *JHA*) 1, 1970, 95-108, and "Essay on the History of Indian Astronomy", to appear in the supplementary volume of the *Dictionary of Scientific Biography*. The *Brāhmapakṣa* texts in the Gaekwad's collection are :  
*Brāhmasphuṭasiddhānta* of Brahmagupta (628). 2529d.  
*Grahañāna* of Āśādharma (1132). 2464b and c. *SATE* 69-72.  
*Karaṇakutūhala* of Bhāskara (1183). 2114a and 2529a.  
*Laghukhecaraśiddhi* of Śrīdhara (1227). 2408b. *SATE* 73-76.  
*Siddhāntasundara* of Jñānarāja (1503). 2114b.  
*Candrārki* of Dinakara (1578). 541e. Pingree D., *Sanskrit Astronomical Tables in the United States* (hereafter *SATIUS*), Philadelphia 1968, pp. 51b-53a.

*Khetasiddhi* of Dinakara (1578). 2648. *SATIUS* 53a-53b and *SATE* 101-112.

*Gaṇitacūdāmaṇi* of Harihara (ca. 1580). 2 08a.

*Tithikalpadruma* of Kalyāṇa (1605). 2529e. *SATE* 123-128.

*Jagadbhūṣaṇa* of Haridatta (1638). 2252. *SATIUS* 55b-59b.

*Grahaśāstrīyādharma* of Vidyādharma (1638). 2083c.

*Pañcāṅgavidyādharī* of Vidyādharma (1643). 2529b. *SATIUS* 60b-61b.

3 The texts that belong to the *Gaṇeśapakṣa* are :

*Grahalāghava* of Gaṇeśa (1520). 2041a, 2114c, and 2181.

*Grahaśāstrīyādharma* of Nṛsimha (1603). 2083d and e. *SATE* 118-123.

*Siddhāntarahasyodāharana* of Viśvanātha (1612). 2041a, 2181, 2545, and 2606.

*Grahaprabodhasārīṇi* of Yādava (1663). 2083a. *SATIUS* 63a-64b. I have not yet been

able to determine the *pakṣas* to which the following two works belong :



expects to find in this region of India at any period after about A.D. 1200. The present paper is the first in a series in which will be published editions of the shorter astronomical texts of these two *pakṣas* preserved in the manuscripts of the Gaekwad's collection and in manuscripts in the Oriental Institute in Baroda, supplemented by those in other libraries of India, Europe, and America.

The *Laghukhecarasiddhi* of Śrīdhara is a short text of 21 verses accompanying a set of planetary tables belonging to the *Brāhmapakṣa*. The epoch of the work is 20 March 1227; as Nīlakaṅṭha, the scribe of manuscript L remarks, this is 16,096 days from the epoch of Bhāskara's *Karaṇakutūhala*, which is 23 February 1183. This interval is equivalent to  $4 \times 4,016$  days; it is interesting to note that 4,016 days is a basic period in the tables of the *Gaṇeśapakṣa*.<sup>4</sup>

The Nīlakaṅṭha mentioned above was a member of the Girinārāyaṇajñāti (II 1 in my tentative genealogy); another member of that family, Harihara (IV 1; *fl. ca.* A.D. 1580), is the only astronomer so far known to have referred to Śrīdhara's work. In verse 114 of his *Gaṇitacūdāmaṇi* he writes :

कुतूहलाद्राजमृगाङ्ककाद्व  
आशाधरात्, खेचरसिद्धितस्तु ।  
पंचाङ्गपत्राद्विदधीत खेटान्  
स्पष्टान् सुखार्थं पुनरत्र सम्यक् ॥

Śrīdhara, in verse 1 of the *Laghukhecarasiddhi*, refers to the *Brahmasiddhānta*, and in verse 21 to the several parts of Bhāskara's *Siddhāntaśiromaṇi*, written in about A.D. 1150. Moreover, as will be shown in the notes, much of Śrīdhara's work is based on Bhāskara's *Karaṇakutūhala*, whose epoch is A.D. 1183, just 43 years before that of the *Laghukhecarasiddhi*, which is, therefore, the earliest text based on that *karāṇa*. We know that Bhāskara's grandson, Caṅgadeva, founded a *maṭha* for the study of his grandfather's works, which was endowed by Soīdeva the Nikumba on 9 August 1207.<sup>5</sup> Further, both Caṅgadeva and his cousin Anantadeva,<sup>6</sup> who established a temple at Bahāḷ in Khāndeśa in A.D. 1222, were astrologers at the court of Siṅghaṇa, the *Yādava* ruler of Devagiri (*ca.* 1210-1246). It is tempting to associate Śrīdhara with these two contemporary relatives of Bhāskara, and to localize him in the territory of the *Yādavas*, probably in Khāndeśa where the inscriptions of Caṅgadeva and Anantadeva were found.

*Laghukarāṇa* of Bhāvā Sadāśiva Bhaṭṭa (1598). 2464d.

*Golasiddhāntacintāmaṇi* of Sadānanda (?). 2408c.

4 *SATIUS* 46b-47b and 62a-64b ; *SATE* 93-100.

5 Pingree D., *Census of the Exact Sciences in Sanskrit* (hereafter *CESS*), A 3 (to appear).

6 *CESS* A 1, Philadelphia 1970, 41a-41b.

The provenance of the surviving manuscripts also suggest western India as the area in which Śrīdhara wrote. Three manuscripts can be definitely asserted to contain the *Laghukhecarasiddhi*.

B. Baroda, Oriental Institute 3094. 2ff. The edges of the leaves are broken off, including some of the text. After the colophon is written : सं. १६७१ ज्येष्ठवदि ५ बुधे सुकदेवेनेदं समलेषि ॥ The date corresponds to 15 June 1614.<sup>7</sup> The text is preserved on ff. 1v-2v; for the tables on ff. 1r and 2v see Appendix B.

L. London, India Office Library 2408 b ( 2930 ).<sup>8</sup> 9ff. After the colophon is written :

संवत् १६११ वर्षे शाके १४७७ प्रवर्तमाने चैत्रशुदि ३ सोमे । अद्येह श्रीजीणंदुर्गे वास्तव्यः  
श्रीगिरिनारायणज्ञातीयः सांकलीयापांड्या श्रीविद्याधरसुतविष्णुरघुनाथनीलकण्ठनरसिंहपुत्रपौत्रादि ष्ठनार्थं  
श्रीनीलकण्ठस्वहस्तेन लिषितं ॥

The date corresponds to 25 March 1555. The text is preserved on ff. 1v-4v.

Calcutta, Asiatic Society G 10081 ( 6842 ). 3ff., of which two ( numbered 3 and 4 ) contain tables. After the colophon is written : शुभं लि° मिश्र टोडरू.  
The manuscript was copied in *Nāgarī* in the eighteenth century.<sup>9</sup> The colophon entitles the work *Khecarasiddhānta*.

There were also three ( or possibly only two ) manuscripts in Oudh in the 1880's that may have contained Śrīdhara's work, though they seem to be too lengthy. The first belonged to *Paṇḍita* Pratāpa Nārāyaṇa of the Allahabad Zila; it is Oudh XX ( 1888 ) VIII 69. 114pp. This manuscript is perhaps identical with another in the catalogue of the same library, Oudh XX ( 1888 ) VIII 71. 16pp., though manuscript 69 is entitled *Khecarasiddhi* and manuscript 71 *Siddhavalī* ( cf. verse 21 d : *satkīrtivallim iva* ). The third manuscript belonged to *Paṇḍita* Vindhyaśvarī Prasāda of the Gonda Zila; it is Oudh XXI ( 1889 ) VIII 6. 12pp., and is entitled *Siddhakheṭī*.

The text here edited is based on manuscripts B and L.

7 The year-number was mis-read as 1971 by Nambiyar R., *An Alphabetical List of Manuscripts in the Oriental Institute, Baroda*, vol. 2, GOS 114, Baroda 1950, p. 1171.

8 SATE 30-31.

9 According to Sengupta P. C., *A Descriptive Catalogue of the Sanskrit Manuscripts in the Collections of the Royal Asiatic Society of Bengal*, vol. 10, part 1, Calcutta 1945, p. 14.

< श्रीश्रीधराचार्यविरचिता >

लघुखेचरसिद्धिः

ओं नमः श्रीगणेशाय ॥  
 नारायणं श्रीधरपादपद्मं  
 पारायणं पुण्यवतां प्रणम्य ।  
 श्रीब्रह्मसिद्धान्तसमां करोमि  
 श्रीश्रीधरः खेचरसिद्धिमल्पाम् ॥ १ ॥  
 नन्दाब्धिरुद्रो नशकोऽर्कनिघ्न-  
 श्वैत्रादिमासैर्युगधोऽष्टयुक्तः ।  
 खभूरसांशेन वियुगदातो  
 युक्तोऽधिमासैः खगुणप्र आद्यः ॥ २ ॥  
 दिनैरधोऽष्टाब्धियुतः स्वराम-  
 खाद्यंशयुग्वेदरसैर्विभक्तः ।  
 लब्ध्वावमोनो विकुरर्कपूर्वः  
 स्याद् द्युव्रजोऽक्षाङ्गुणोद्धृतोऽसौ ॥ ३ ॥  
 ध्रुवाः फलस्था निहताः समेताः  
 क्षेपान्विताः स्युर्ध्रुवकास्तु मध्याः ।  
 फलस्य शेषेण हता द्युयोगा  
 युक्ता ग्रहस्य स्वसमाधुवाद्वयः ॥ ४ ॥  
 गत्यध्वघाता खगजैर्विलिप्ता  
 हता ग्रहे प्राक्परयोर्ऋणं स्वम् ।  
 मध्यो रविर्जीवकुजार्कजानां  
 शीघ्रोच्चसंज्ञाः खचराः स्वयं च ॥ ५ ॥

Apparatus

Invoc. शिवाय B. after श्रीगणेशाय L adds: श्रीसूर्याय नमः ॥ अथ लघुखेचरसिद्धिग्रन्थं लिख्यंते ॥  
 1a श्रीधृत° L. 1c-d °रोमि श्रीश्री° in tear B. 2c स्वयूरसां° in tear B. 2d युतो L.  
 3b खाद्यंश° in tear B. 3c लब्धो B. 4-5b : cf verses added by B after col. 4a  
 फलस्था नि° in tear B. °तास्तत्रैते L, °ताः समेता in marg. L. 4b स्यात् L ध्रुवकः समाद्यः  
 L. 4c स्थानैस्तु शेषैस्तु B. 4d युता L ग्रहः स्यात्सस° B. ध्रुवकाड्याः in tear B. °द्याः in  
 marg L. 5a गत्याध्व° L °घातः BL. 5c-6b om. B.

ज्ञशुक्रयोर्मध्यरविर्ग्रहाः स्युः  
 शीघ्रोच्चसंज्ञौ भवतस्तयोस्तौ ।  
 ग्रहोनमुच्चं मृदुकेन्द्रमस्मिन्  
 त्र्यङ्गाधिके षड्भगणान्तरे दोः ॥ ६ ॥

भौमाशुकेन्द्रस्य पदैष्ययात-  
 स्वल्पस्य लिप्ताः खखवेदभक्ताः ।  
 आप्तांशहीनाद्यमसृङ्मृदूच्चं  
 स्फुटं भवेत् कार्कीमृगादिकेन्द्रे ॥ ७ ॥

भुजांशकाः खेन्दुहृतास्तु मान्द-  
 कोष्ठास्तदैष्यान्तरनिघ्नशेषात् ।  
 दिगात्तयुञ्जन्दफलं ग्रहेषु  
 स्वर्णं स्वकेन्द्रेऽजतुलादिगे स्यात् ॥ ८ ॥

रवेः फलं षड्विहृतं विलिप्ता  
 स्वर्केऽर्कयन्त्रेहृतं विधोस्तु ।  
 मृदूच्चगत्यूनितखेचरस्य  
 गतिर्गतैष्यान्तरताडिताप्ता ॥ ९ ॥

दिग्भिर्विलिप्ता स्वमृणं गतौ स्यात्  
 कुलीरनक्रादिगते स्वकेन्द्रे ।  
 बाणाब्धिवेदोनशकस्य लिप्ताः  
 खान्नाैर्विभक्ता हायनांशकाः स्युः ॥ १० ॥

यदायनांशैः क्रियपूर्वगेऽर्के  
 शङ्कुद्युतिर्मध्यदिनेऽक्षभा सा ।  
 त्रिस्थाक्षया दिग्गजदिग्घतात्त्या  
 त्रयाप्ता चरार्धस्य विनाडिकाः स्युः ॥ ११ ॥

### Apparatus

6a ज्ञशुक्रयोः above line L. 6d °धिके षड्° in tear B; °गणांतरिंदोः L. 7c °व्यमष्ट° in tear B. 8b = 15b, 8c L has मंदफलं मंदकोष्ठके युक्तं कार्यं. 8c °स्यु° in tear B. 8d ऽजितुलादिके L. 9b °हृतं L. 10a गतिविषये above line L. 10c-11b om. L. 11a कयपूर्वगे B. 11b क्षभाया BL. 11d चराख्याश्च B.

युक्तार्थनार्कस्य भुजाभतुल्य-  
 खण्डैक्यमेध्याहतशेषकेन ।  
 व्योमाग्निभक्तेन युतं चरं स्यात्  
 तद्ग्री गतिः षष्टिहृता ग्रहाणाम् ॥ १२ ॥  
 क्षयं स्वमस्तोदययोर्विलिप्ताः  
 सूर्ये तुलादौ स्वमृणं क्रियादौ ।  
 इत्थं रवीन्दू व्रजतः स्फुटत्वं  
 मन्दस्फुटा भूमिसुतादयः स्युः ॥ १३ ॥  
 चरं विधायथ मृदुस्फुटत्वे  
 विधेयमेतेषु विशेष एषः ।  
 ग्रहोनशीघ्रं चलकेन्द्रमेत-  
 च्चक्राद्विशोध्यं रसभाधिकं चेत् ॥ १४ ॥  
 तदंशकाधो दशभिर्हृतः स्यात्  
 कोष्ठस्तदैष्यान्तरनिघ्नशेषात् ।  
 दिगात्तहीनो गतकोष्ठ एष्ये  
 हीनं फलं स्यादधिके तु युक्तम् ॥ १५ ॥  
 स्वर्णं ग्रहे मेषतुलादिकेन्द्रे  
 प्राक्संस्कृतो मन्दफलार्धकाभ्याम् ।  
 ग्रहस्तदुत्थाखिलमन्दजेन  
 मध्योऽथ शीघ्रेण परिस्फुटः स्यात् ॥ १६ ॥  
 फलैर्विपूर्वैर्विकुजा स्फुटा वा  
 मन्दस्फुटा शीघ्रगतेर्विशुद्धा ।  
 भुक्तिर्हता गम्यगतात्तरेण  
 खखाङ्गभक्ता ऋणमल्प एष्ये ॥ १७ ॥

### Apparatus

12a यतुल्यैः L. 13b स्वर्के B. कृयादौ L. 14a विधीयाथ B. मृदुस्फुटत्वं B. 14b विशेषमेषः B.  
 15a तदंशकेभ्यो BL. °गतः BL. 15b=8b. गतकोष्ठकान्तैष्ये कोष्ठके हीने फलकोष्ठके हीनं स्यात् above  
 15c L. 15d हीने BL 16a °तुलादिगे तन् B. 16b मंदचलार्ध° L. 16d पुनः in marg. L.  
 17a °वि° in tear B. 17b गति above line L. 17d °भक्ता om. B, but add above  
 line.

मन्दस्फुटे स्यादधिके जवे स्वं  
 वक्रा गतिश्चेदृणतो विशुद्धा ।  
 मेषादिगोऽर्केऽक्षमुवश्चरेण  
 युक्ता दिनार्धं रहितास्तुलादौ ॥ १८ ॥

सूर्येन्दुयोगस्य स्वगम्यलिप्ताः  
 खखाष्टभिर्व्यर्कविधोर्नखागैः ।  
 भाज्या युतिर्भूतिथियः फलं स्यात्  
 स्वमुक्तिभिर्गम्यगता दिनादिः ॥ १९ ॥

वक्रावक्रोदयास्तोक्त-  
 भागा हीनाथवाधिकाः ।  
 तल्लिप्ताः केन्द्रमुक्त्याप्ता  
 दिनैर्गम्या गताः स्फुटाः ॥ २० ॥

पाटीकुड्कबीजगोलसहितान् गणितान् पैतामहादीन् वयं  
 सिद्धान्तानपि मन्महे प्रतिदिनं खेटानपि प्रस्फुटान् ।  
 इत्याकर्ण्य विदां वचांसि कृपया श्रीश्रीधरः प्रस्फुटां  
 चक्रे खेचरसिद्धिमिन्दुधवलां सत्कीर्तिवल्लीमिव ॥ २१ ॥

इति श्रीगणकचक्रचूडामणिश्रीश्रीधराचार्यविरचिता लघुखेचरसिद्धिः समाप्ता ॥

### Apparatus

18a स्यात्स्वजवे धिके स्वं B, स्यादजवे अधिके जवे स्वं L. गत्याधिके फले above line L. 19d  
 स्वरमुक्तितो B. 20 om. B.

21a गणितान् om. B 21b सिद्धांतानिपि B, सिद्धांतादपि L खेटान् L col. in B : इति  
 श्रीश्रीधरकृता खेचरसिद्धिः ॥ शुभं मे भूयात् after the col. B adds :

लब्धाङ्कसंख्या भवतीह कोष्ठैः संयुतैर्वा विद्युतैस्तथैव ।

तत्कोष्ठकस्था(स्थ)श्रुवन्तान्तरैक्यं

क्षेपः स्थितं (क्षेपान्वितं) स्यात्(द)श्रुवकः समाद्यः(दं) ॥ १ ॥

शुपिण्डशोषाङ्कयुतिशु(शु)भोगै-

स्तथैव साध्याथ समासमाद्याः ।

भवेत्(द)ग्रहः खाष्टहताध्वनिघ्रा

गतिर्ग्रहे प्राक्परयोर्ऋणं स्वम् ॥ २ ॥

Cf. 4-5b.

Mathematical notes.

2-3d. The years since Śaka 1149 = A.D. 1227 multiplied by 12 give the *saura* months; these, as is usual in Indian astronomy, are increased by the lapsed synodic months of the current year beginning with *Caitra*. The sum is approximately the lapsed *saura* months,  $n$ , since epoch. The *adhimāsas*,  $a$ , are found by the formula :

$$a = \frac{60n}{61} \times \frac{1}{32} = 0; 1, 50, 39, 20n.$$

This is an approximation to the correct *Brāhmapakṣa* formula ( *Siddāntaśiromaṇi*, *Grahagaṇita* 1, 2, 10-11 ) :

$$a = \frac{1,593,300,000n}{51,840,000,000} = \frac{5,311n}{172,800} = 0; 1,50,38,45n.$$

The 8 that is added to  $n$  is the *kṣepa* for the beginning of Śaka 1149, representing approximately the accumulated fractional *adhimāsa* at that time. In 1227 there had elapsed since the beginning of the current *Kaliyuga* in —3,101 exactly 4,328 years containing 51,936 *saura* months and 1,596 *adhimāsas*; the accumulated fractional *adhimāsa* was  $0;15,2 = 8 \times 0;1,52,45$ . The sum of the lapsed *saura* months and the lapsed *adhimāsas* is the number of lapsed synodic months.

Thirty times the lapsed synodic months is the number of lapsed *tithis* till the beginning of the current synodic month; this increased by the lapsed days ( *i.e.*, *tithis* ) of the current synodic month is the number of lapsed *tithis*,  $t$ . The formula to find the lapsed *avamas*,  $u$ , is :

$$u = \frac{704t}{703} = \frac{1}{64} = \frac{11t}{703} = 0;0,56,19,48t.$$

This is precisely the approximation used by Brahmagupta in *Brāhmasphuṭa-siddhānta* 1, 42-43. The 48 is another *kṣepa*, representing the accumulated fractional *avama* at the beginning of Śaka 1149. In the 1,972,948,328 years between the beginning of the current *Kalpa* and that date there were, according to the *Brāhmapakṣa*, 11,533,129,713 *avamas*, and the accumulated fractional *avama* was  $0;51,33,46,8,45 = 48 \times 0;1,4,27,12,40,56,15$ . Clearly 48 is not a very good approximation to the *kṣepa* that is required.

The lapsed *tithis* diminished by the lapsed *avamas* equal the lapsed civil days—that is, the *ahargaṇa*. Since the epoch, 20 March 1227, was a Saturday, the *ahargaṇa* diminished by one is a set of days beginning with Sunday.

3d-4. The mean motion tables of the *Laghukhecarasiddhi* give four elements : the mean motions in 1, 10, and 100 “years” of 365 days each; the mean motions in 1, 10, and 100 days; the *kṣepakas* or epoch mean longitudes; and the longitudes of the mandoccas. Therefore, the quotient of the division

of the *ahargaṇa* by 365 is the number of "years" lapsed since epoch. This is factored into multiples of 100, 10, and 1, the appropriate multiplications performed (*nihatāḥ*), the products summed (*sametāḥ*), and the sums added to the *kṣepakas*; the results are the mean longitudes of the planets at the beginning of the current "year" (*svasamādhruvāḥ*). The remainder of the division of the *ahargaṇa* by 365 is the number of lapsed days in the current "year"; this multiplied by the planets' respective mean daily motions gives the mean progresses of the planets during this period. The sum of these mean progresses and the *svasamādhruvāḥ* are the mean longitudes of the planets at 6 A.M. at the prime meridian of the current day.

5a-b. The *deśāntara* correction measures the motion of the planet in the fraction of a day representing the longitudinal difference between a given locality and the prime meridian. In these lines *adhva* is the distance in *yojanas* between the points on the equator intercepted by the local meridian and the prime meridian, and the circumference of the earth is assumed to be 4,800 *yojanas*.

7. This verse is based on *Karaṇakutūhala* 2, 5. The correction is also found in *Siddhāntaśiromaṇi*, *Grahagaṇita* 2, 25 (cf. *Brāhmasphuṭasiddhānta* 2, 37-40), though there the maximum correction is 6;40° rather than  $\frac{2,700'}{400} = 6;45^\circ$ .

8. The tables of the *manda* and *śighra* equations in the *Laghukhecarasiddhi* are for intervals of 10° of argument. This verse instructs one on how to enter these tables and use linear interpolation to find the correct equation.

9a-b. These lines seem to prescribe an increment to the Sun's equation, measured in minutes, of a three hundred and sixtieth, to the Moon's of a hundred and twentieth. Perhaps, however, they are related to *Karaṇakutūhala* 2, 11.

10c-d. It is assumed that the sidereal and the tropical zodiacs coincided in *Śaka* 445 = A.D. 523, and that the tropical vernal point processes from sidereal Aries 0° at the rate of one minute a year or 1° in 60 years.<sup>10</sup> This is the precessional theory of *Karaṇakutūhala* 2, 17, except that Bhāskara makes the year of coincidence A.D. 522.

11-14b. Cf. *Karaṇakutūhala* 2, 19-20.

14c-18b. Cf. *Karaṇakutūhala* 2, 7-15.

19-20. Cf. *Karaṇakutūhala* 2, 21-22. The *śighra*-anomalies required for the occurrences of the planetary phenomena are tabulated with some errors in table 23 of the *Laghukhecarasiddhi*; the correct values are given in *Karaṇakutūhala* 6, 5-8.

<sup>10</sup> See Pingree D., "Precession and Trepidation in Indian Astronomy before A.D. 1200," *JHA* 3, 1972, 27-35.



## APPENDIX A

*Jyotiṣa* Manuscripts in the Gaekwad's Collection. The numbers in parentheses are the serial numbers of the printed catalogue.

- 2041 a (2933) *Grahalāghava* of Gaṇeśa with the *Siddhāntarahasyodāharaṇa* of Viśvanātha. 85ff. Copied from 2181.
- 2041 b (3057) *Tājikālaṅkāra* of Śambhurāma. 35ff.
- 2041 c (2896) *Jyotiṣaratnamālā* of Śrīpati. 36ff.
- 2042 b (3031) *Phaladīpikā* of Haraji. 28ff. Copied (from a manuscript copied?) in Saṃ. 1723 = A.D. 1666.
- 2049 a (3001) *Jyotiṣasāroddhāra* of Harṣakīrti. 20ff. Copied by Labdhicandra, the pupil of Kalyāṇanidhāna, at Bāvalligrāma. *SATE* 25.
- 2049 b (3043) *Aṣṭhavanakṣatraphala*. 30ff. Copied by Gokula Bhaṭṭa on Friday 9 *śuklapakṣa* of *Caitra* in Saṃ. 1688 = 1 April, 1631. *SATE* 25.
- 2049 c (2967) Tables. 24ff. Formerly the property of Jivarāja, < the son of > Prabhūjī Bhaṭṭa. *SATE* 25.
- 2049 d (3039) *Bhuvandīpaka* of Padmaprabhu Sūri. 14ff. *SATE* 26.
- 2051 (3108) *Sarvārthacintāmaṇi* of Veṅkaṭaśarma. Ff. 1-19 and 19b-77.
- 2072 b (2994) *Ṣuṭpañcāśīkāvṛtti* of Bhaṭṭotpala. 11ff.
- 2076 a (3087) *Jātakapaddhati* of Keśava. 13ff. Copied by Mukundajika, the son of Nārāyaṇa Jośī, at Rājakoṭa on Sunday 2 *śuklapakṣa* of *Mārgaśīrṣa* in Saṃ. 1706 = 25 November, 1649.
- 2076 b (3091) *Keśavapaddhatyudāharaṇa* of Viśvanātha. 45ff.
- 2083 a (2969) *Grahaprabodhasārīṇi* of Yādava. Ff. 5-37. *SATE* 26-27.
- 2083 b (2970) *Grahalāghavasārīṇi* I. Ff. 1-2 and 4-8. *SATE* 27.
- 2083 c (2961) *Grahavidyādharma* of Vidyādharma. 6ff. Copied by Morārājika, the son of Prabhūjī Bhaṭṭa, for the use of himself and his brothers Jivarāja and Valabhajī. *SATE* 27.
- 2083 d (2945) *Grahakaumudī* of Nṛsiṃha. 3ff. *SATE* 27-28.
- 2083 e (2946) Tables of the *Grahakaumudī* of Nṛsiṃha. 71ff. *SATE* 28.
- 2091 a (3118a) *Samarasāra* of Rāmacandra. 6ff. Copied by Śivadeva, the son of Harikṛṣṇa, in A.D. 1679.
- 2091 b (3118b) *Samarasāraṭīkā* of Bharata. 15ff. Copied by Śivadeva, the son of Harikṛṣṇa, in A.D. 1679.
- 2091 c (3067) *Laghujātaka* of Varāhamihira. 14ff. Copied by Prabhujika, the son of Mukundajī Bhaṭṭa of the Girinārāyaṇajñāti, at Nūtanapura on Friday 7 *śuklapakṣa* of *Āśāḍha* in Saṃ. 1797 = 13 June, 1740 for the brothers Jivarā < ja >, Vallabhajī, Morārājī, and Bhavānī.
- 2091 d (3011) *Praśnajñāna* of Brahmārka. 13ff. Copied on Saturday 6 *kṛṣṇapakṣa* of *Caitra* in Saṃ. 1692 = 16 April, 1636.

- 2093 (2853) *Gaṇitatattvacintāmaṇi* of Lakṣmīdāsa. Ff. 1-138, 140-198, and 200-255. Copied by Roḍūrāma at Oḍapura on Thursday 7 śuklapakṣa of Mārgaśiṛṣā in (expired) Saṃ. 1817 = 3 December, 1761 Gregorian.
- 2110 (2990) *Yogayātrā* of Varāhamihira. Ff. 3-30. Copied by Bhāṇajī, the son of Vidyādhara of the Girinārāyaṇajñāti, on Saturday 1 kṛṣṇapakṣa of Māgha in Saṃ. 1728, Śaka 1593 = 2 February, 1672.
- 2114 a (2927) . *Karaṇakutūhala* of Bhāskara with a bhāṣya. Ff. 2-73. Copied in A.D. 1510.
- 2114 b (2902) *Siddhāntasundara* of Jñānarāja. 37ff. Copied in A.D. 1782.
- 2114 c (2938) *Grahalāghava* of Gaṇeśa. Ff. 1-8, 10-12, and 14.
- 2114 d (2978) *Pārasīprakāśa* of Vedāṅgarāya. 11ff.
- 2115 (2999) *Jyotiṛvidābharaṇa* of Kālidāsa, 102ff.
- 2119 (2897) *Jyotiṣaratnamālā* of Śrīpati with the vivaraṇa of Mahādeva- 148ff.
- 2123 (3019) *Muhūrtacintāmaṇi* of Rāma with his own *Pramitākṣarā*. Ff. 1-55 and 55b-196.
- 2151 (3090) *Keśavapaddhatyudāharaṇa* of Viśvanātha. 57ff.
- 2171 (2989) *Bṛhatsaṃhitāvivṛti* of Bhaṭṭotpala. 532ff.
- 2181 (2932) *Grahalāghava* of Gaṇeśa with the *Siddhāntarahasyodāharaṇa* of Viśvanātha. 85ff.
- 2182 (3052) *Varṣatantraṭīkā* of Viśvanātha. 57ff.
- 2186 (3106) *Śakunārṇava* of Vasantarāja. 97ff.
- 2219 (2983) *Bṛhatsaṃhitā* of Varāhamihira. 37ff.
- 2252 (2971) *Jagadbhūṣaṇa* of Haridatta. Ff. A, 1-13, B, and 14-88. Formerly the property of Maṇirāma Govīnda Śarman. Contains a record of the nativity of Bahurāvala, the son of Latasiṃghajī, on Saturday 2 kṛṣṇapakṣa of Māgha in Saṃ. 1755, Śaka 1620 = 4 February 1699. SATE 28-30.
- 2328 (3014) *Hāyanaratna* of Balabhadra. 222ff.
- 2330 (3073) *Vṛddhayavanajātaka* of Mīnarāja. 282ff.
- 2339 (3074) *Vṛddhayavanajātaka* of Mīnarāja. 283ff. Copied from 2330.
- 2343 a (2907) *Yantrarājaṭīkā* of Malayendu. 23ff.
- 2343 b (2906) *Yantrarājaṭīkā* of Malayendu. 60ff.
- 2345 b (3136) *Svapnacintāmaṇi* of Jagaddeva. Ff. 1-7, 13-15, 18, and 21-29. Copied by Sāmi Harisaṃkaragiri for Rāma on Sunday 2 kṛṣṇapakṣa of Jyeṣṭha in Saṃ. 1687 = 16 May, 1630.
- 2345 c (3133) *Ramalaśāstra* of Rāma .13ff. Copied on Sunday 1 śuklapakṣa of Āṣāḍha in Saṃ. 1810 = 1 July, 1753 Gregorian.
- 2356 (3075) *Jātakābharaṇa* of Ḍhuṇḍhirāja. 83ff.
- 2359 a (3062) *Tājikakaustubha* of Bālakṛṣṇa Bhaṭṭa. 42ff. Copied by Rāma-kṛṣṇa Muni at Bhilaiḍānagara in Meḍapāṭadeśa on the side of Mt.

- Citrakūṭa on Friday 12 *śuklapakṣa* of Śrāvāṇa in *Sam.* 1810, Śaka 1675 = 10 August 1753 Gregorian.
- 2359-b (3063) *Tājikabhūṣaṇa* of Gaṇeśa. 26ff. Copied in A.D. 1733.
- 2359 c (3095) *Janmapaddhati*. 12ff.
- 2367 (2798) *Lilāvati* of Bhāskara. 52ff.
- 2372 a (3060) *Tājikapaddhati* of Keśava. 7ff. Copied by Mujundajika, the son of Nārāyaṇa Jośī of the Girinārāyaṇajñāti, at Rājadurga on Friday 7 *kṛṣṇapakṣa* of *Caitra* in *Sam.*, 1706 = 12 April 1650.
- 2372 b (3080) *Muktāvalipaddhati* of Śīva. 7ff. Copied by Mukundajika, the son of Nārāyaṇa Bhaṭṭa, for his son Viśvanātha on Sunday 2 *śuklapakṣa* of *Māgha* in *Sam.* 1721, Śaka 1586 = 7 January 1665.
- 2408 a (2924) *Gaṇitacūḍāmaṇi* of Harihara. 13ff. Copied by Puruṣottama, the son of Narasiṃha of the Girinārāyaṇajñāti, on Friday 2 *śuklapakṣa* of *Mārgaśīrṣa* in *Sam.* 1656, Śaka 1521 = 9 November 1599. *SATE* 30.
- 2408 b (2930) *Laghukhecarasiddhi* of Śrīdhara. 9ff. Copied by Nilakaṇṭha, the son of Vidyādhara of the Girinārāyaṇajñāti, for himself and his brothers Viṣṇu, Raghunātha, and Narasiṃha at Jirṇadurga on Monday 3 *śuklapakṣa* of *Caitra* in *Sam.* 1611, Śaka 1477 = 25 March 1555. *SATE* 30-31.
- 2408 c (2903) *Golasiddhāntacintāmaṇi* of Sadānanda. 10ff. *SATE* 31.
- 2409 a (2792) *Lilāvati* of Bhāskara. 23ff. Copied for Mathurādāsa, the son of Trigovinda Śarman, at Mihakaragrāma near Bālāpura in Varāradsa on Thursday 12 *kṛṣṇapakṣa* of *Jyeṣṭha* in *Sam.* 1653 = 10 June 1596.
- 2426 (2895) *Jyotiṣaratnamālā* of Śrīpati. 41ff. Copied on Sunday <1> 2 *śuklapakṣa* of *Caitra* in *Sam.* 1730 = 5 April 1674.
- 2457 (3079) *Kāmadhenupaddhati* of Jayarāma Bhaṭṭa. 71ff. Copied on Sunday 5 *śuklapakṣa* of *Mārgaśīrṣa* in Śaka 1650 = 24 November 1728.
- 2460 (3025) *Muhūrtamārtaṇḍa* of Nārāyaṇa with his own *Mārtaṇḍavallabhā*. 121ff.
- 2464 a (2941) *Kalpalatā*. 28ff. *SATE* 31.
- 2464 b (2922) *Grahañjāna* of Āśādhara. 5ff. Copied by Nilakaṇṭha, the son of Nārāyaṇa Bhaṭṭa of the Girinārāyaṇajñāti, on Monday 13 *kṛṣṇapakṣa* of *Āśāḍha* in *Sam.* 1694, Śaka 1559 = 10 July 1637. *SATE* 31-32.
- 2464 c (2923) Tables of the *Grahañjāna* of Āśādhara. Ff. 1 and 3-6. Copied by Vidyādhara Jośī of the Girinārāyaṇajñāti. *SATE* 32.
- 2464 d (2949) *Laghukaraṇa* of Bhāvā Sadāśīva Bhaṭṭa. 7ff. *SATE* 32-33.
- 2464 e (3040) *Yaddhajayārṇavatantra*. 33ff. Copied for Durlabharāma on 8 *kṛṣṇapakṣa* of *Māgha* in *Sam.* 1838 = ca. 5 February 1782 Gregorian. *SATE* 33.
- 2464 f (2880) *Gaṇitasārasaṅgraha* of Mahāvīra. 82ff. Copied for Brahmaśāmala, the pupil of Bhaṭṭāraka Sumatikīrtideva of the spiritual lineage

of Kundakundācārya in the *Balātkāra gaṇa* in the Sarasvatigaccha of the Mūlasaṅgha. Donated by members of the Humbajñāti and the Uttareśvaragōtra at Jaladurga. *SATE* 33-34.

- 2491 (3051) *Samjñātāntra* of Nilakaṅṭha with the *īkā* of Viśvanātha. 97ff.
- 2508 (2899) *Sārāvalī* of Kalyāṇavarman. Ff. 1-34, 38-163, and 165-168.
- 2517 (3000) *Jyotiribandha* of Śivarāja. Ff. 1-72 and 72b-330.
- 2520 a (3100) *Yavanajātaka* of Yavanācārya and *Bālabodhajātaka* of Haridatta. 32ff. Formerly the property of Jivarāja, the son of Prabhuji Bhaṭa.
- 2520 b (3065) *Bṛhajjātaka* of Varāhamihira. Ff. 1-6, 8-18, 20-28 and 32-37.
- 2520 c (3070) *Laghujātaka* of Varāhamihira with the *Śiṣyāhitā* of Bhaṭṭotpalā. 31ff.
- 2521 a (3048) *Tājika* of Nilakaṅṭha. 38ff. Copied by Nātharāma at Savāi Jayapura on Thursday <1> 3 *śuklapakṣa* of *Caitra* in *Sam.* 1817, *Śaka* 1682 = 16 April 1761 Gregorian.
- 2528 a (3022) *Muhūrtakalpadruma* of Viṭṭhala Dikṣita. 36ff. Copied by Śivadeva on Saturday 3 *kṛṣṇapakṣa* of *Pauṣa* in *Sam.* 1749, *Śaka* 1614 = 14 January 1693.
- 2528 b (3036) *Vivāhapaṭala* of Śārṅgapāṇi. 30ff. Copied on Thursday 15 *śuklapakṣa* of *Pauṣa* in *Sam.* 1654 = 12 January 1598.
- 2528 c (3037) *Vivāhavṛndāvāna* of Keśavārka. 16ff. Copied (from a manuscript copied?) by Nārada of the Kāvicaññāti on Tuesday 10 *śuklapakṣa* of *Śrāvāna* on *Sam.* 1455, *Śaka* 1320 = 23 July 1398.
- 2528 d (3096) *Janmapatṭrikāpaddhati*. 18ff.
- 2528 e (3023) *Muhūrtamārtaṇḍa* of Nārāyaṇa. 21ff. Copied in A.D. 1795.
- 2528 f (3026) *Muhūrtadīpaka* of Mahādeva. Ff. 1-2 and 4-9. Copied by Gaṅgārāma, the son of Devakṛṣṇa of the Udīcyaññāti, at Nimrapura on Wednesday 1 *śuklapakṣa* of *Śrāvāna* in *Sam.* 1742, *Śaka* 1607 = 22 July 1685.
- 2528 g (3122) *Svarodaya*. 20ff.
- 2529 a (2925) *Karaṇakutūhala* of Bhāskara. 8ff. Copied on Saturday 12 *kṛṣṇapakṣa* of *Mārgaśīrṣa* in *Sam.* 1765 = 27 November 1708. *SATE* 38.
- 2529 b (2960) *Pañcāṅgavidyādharī* of Vidyādharma. 6ff. Copied by Morārajika, the son of Prabhuji Bhaṭa, on Wednesday 8 *kṛṣṇapakṣa* of *Mārgaśīrṣa* in *Sam.* 1783. *Śaka* 1648 = 7 December 1726. *SATE* 38.
- 2529 c (3061) *Mañitthatājika* of Mañittha. 6ff *SATE* 38.
- 2529 d (2768) *Brāhmasphuṭasiddhānta* of Brahmagupta. 27ff. Copied on Sunday 7 *kṛṣṇapakṣa* of *Mārgaśīrṣa* in *Sam.* 1678 = 25 November 1621. *SATE* 38.
- 2529 e (2962) *Tithikalpadruma* of Kalyāṇa. A : 8ff., and B : ff. 8-10 and 10b-22. B was copied by Prabhuji Bhaṭa. Formerly the property of Jivarā <ja>, and then of Nānu Bhaṭa. *SATE* 38-39.

- 2541 a ( 2929 ) *Brahmatulyodāharaṇa* written for Rāya Rāyasimha. 35ff. Copied by Kuśalasāgara, the pupil of Lāvaṇyaratnaji, at Pattana on Friday 5 *kr̥ṣṇapakṣa* of *Pauṣa* in *Sam.* 1730, *Śaka* 1595 = 16 January 1674. *SATE* 40.
- 2541 b ( 3058 ) *Tājikasāra* of Haribhaṭṭa. 20ff. *SATE* 40.
- 2541 c ( 3059 ) *Kārikā* of Sumatiharṣa. 20ff. *SATE* 40.
- 2541 d ( 3099 ) *Lagnacandrikā* of Kāśinātha. 17ff. *SATE* 40.
- 2541 e ( 2948 ) *Candrārkiṭippaṇa* of Dinakara. 2ff. *SATE* 40.
- 2545 ( 2934 ) *Siddhāntarahasyodāharaṇa* of Viśvanātha. 80ff. Copied by Durlabha Travāḍī for Haradevajī, the son of Chaganata Travāḍī.
- 2546 ( 3078 ) *Jātakābharana* of Dhunḍhirāja and *Kāmadhenupaddhati* of Jayarāma Bhaṭṭa. 87ff. Copied at Nalinagara on Thursday 4 *kr̥ṣṇapakṣa* of *Vaiśākha* in *Sam.* 1771, *Śaka* 1636 = 22 April 1714.
- 2606 ( 2937 ) *Siddhāntarahasyodāharaṇa* of Viśvanātha. Ff. 2-4, 6-45, and 47-95.
- 2648 ( 2947 ) *Khetasiddhi* of Dinakara. A : 3ff., B : 1f., C : 12ff., and D : 75ff. Copied by Nilakaṇṭha, the son of Nārāyaṇa Bhaṭṭa, on Friday 8 *kr̥ṣṇapakṣa* of *Caitra* in *Sam.* 1683, *Śaka* 1549 = 7 April, 1626. *SATE* 41-42.
- 2657 a ( 2793 ) *Lilāvati* of Bhāskara. 14ff. Copied in A.D. 1673.
- 2657 b ( 2975 ) *Gaṇitanāmamālā* of Haridatta. 4ff.
- 2658 ( 2801 ) *Lilāvati* of Bhāskara. 41ff. Copied in A.D. 1792.

**Index of authors ( their dates in the Christian era are given in parentheses ).**

- Āśādhara ( 1132 ). 2464b and c.
- Kalyāṇa ( 1605 ). 2529c.
- Kalyāṇavarman ( ca. 800 ). 2508.
- Kālidāsa ( ca. 1242 ). 2115.
- Kāśinātha ( before 1670 ). 2541d.
- Keśava ( 1496 ). 2076a, 2151, and 2372a.
- Keśavārka ( before 1398 ). 2528c.
- Gaṇeśa ( 1520-1554 ). 2041a, 2114c, and 2181.
- Gaṇeśa ( ca. 1600 ). 2359b.
- Jagaddeva ( ca. 1175 ). 2345b.
- Jayarāma Bhaṭṭa ( before 1650 ). 2457 and 2546.
- Jñānarāja ( 1503 ). 2114b.
- Dhunḍhirāja ( ca. 1525 ). 2356 and 2546.
- Dinakara ( 1578-1583 ). 2541e and 2648.
- Nārāyaṇa ( 1571-1572 ). 2460 and 2528e.
- Nilakaṇṭha ( 1569-1587 ). 2491 and 2521a.
- Nṛsimha ( 1603 ). 2083d and e.
- Padmaprabhu Sūri ( before 1315 ). 2049d.

- Balabhadra (1629-1655). 2328.  
 Bālakṛṣṇa Bhaṭṭa (1632). 2359a.  
 Brahmagupta (628-665). 2529d.  
 Brahmārka (before 1622). 2091d.  
 Bhaṭṭotpala (965-969). 2072b, 2171, and 2520c.  
 Bharata (ca. 1450). 2091b.  
 Bhāvā Sadāśiva Bhaṭṭa (1598). 2464d.  
 Bhāskara (1150-1183). 2114a, 2367, 2409a, 2529a, 2657a, and 2658.  
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 Mahādeva (1263). 2119.  
 Mahādeva (1647-1661). 2528f.  
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 Rāma (before 1657). 2345c.  
 Rāmacandra (1447-1449). 2091a.  
 Lakṣmīdāsa (1501). 2093.  
 Varāhumihira (ca. 550). 2091c, 2110, 2219, and 2520b and c.  
 Vasantarāja (ca. 1095). 2186.  
 Viṭṭhala Dīkṣita (1626). 2528a.  
 Vidyādharma (1638-1643). 2083c and 2529b.  
 Viśvanātha (1612-1630). 2041a, 2076b, 2181, 2182, 2491, 2545, and 2606.  
 Veṅkaṭaśarma (1654). 2051.  
 Vedāṅgarāya (1643). 2114d.  
 Śambhurāma (1730). 2041b.  
 Śārṅgapāṇi (before 1598). 2528b.  
 Śiva (1478). 2372b.  
 Śivarāja (ca. 1450). 2517.  
 Śrīdhara (1227). 2408b.  
 Śrīpati (1039-1056). 2041c, 2119, and 2426.  
 Sadānanda (?). 2408c.  
 Sumatiharṣa (1616-1622). 2541c.  
 Harājī (before 1655). 2042b.  
 Haridatta (1471). 2520a.  
 Haridatta (1638). 2252.  
 Haridatta (before 1697). 2657b.  
 Haribhaṭṭa (1523). 2541b.  
 Harihara (ca. 1580). 2408a.  
 Harṣakīrti (before 1673). 2049a.

**Chronological list of dated Manuscripts**

- 2528c : 23 July 1398.  
 2114a : 1510.  
 2408b : 25 March 1555.  
 2409a : 10 June 1596.  
 2528b : 12 January 1598.  
 2408a : 9 November 1599.  
 2529d : 25 November 1621.  
 2648 : 7 April 1626.  
 2345b : 16 May 1630.  
 2049b : 1 April 1631.  
 2091d : 16 April 1636.  
 2464b : 10 July 1637.  
 2076a : 25 November 1649.  
 2372a : 12 April 1650.  
 2372b : 7 January 1665.  
 2042b : 1666.  
 2110 : 2 February 1672.  
 2657a : 1673.  
 2541a : 16 January 1674.  
 2426 : 5 April 1674.  
 2091a : 1679.  
 2091b : 1679.  
 2528f : 22 July 1685.  
 2528a : 14 January 1693.  
 2529a : 27 November 1708.  
 2546 : 22 April 1714.  
 2529b : 17 December 1726.  
 2457 : 24 November 1728.  
 2359b : 1733.  
 2091c : 13 June 1740.  
 2345c : 1 July 1753 **Gregorian**.  
 2359a : 10 August 1753 **Gregorian**.  
 2521a : 16 April 1761 **Gregorian**.  
 2093 : 3 December 1761 **Gregorian**.  
 2464e : 5 February 1782 **Gregorian**.  
 2114b : 1782.  
 2658 : 1792.  
 2528e : 1795.

## APPENDIX B

On f. 2v manuscript B has two tables. The first is a table of the *kṣepakas* of the planets for 20 March 1227, which differs somewhat from that reconstructed from tables 1-9 in manuscript L<sup>11</sup>. This table is reproduced here as it appears in B.

ग्रंथादौ क्षेपकाः रव्यादीनाम्

र	चं	मं	बु	वृ	शु	श	उ	पा
११	०	०	२	१०	४	१०	४	२
२८	१५	२६	११	२१	६	१	४७	०
३०	४१	१६	१२	३२	१५	५०	४०	३२
३०	४१	१५	४८	३०	५३	२२	२२	१३

The second table is table 1 (for the Sun) of the *Laghukhecarasiddhi*.

On f. 1r of B is written, in a different hand, a table for *tithis*, *nakṣatras*, and *yogas* for *Śaka* 1550-1557 = A.D. 1628-1635; it is divided into three sections (the first two sections and most of the third for *Śaka* 1550 are torn off). The first section tabulates the *abdapa* (yearly parameter : about 1; 15, 31, 15 days), the *tithidhruva* about(10; 56, 6, 45 module 30), and the *nakṣatrayogadhruva* (about 10; 2, 30 module 27). The second section tabulates the *tithikendra* (about 7; 5, 48, 15 module 27; 59, 32), the *nakṣatrakendra* (about 7; 0, 30 module 27; 13, 50), and the *yogakendra* (about 7; 31, 46 module 29; 16, 3). The third section tabulates the *tithivāra* (about 1; 11, 42), the *nakṣatravāra* (about 1; 18, 2, 50), and the *yogavāra* (about 1; 17, 52, 20). The entries for *Śaka* 1551 = A.D. 1629 are :

<i>abdapa</i>	2; 36, 35
<i>tithidhruva</i>	17; 23, 18
<i>nakṣatrayogadhruva</i>	15; 2, 58
<i>tithikendra</i>	22; 4, 40
<i>nakṣatrakendra</i>	21; 8, 55
<i>yogakendra</i>	22; 43, 36
<i>tithivāra</i>	2; 59, 41
<i>nakṣatravāra</i>	2; 39, 35
<i>yogavāra</i>	2; 39, 22

The parameters and the functions of this table are not unlike those utilized in the *Pañcāṅgavidyādhari*<sup>12</sup> written by Vidyādhara of the Girinārāyaṇa-

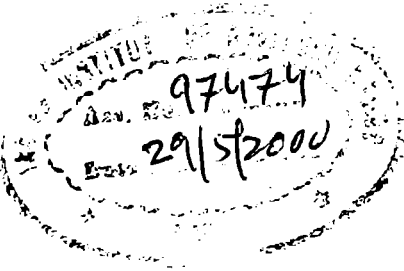
11 SATE 74.

12 SATIUS 60b-61b.



jñāti ( VI 3 ) at Jīrnagaḍḍha in A.D. 1643; he was the grandson of the Haihara who mentions the *Laghukhecarasiddhi* in his *Gaṇitacūḍāmaṇi*. Both Vidyādhara's *Pañcāṅgavidyādhari* and his *Grahavidyādhara*, written at Rājakoṭa in A.D. 1638, will be edited later in this series; manuscripts of both are in the Gaekwad's collection ( 2083c and 2529b), and of the first in the Smith Indic collection ( manuscript 30 ) at Columbia University in New York.<sup>13</sup>

Vidyādhara himself was the scribe of the Gaekwad's manuscript of the tables accompanying Āśādihara's *Grahajñāna* ( 2464c ). This is a very carefully written and neat manuscript, quite different from f. 1r of manuscript B. However, it remains possible that the Baroda manuscript at some period in its history ( presumably in the 1620's and 1630's ) belonged to a member of the *Girīnārāyaṇajñāti*.




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13 *SATIUS* 17a-17b.

