ART. XIV.—*Brief Notes on the Age and Authenticity of the Works of Âryabhata, Varâhamihira, Brahmagupta, Bhaṭṭotpala, and Bhâskarâchârya.* By Dr. BHÂU DÂJÎ, Honorary Member R.A.S.

[Communicated by F. HALL, Esq., July 4, 1864].

I. ÂRYABHATA.

THE name of this celebrated astronomer is written either Âryabhata or Âryabhaṭṭa, but generally with one *t* only. In an old manuscript of the Brahma Sphuṭa Siddhânta of Brahmagupta, copied in Samvat 1678, or A.D. 1621, the name occurs about thirty-three times,¹ and is invariably written Âryabhata; and a double *t* cannot be introduced without violating the Âryâ metre. Bhaṭṭa Utpala, in his commentary on the Vârâha Sanhitâ, cites a passage from Varâha Mihira as follows:—

लङ्कार्धरात्रसमये दिनप्रवृत्तिं जगद् चार्यभटः ।

Here the word has only one *t*, and would not scan with two. This scholiast almost always writes, when quoting Âryabhata, तथा चार्यभटः. In a commentary by Someṣvara on the Âryabhaṭṭiya Sûtra, of which the manuscript in my possession was copied about three hundred years ago, the name is spelt with only one *t* :

आचार्यार्यभटोक्तसूत्रविवृतिः ।

In a copy of the Mahâ Âryasiddhânta, dated Śaka 1676, A.D. 1598, is the following line:—

इत्यार्यभटप्रोक्तास्त्रिद्वान्तावन्महाकालात् ।

Bhaṭṭa Utpala and Someṣvara sometimes call him Âchâryabhata or Âchârya Âryabhata; Brahmagupta, in his Siddhânta, chap. x. 62, Âryâḥ, and in chap. xxi. 40, Âchâryabhata. In his Khaṇḍa Khâḍya Karaṇa, copied Samvat 1783, he is called

¹ Colebrooke states that Brahmagupta cites Âryabhata "in more than a hundred places by name." Misc. Ess. vol. ii. p. 475. He evidently includes citations or allusions by the learned commentator Chaturveda Prthûdaka Svâmin, whose commentary I regret I do not possess.

Âchârya Âryabhata or Âryabhata. In a commentary on it by Âmarâja, he is simply called Âchâryabhata. Hence it appears to me clear that the proper spelling of this name is Âryabhata.

The works attributed to Âryabhata, and brought to light by European scholars, are :—

An Âryasiddhânta (Mahâ Ârya Siddhânta), written, according to Bentley, in the year 4423 of the Kali Yuga, or A.D. 1322.¹

Another Âryasiddhânta, called Laghu, a smaller work, which Bentley supposed was spurious,² and the date of which, as stated in the text, was interpreted to mean the year of the Kali Yuga 3623, or A.D. 522. Of both these works Mr. Bentley possessed imperfect copies. He assumed a comparatively modern work, attributed to Âryabhata, and written in A.D. 1322, as the genuine Âryasiddhânta, and, reasoning on this false premiss, has denounced as spurious the real and older work, and has, further, been led into the double error of condemning the genuine works of Varâha Mihira, Brahmagupta, Bhaṭṭa Utpala, and Bhâskarâchârya, containing quotations and references to the older work, as modern impostures, and of admitting as genuine a modern treatise (the Jâtakârṇava) as the work of Varâha Mihira.

Colebrooke, not having the works of Âryabhata before him, suggested that the older work might be a fabrication, but, from citations and references to Âryabhata in the works of Brahmagupta and Bhaṭṭa Utpala, came to a singularly accurate conclusion as to the age of Âryabhata, whose works he thought were different from either treatise in the possession of Bentley. "We shall, however," writes Colebrooke, "take the fifth [century] of Christ as the latest period to which Âryabhata can, on the most moderate assumption, be referred."³ In one place, indeed, Colebrooke correctly guesses that the Laghu Ârya Siddhânta is either the Âryashtasata or the Daśagîtikâ.⁴

¹ A Historical View of the Hindu Astronomy. London, 1825, p. 128

² Ibidem, pp. 163, 169.

³ Colebrooke's Misc. Ess. vol. ii. p. 477.

⁴ Ibid. p. 467.

The following passage in the Mahâ Âryasiddhânta explains itself:—

इत्यार्यभट्टप्रोक्तात्सिद्धान्ताद्यन्महाकालात् ।

पाटैर्गतमुच्छेदं विशिषितं तन्मया खोक्त्या ॥

“That (knowledge) from the Siddhânta, propounded by Âryabhata, which was destroyed, in recensions, by long time, I have, in my own language, thus specified.”

In another copy, the verse commences differently, having *Vṛddha* for *iti*; i.e. the first Âryabhata is called *Vṛddha* or old, whilst himself is the modern Âryabhata.

Strange to say, the date corresponding to A.D. 1322, mentioned by Bentley, is not to be found in my copies. But I believe he was here, for once, correct.

In the first volume of the Transactions of the Madras Literary Society, a paper was published by Mr. Whish, evidently founded on the works of Âryabhata senior. But, although Mr. Whish's paper is not available to me, I am positive he did not recognize his Âryabhaṭṭīya Sūtra as the work of Âryabhata senior.

Professor Lassen has some admirable remarks on Âryabhata.¹ He observes: “Of Âryabhaṭṭa's writings we have the following. He has written a short outline of his system, in ten strophes, which composition he therefore called *Daṣagītaka*; it is still extant.² A more extensive work is the *Âryāśṭaṣaṭa*, which, as the title informs us, contains eight hundred distichs, but has not yet been rediscovered. The mean between these works is held by the *Âryabhaṭṭīya*, which consists of four chapters, in which the author treats of mathematics in one hundred and twenty-three strophes.³ In it he teaches the method of designating numbers by means of letters, which I shall mention again by and by. Besides, he has left a com-

¹ Indische Alterthumskunde, vol. ii., p. 1136.

² See Colebrooke's Misc. Ess. ii. p. 467. To the friendly offices of Mr. Gundert, a German missionary in India, I am indebted for a copy of this work, from a MS. in the possession of the Rājā of Kerkal, in Malabar. It is here called *Daṣagītaka Sūtra*. I have also received from him a copy of the *Âryabhaṭṭīya*.

³ C. M. Whish names this work in the first dissertation mentioned in note 1, p. 1134, as well as in the second: *On the Quadrature of the Circle*, etc., in Trans. of the Roy. As. Soc. iii. p. 609. Also *Masūdi* and *Albirūnī* record it; see Reinaud's *Mémoire*, etc., pp. 321 and 322.

mentary on the Sūrya Siddhānta, which has been elucidated by a much later astronomer, and is, probably, the work called *Tantra* by Albīrūnī.¹ This may be the same which was communicated to the Arabs, with two other Siddhāntas, during the reign of the Khalif *Almansūr*, (which lasted from A.D. 754 till 775), by an Indian astronomer who had come to his court, but of which only the book properly so called, *i.e.* that of *Brahmagupta*, had been translated into Arabic, by order of that Khalif, by *Muhammed bin Ibrāhīm Alfazārī*, and had received the title of the great *Sind-hind*. (See Colebrooke's Misc. Ess. ii. p. 504 seqq.) From this juxtaposition it appears that sufficient materials are at hand for investigating the doctrines of this founder of mathematical and astronomical science in India. Therefore it would be very desirable if a mathematician and astronomer, provided with a competent knowledge of Sanskrit, were to undertake to fill up this great gap in the knowledge which we have hitherto possessed of the history of both these sciences."

To my learned friend Dr. Fitzedward Hall we are indebted for the first and accurate statement that, "as reference is made, in the Ārya Siddhānta, to Vṛddha Āryabhaṭṭa, there should seem to have been two writers called Āryabhaṭṭa." This correct reference Dr. Hall was enabled to make from having possessed himself of "two copies of the Ārya Siddhānta, both imperfect, and very incorrect." "This treatise is in eighteen chapters; and I more than suspect it to be the same composition which Mr. Bentley also had seen in a mutilated form,"² [*i.e.* the Mahā Ārya Siddhānta].

¹ See Wilson's Mackenzie Coll. i. p. 119, No. v. The title is Sūrya Siddhānta-prakāṣa, and it contains the Sūtras of the Sūrya Siddhānta, with Āryabhaṭṭa's commentary, and explanations of it by a later author of the sixteenth century. The work contains three chapters with the superscriptions: *Ganita*, *i.e.* Arithmetic, Algebra, and Geometry, *Kālakriyā*, by which very likely the doctrine of the calculation of the great periods must be understood; the title *Gola* of the third chapter designates the Globe, but is intended to denote Astronomy. Albīrūnī mentions a *Tantra* of Āryabhaṭṭa; see Reinaud's *Mémoire*, p. 335. In the commentary of *Paramādīśvara* on Āryabhaṭṭa's explanation of the Sūrya Siddhānta (called Sūrya-Siddhānta-vyākhyāna, and surnamed by the special title *Bhaṭṭiyādi-pikā*, the title of which Mr. Gundert has communicated to me, and which work is likely to be the same with the one adduced in the *Mackenzie Collection*, vol. ii. p. 121, named *Āryabhaṭṭa-vyākhyāna*), the work of Āryabhaṭṭa is called *Tantra-Bhaṭṭiya*.

² On the Ārya-Siddhānta. By Fitzedward Hall, Esq., M.A. Journal of the American Oriental Society, vol. vi. p. 559.

In an "Additional Note on Âryabhaṭṭa and his Writings," by the Committee of Publication, appended to Dr. Hall's paper, the learned writer under the initials W. D. W. brings to light the contents of Bhûta Vishṇu's "Commentary on the Daśagîṭikâ of Âryabhaṭṭa," from a manuscript of the Berlin Library, a copy of which was supplied to him by Prof. Weber.

From the nature of the contents given in Appendix A, it is clear to me that the treatise which is described as "a brief one, containing only about one hundred and fifty stanzas," consists not only of the Daśagîṭi Sûtra, with a commentary by Bhûta Vishṇu, but also of the Âryâshṭaśata of Âryabhaṭṭa, which was hitherto believed to be unrecoverable. The learned writer correctly remarks that the treatise is undoubtedly the same as Bentley's *Laghu Ârya Siddhânta*, and also that "the other Ârya Siddhânta, judging it from the account given of it by Bentley, appears to be, in comparison with this, a quite ordinary astronomical treatise, representing the general Hindu system with unimportant modifications." Yet he falls very nearly into the same error as Colebrooke, when he proceeds to remark: "Yet it seems clear that Brahmagupta and others have treated them as works of the same author, and have founded upon their discordances a charge of inconsistency against Âryabhaṭṭa."¹ The fact is, as we shall see, that Brahmagupta, Bhaṭṭa Utpala, and Bhâskara Âchârya know and cite only the elder Âryabhaṭṭa.

The next and last paper is on some fragments of Âryabhaṭṭa, by Dr. H. Kern in the *Jour. Roy. As. Soc.* vol. xx. pp. 371 seqq. After briefly noticing the works known to former writers as the works of Âryabhaṭṭa, and after alluding to the conclusion Dr. Hall arrived at, that there were two authors of the same name, he adds: "If the same course were adopted in regard to all the works ascribed to Âryabhaṭṭa, or to an Âryabhaṭṭa, if the contents were compared with the numerous fragments scattered in different works, chiefly commentaries, one might indulge the hope that the question of the authorship of Âryabhaṭṭa would be settled in a satisfactory manner."

¹ *Journal of the American Oriental Society*, vol. vi. pp. 561 and 564.

Dr. Kern proceeds "to contribute a small share towards solving the question," by giving extracts from the commentary of Bhaṭṭa Utpala on the Vārāhī Sanhitā of Varāha Mihira. In an additional note, at the conclusion of the paper, the learned author states that he was enabled, "by the kindness of Prof. Weber, to ascertain that all the quotations of Utpala, with the exception of one half-stanza, occur in a manuscript of the Berlin Library." Some of the passages puzzle him, especially the date A.D. 475, about which he observes: "Unfortunately, it is not clear whether the date of Âryabhaṭṭa is meant, or that of Bhûtavishṇu."¹

Adopting Dr. Kern's suggestion, I proceed to state briefly the result of an examination of the various works attributed to Âryabhaṭa. In a diligent and expensive search for old and rare Sanskrit, Prakrit, Arabic, and Persian manuscripts, noiselessly conducted for many years past, I have succeeded in procuring the following works whose authorship is attributed to Âryabhaṭa.

A. Three copies of what has been called the Vṛddha or Laghu Ârya Siddhānta, but, correctly speaking, Âryabhaṭīya Sûtra, consisting of the Daṣagīti Sûtra, or Daṣagītikā, and the Âryāshṭaṣata, or one hundred and eight couplets. These copies contain the following number of Âryās:—

	Daṣagīti Sûtra.	Âryāshṭaṣata.
Copy <i>a</i>	13	108
„ <i>b</i>	13	108
„ <i>c</i>	13	108

There are two introductory stanzas at the commencement of copy *a*, evidently an after-addition, and not in the Ârya metre. This is a copy of a manuscript written in Śaka 1760, or A.D. 1838.

Copy *b*. The date of the original manuscript is omitted.

Copy *c* is an old manuscript, without date; but, from the character of the letters, and from the worn-out paper, it appears to be more than three hundred years old. It has, in addition, a Bhāṣhya, or commentary, by Someṣvara, containing

¹ P. 387.

about 64,000 letters. Unfortunately, portions are illegible or destroyed. The scholiast gives no information about himself, but adds that his commentary is founded upon one by Bhâskara. At the conclusion are the words *iti someṣvara-virachite âchâryabhaṭṭiyaṃ bhâshyaṃ samâptam iti*.

B. Of the Mahâ Ârya Siddhânta I have a copy from Gujerat, containing eighteen chapters, copied in Śaka 1676, or A.D. 1754.

Two others are fresh copies of one or two originals, one of which has the date Śaka 1762, or A.D. 1840.

The Aryâs are from 600 to 612. There is no commentary.

I hope soon to be in possession of fresh copies of both these Siddhântas, with commentaries.

C. The Brahma Sphuṭa Siddhânta, or Brahma Siddhânta, of Brahmagupta, from Gujerat; transcribed in Śaka 1544, or A.D. 1622. Of this I have sent a copy to my learned friend, Professor Whitney.

D. The Khaṇḍa Khâdya Karaṇa, of Brahmagupta, with a Bhâshya, by Âma Śarman, son of Paṇḍita Mahâdeva, of Ânandapura; copied in Samvat 1783, or A.D. 1726. (Ânandapura is the modern Wadanagara, in Katyawar). This manuscript was sent to me by a learned Pandit, of Benares, whose acquaintance I was glad to make at Delhi last year.

E. The Vârâha Sanhitâ, with the commentary of Bhaṭṭotpala. Another copy of the text only.

F. The Bṛhaj Jâtaka of Varâha Mihira; two copies, one lithographed in Bombay.

G. The Laghu Jâtaka of Varâha Mihira.

H.	{	The Vâsishṭha Siddhânta. Samvat 1810, or A.D. 1733.
		The Vyâsa Siddhânta.
		The Brahma Siddhânta.
		The Romaka Siddhânta. Copied Samvat 1727, or A.D. 1670.
		The Sûrya Siddhânta, with the Vâsanâbhâshya.
		The Sârvaabhauma Siddhânta.
		The Tattva Viveka Siddhânta (imperfect).
		A commentary on the Siddhânta Śiromani by Vâchaspati.
		The Sundara Siddhânta.

I am glad to announce that, in the Āryabhaṭīya, or Ārya-bhaṭīya Sūtra, we have got all the works of the elder Ārya-bhaṭa, at least all those which were known to Brahmagupta, Bhaṭṭa Utpala, and Bhāskara Āchārya.

My copies of the Āryabhaṭīya, or Laghu Ārya Siddhānta, are evidently identical with the one which Whish possessed, and with the Berlin manuscript; the latter containing about twenty-seven verses or Āryās more, in the shape of a commentary on the Daśagītikā, by Bhūtavishṇu, which I have not.

Lassen's Āryabhaṭīya is, undoubtedly, the same work. Brahmagupta having cited and controverted a work of Ārya-bhaṭa, as Āryāshṭaśata, Colebrooke understood and published that "Āryabhaṭa was the author of the Āryāshṭaśata (eight hundred couplets)."¹ That Āryāshṭaśata means eight hundred couplets is also assumed in the passage I have quoted from Lassen. None of the learned scholars who have written so ably on Āryabhaṭa have impugned the correctness of the translation. Professor Whitney goes so far as to state that Dr. Hall "has farther made it at least a probable supposition that the treatise in question (*i.e.*, the Mahā Ārya Siddhānta) is, in conformity with Colebrooke's earlier conjecture, to be identified with that so often credited to Āryabhaṭa by the name of Āryāshṭaśata."²

But Āryāshṭaśata, I venture to affirm, means a treatise of one hundred and eight couplets. *Asṭādhikam śatam Aśṭaśatam.*³ The Āryā from Brahmagupta, referring to this Āryāshṭaśata, is as follows; it is in the Tantra Dūshaṇādhyāya, Chapter xi. Āryā 8:—

आर्याष्टशते पाता भ्रमन्ति दशगीतिके स्थिराः पठिताः ।

मुक्तैन्दुपातमपमण्डले भ्रमन्ति स्थिरा नातः ॥

"In the Āryāshṭaśata, the Pātas (nodes) revolve; in the Daśagītikā, they are described as stationary."

These two statements, which led Brahmagupta to censure

¹ Colebrooke's Misc. Ess., vol. ii. p. 467.

² Journal of the American Oriental Society, vol. vi. p. 560.

³ See the Siddhānta Kaumudī of Bhāṭṭojī Dīxita. Calcutta, 1864, vol. i. p. 360.

Āryabhaṭa for inconsistency of doctrine, are to be found in my copies of the Āryabhaṭīya Sūtra. They are as follows :—

दशगी. आ. ११ बुधभृगुकुजगुरुशनिववरषाः गत्वांशकान् प्रथमपाताः ।

सवितुरभीषां च तथा द्वात्रिंशत्माहलयास्त्रिंश मन्दोच्चम् ॥

गोलपाद आर्या २ ताराग्रहेन्दुपाता भ्रमन्यजस्रमपमण्डले ऋक्ष ।

अर्काच्च मण्डलार्धे भ्रमति हि तस्मिन्बितिक्षाया ॥

In the twenty-fourth chapter (Sandhyādhyāya), Ārya 10, of his Brahma Siddhānta, Brahmagupta tells us that—

भटब्रह्माचार्येण जिष्णुतनयेन गणितगोलविदा ।

आर्याष्टसहस्रेण स्फुटसिद्धान्तः कृतो ब्राह्मः ॥

“Bhaṭa Brahmācārya, the son of Jishṇu, mathematician and astronomer, composed the Brahma Sphuṭa Siddhānta, in 1008 Āryās.” The word Āryāṣṭaśahasreṇa means 1008, and not 8000; and my copy of Brahmagupta’s Siddhānta consists of the former number of couplets.

Analogous examples may be produced from the Smṛtis, where numbers are given. But, to set aside all doubt of the correctness of my translation of the word Āryāṣṭaśata, I produce nearly all the passages in the Āryabhaṭīya Sūtra which have been controverted by Brahmagupta :—

ब्रह्मगुप्तसिद्धान्त अध्याय १ आर्या ९ दशगीति. आर्या ५ का होम न
युगपादानार्यभटसत्त्वारि समानि वोढमनुर्युगश्रवणनास्ते च ।

कृतयुगादीनि । यदभिहितवान्न

तेषां स्मृत्युक्तसमानमेकमपि ॥

ब्र. आर्या १२ मनुसंधियुगमिक्त्वा- कालपाद. आर्या ८ अष्टोत्तरसाहस्रं
र्यभटसत्त्वमनुर्यतः श्रवणयुगः । कल्प- ब्राह्मो दिवसो ग्रहयुगानां ।
श्चतुर्युगानां सहस्रमष्टाधिकं तस्य ॥

ब्र. आ. ६० अकृतार्थभटः शीघ्रग- दशगीति आर्या ४ चंद्रोच्चर्जुषिख-
मिंदूच्चं पातमल्पगं स्वगतेः । ति- धबुधसुगुशिथुनभृगुजषपितुभृशे-
थ्यंतग्रहणानां घुणाक्षरं तस्य सं- षार्काः । बुधिनचपातविलोमा बु-
वादः ॥ धा. ह्यजाकीदयाच्च लंकायां ॥

ब्र. अ. २ आ. ३३ आर्यभटस्याज्ञा- दशगीति आ. १० झार्धानि मंद-
नात् मध्यममंदोच्च शीघ्रपरिधी- वृत्तं शशिनः क्षगक्षधदक्षयोक्ते-

नां । न स्पष्टा भौमाद्याः स्पष्टा ब्र-
ह्मोक्तमध्यादैः ॥

ब्र. अ. ६ आर्या. २१ आर्यभटः चेचां-
शैर्दृष्टादृष्टाबहुक्तवांसदसत् । दृ-
ग्गणितविसंवादात् दृग्गणितं स्व-
कालांशैः ॥

ब्र. तंचद्रूषणाध्याय ११ आर्या ४
आर्यभटो युगपादानस्त्रीन् व्यती-
तानाह कलियुगादौ यत् । तस्य
कृतांतर्धस्मान् स्वयुगाद्यंती न तत्
तस्मात् ॥

ब्र. अ. ११ आ. ५ युगरविभगणाः
स्युघ्नितियत्प्रोक्तं तंचयोर्युगं स्पष्टं ।
त्रिंशती रव्युदयानां तदंतरं हेतुना
केन ॥

ब्र. अ. ११ आर्या ६ युगवर्षादीन-
वदचैत्रसितादेः समप्रवृत्तान् यत् ।
तदसंबतः स्फुटयुतं गं न स्वीर्याकंद-
पातानां ॥

ब्र. अ. ११ आर्या ९ आर्यभटो जा-
नानाति ग्रहाष्टकगतिं यदुक्तवांसद-
सत् । राजकृतं न ग्रहणं तस्मातो
नाष्टमो राजः ॥

ब्र. अ. ११ आर्या ११ ओकारो दि-
नचारे गुरोदधिक्यस्य भवति
कल्पादौ । न भवत्कार्का यस्मादौ-
कारे विस्वरस्तस्मात् ॥

ब्र. अ. ११ आ. १२ सूर्योदयाच्चतुर्थान्
दिनपान् यदुवाच तदसदार्यभटः ।
लंकोदये यतो ऋक्षास्तमयं प्राह

भ्यः । झागुलझलदडत्तथा शनि-
गुरुकुजभृगुबुधोच्च शीघ्रेभ्यः ॥

गोलपाद आर्या ४ चंद्रोशैर्द्वादश-
भी रविचिह्नो कतिरस्थितैर् । दृश्यः
नवभिर्भृगुर्भृगोस्तैर्द्वाधिकैर्द्वाधिकैर्य-
थासंख्याः ॥

दशगीति आर्या ५ कल्पादेर्युगपा-
दागचगुरुदिवसाच्च भारतात् पूर्वं ।

दशगीति आर्या ३ युगरविभगणाः
स्युघ्नशशचयगियिङ्गुशुक्लकुडि
शिवुण्णष्टस् प्राक् । कालपाद आ.
५ रविभगणारव्यब्दा ।

कालपाद आ १२ युगवर्षमासदि-
वसाः समं प्रवृत्तास्तु चैत्रशुक्लादेः ।
कालो यमनाद्यंतो ग्रहभैरनुमीय-
ते चेत्ते ॥

गोलपाद. ४८ चित्तिरवियोगात्
दिनकृत् रवीदुंयोगात् प्रसाधि-
तश्चेदुः । शतितारा ग्रहयोगास्तथैव
तारा ग्रहाः सर्वे ॥

दशगीति आर्या ५ गचगुरुदिव-
साच्च भारतात् पूर्वं ।

कालकियापाद. आर्या १६ सप्तैते
होरेशाः शनैश्चराद्या यथाकमं शी-
घ्राः । शीघ्रकमाच्चतुर्थो भवति च

सिद्धपुरे ॥

ब्र. अ. ११ आ. १९ गसगियियोजन-
परिधिन्निभूयासं पुन्य लावदता।
आत्माज्ञानं ख्यापितमनिश्चयः स्व-
मतिकृतकत्वात् ॥

ब्र. अ. ११ आ. १७ प्राणिनैतिकलांभं
यदि तत् क्व कुतो व्रजेत्किमध्वानं।
आवर्तनमूर्थाच्चैत्र पतन्ति समुद्रयाः
कस्मात् ॥

ब्र. अ. ११ आ. २२ उत्तरगोले ग्रा-
यां विषुवज्यातो यदुक्तमूनायां।
सममंडलगस्तद् सत्क्रांतिज्यायां
यतो भवति ॥

ब्र. अ. ११ आ. २३ व्यासार्द्धेन विभ-
क्ता दृग्गतिजीवा चतुर्गुणा लब्धं।
लंबननाडाः पंचदशगुणितयात्रि-
ज्यया भक्ता ॥

ब्र. अ. ११ आ. २६ लम्बनमृणधन-

मूर्योदयात् दिनपः ॥ गोलपाद-
आर्या. १३ उदयो यो लंकाया
सी-स्तमयः सवितुरेव सिद्धपुरे। म-
ध्याह्ने यमकोट्यां रोमकविषये
धराचं स्यात् ॥

दशगीति. आर्या. ७ नृषियोजनं
जिह्वभूयासः।

दशगीति. आ. ६ प्राणिनैति कलां
भंखयुगांश्च ग्रहजवो भवांश्च शर्कः।
गोल. आ. ९ अनुलोमगतिर्नीत्यः
पश्चत्यचलं विलोमगं यद्वत्। अच-
लानि भानि तद्वत् समपश्चिमगानि
लंकायाः ॥

गोलपाद. आर्या ३१ सा विषुव-
ज्योना चेत् विषुवदुदक् लंबकेन
संगुणिता। विषुज्यया विभक्ता ल-
ब्धः पूर्वापरः शंकुः ॥

गोलपाद. आर्या. ३२। ३३। ३४।
क्षितिजादुन्नतभागानां या ज्या स-
परतो भवेत् शंकुः। मध्यान्नतभाग-
ज्या छाया शंकोस्तु तस्यैव ॥ मध्य-
ज्योदयजीवासंवर्गे व्यासदलहृते य-
स्यात्। तन्मध्यज्या छत्योर्विशेषमूलं
स्वदृक्षेपः ॥ दृक्षेपकृतिविशेषित-
स्य मूलं स्वदृग्गतेः कुवशात्। क्षिति-
स्वमदृक्काया भूयासार्धे नभो म-
ध्यात् ॥

गोलपाद. आर्या. ३५। ३६ विक्षे-

मुक्तं पूर्वापरस्थितौ दिनार्धस्य। यु-
क्तौ भावो यद्भवति तत् ऋणध-
नयो स्थितौ कतरत् ॥

पगुणाक्षज्या लम्बकभजिता भवेत्
ऋणमुदक्षे। उदये धनमस्तमये
दक्षिणगेन्धनमृणं चन्द्रे ॥ विक्षेपाप-
कममुत्क्रमणं विस्तरार्धद्वतियुक्त-
मुदगृणमुदगयनेदक्षिणगे धनमृणं
चन्द्रे ॥

ब्र. अ. ११ आ. ३४ विक्षेपगुणाक्षज्या
लम्बकभक्ता यषृणधनं यत्। उक्तमु-
दयास्तमयोर्नम्रतिघटिकं तस्तद-
सत् ॥

गो. आं. २९ विक्षेपगुणाक्षज्या लं-
बकभजिता भवेत् ऋणमुदक्षे।
उदये धनमस्तमये दक्षिणगे ध-
नमृणं चन्द्रे ॥

ब्र. अ. ११ आर्या ४३ जानात्येकम-
पि यतो नार्यभटो गणितकालगो-
ज्ञानां। नमया प्रोक्तानि ततः पृथक्
पृथक् दूषणान्वेषां ॥

दश. आ १ आर्यभटस्त्रीणि गदति
गणितं कालक्रियां गोलं।

These extracts are given as in the original, without any attempt at correction. Colebrooke quotes and translates the following passage as from Āryabhaṭa, cited by Pṛthūdaka :—¹

भपञ्जरः स्थिरो भूरेवावृत्तावृत्त्य प्रातिदैवसिकौ उदयास्तमयौ सपाद-
यति नक्षत्रयहाणाम् ॥

“The sphere of the stars is stationary; and the earth, making a revolution, produces the daily rising and setting of stars and planets.”

With regard to this passage, Dr. Hall remarks that he has not sought it out in his manuscript of the Mahâ Ārya Siddhânta. Nor would he find it there. The fact is, the Laghu Ārya Siddhânta is metrical; and the passage quoted is not so. This is observed by Dr. Hall; but he went in the wrong track in stating that “this extract might go to prove that Ārya, besides his works in verse, wrote others in prose.”²

I do not find the passage, literally, in either of the Siddhântas; but I have no doubt that it is only a paraphrase of the follow-

¹ Colebrooke's Misc. Ess. vol. ii. p. 392.

² Journal American Oriental Society, vol. vi. p. 558.

ing line from Âryabhata, in Pṛthûdaka's own words; Âryabhataiya, Golapâda, Âryâ ix. :

अनुलोमगतिर्नैऋः पश्चत्यचलं विलोमगं यद्वत् ।

अचलानि भानि तद्वत्समपश्चिमगानि लङ्कायाम् ॥

“As a person in a vessel, while moving forwards, sees an immoveable object moving backwards, in the same manner do the stars, however immoveable, seem to move (daily). At Lankâ (*i.e.* at a situation of no geographical latitude) they go straight to the west (*i.e.* in a line that cuts the horizon at right angles, or, what is the same, parallel to the prime vertical at Lankâ).”¹

I have no doubt that, in the following passage, which has been a theme of fruitful discussion, the first line only is from Âryabhata (it is the latter half of the fourth Âryâ of the Kâlapâda chapter, in my MS.); the second line is, in all likelihood, an addition by Bhaṭṭa Utpala :²

गुरुभगणा राशिगुणा आश्वयुगाद्या गुरोरब्दाः ।

गुरुभगणानां संख्या जिनयमवेदतुह्यभुजतुल्या ॥

“The revolutions of Jupiter, multiplied by the number of the signs (twelve), are the years of Jupiter, called Âṣvayuja, etc.; his revolutions are equal to the number of the Jinas, a couple, the Vedas, the seasons, the fires (*i.e.* 364,224).”

Âryabhata having an alphabetical notation of his own, it was surprising to find him make use of our arithmetical notation, which the second line quoted above implies. But now the enigma is solved: the second line is not of Âryabhata.

The Daśagîti Sûtra, as the name purports, is composed of ten Âryâs; the three additional ones, in my copies, relating to—1. invocation, 2. the alphabetical notation, and 3. the fruit or advantage of knowing the Daśagîti Sûtra. The Âryâshtaśata consists of three chapters, viz., 1. Gaṇita; 2. Kâlakriyâ; and 3. Gola. As the Âryabhataiya consists of the Daśagîti Sûtra and Âryâshtaśata, the treatise consists of four chapters,

¹ Journ. Roy. As. Soc. vol. xx. 1863, p. 376.

² Ibid. p. 378. The couplet in the Âryabhataiya is as follows:—

कालपाद् आर्या ४ खोच्चभगणा स्वभगणैर्विशेषिताः खोच्चनीचपरिवर्ताः ।

गुरुभगणा राशिगुणास्त्वाश्वयुजाद्या गुरोरब्दाः ॥

called pādas, of which the Daśagīti Sūtra is the first, and the remaining three as above. This arrangement was not clearly perceived by the learned writer of the additional note to Dr. Hall's paper.¹

Any one studying the Commentary of Munîṣvara, *alias* Viṣvarūpa, styled Marīchi, on the Siddhānta Śiromaṇi of Bhāskarāchārya, and also his Sārvaśhauma Siddhānta, cannot fail to remark that he clearly notices two Âryabhāṭas. He calls, however, the author of the so-called Mahâ Ârya Siddhānta, Laghu Âryabhāṭa, or Âryabhāṭa junior; and, in quoting from the senior, calls him simply Âryabhāṭa. Sometimes Âryabhāṭa junior appears only as plain Âryabhāṭa; in all likelihood, from the fault of copyists.

Gaṇeṣa, in his commentary on Bhāskarāchārya's Līlāvatī, had only to deal with Âryabhāṭa junior; and, accordingly, he speaks of only one Âryabhāṭa.

The Sundara Siddhānta of Jñānarāja also distinguishes a Laghu from a Vṛddha Âryabhāṭa. Besides the passages referred to by Brahmagupta, all those cited by Bhaṭṭa Utpala and Bhāskara Āchārya are found in my copy of the Âryabhāṭīya. There cannot now, therefore, possibly be any doubt of our having a correct copy of the works of Âryabhāṭa senior; and I shall take the earliest opportunity of publishing the original text, with the commentary of Someṣvara, for the gratification of learned orientlists.

I shall now proceed to an examination of Âryabhāṭa's age. Âryabhāṭa was born in A.D. 476. This date is given, by himself, in the Âryaśṭaṣaṭa, as follows:—

षष्ठ्यब्दानां षष्टिर्यदा वतीतास्त्रयश्च युगपादाः ।

अधिका विंशतिरब्दास्तदेह मम जन्मनो -तीताः ॥

Dr. Kern quotes a corrupt version of it from the Berlin manuscript. The correct translation is: "When three of the four Age-quarters and 60×60 [= 3600] years are past, then are past upwards of twenty-three years from my birth." This gives, for the birth of Âryabhāṭa, the year A.D. 476; as the

¹ Journal of the American Oriental Society, vol. vi. p. 561.

fourth Age-quarter, or Kali Yuga, commenced 3101 years before Christ.

Strange to say, the commentator Someśvara understands the verse to mean that 3623 years had elapsed of the Kali Yuga at the birth of Âryabhata. The commentator whom Mr. Whish consulted fell, perhaps, into the same error; as Mr. Whish does not appear to have given the exact date, but refers Âryabhata simply to the beginning of the sixth century of the Christian era. Âryabhata calls himself a native of Kusumapura, or Pataliputra. Beyond a doubtful allusion to the Brahma Siddhânta, he never mentions any previous author, and rather prides himself on his originality. His work is written with great attention to conciseness. His system of notation is quite original. The account given of it by Lassen is not altogether correct. In the invention of a new system of notation, the Indian Âryabhata may be compared to the Grecian Archimedes. The ratio of the diameter to the circumference was given, by Archimedes, in his book *De dimensione circuli*, as seven to twenty-two; while that of Âryabhata is as one to 3.1416. Âryabhata has the following notice of the Buddhist system of measuring time:—

कालपाद आर्या ९ उत्सर्पिणी युगार्धं पञ्चादवसर्पिणी युगार्धं च ।

मध्ये युगस्य सुषमा चादावन्ति च दुःषमंदूञ्चात् ॥

This arrangement is different from that of Hemâchârya and other Jaina authorities. (See Appendix A).

II. VARÂHA MIHIRA,¹

as we have already seen, cites Âryabhata by name in the passage given by Bhatta Utpala from Varâha's Pancha Siddhântikâ Karaṇa, quoted in his commentary on the Varâhî Sanhitâ.² The Pancha Siddhântikâ Karaṇa I have

¹ Varâha Mihira calls himself the son of *Âdityadâsa*, under whom he studied and obtained the highest gift from the Sun in Kapitthaka (a grâma, according to Bhaṭṭotpala), and an Âvantika, or native of Ujjayinî. Bhaṭṭotpala calls him a Mâgadha brâhmana, or dvijavara (best of Brâhmanas), and Âvantikâchârya. Varâha's son was Pṛthuyâsa, who composed the Shaṭpanchâṣikâ, on which also Bhaṭṭotpala has a commentary.

² The passage is given by Dr. Kern, Jour. Roy. As. Soc. vol. xx. p. 383.

as yet failed in recovering. Colebrooke¹ assigned to him the close of the fifth century of the Christian era, from a calculation of the position of the colures affirmed as actual in his time by Varāha Mihira. Since then no further solid data have been discovered to fix the era of this celebrated astronomer. I have failed to find out the date of his birth, but am glad to have discovered that of his death in a commentary on the Khaṇḍa Khādyā of Brahmagupta, by Āmarāja :—

नवाधिकपंचशतसंख्यशके वराहमिहिराचार्यो दिवं गतः

“Varāha Mihira Āchārya went to heaven in the 509th [year] of the Śaka Kāla, i.e. A.D. 587.”

There is no reason to doubt the correctness of this statement.

The following passage, quoted by Bhaṭṭa Utpala, in his commentary on the Vārāhī Saṁhitā, from a Tantra by Varāha Mihira, shows that he flourished after Śaka Kāla 427, i.e. after A.D. 505 :

यथाचाहर्गणानयनं

सप्ताश्विवेदसंख्यं शककालमपास्य चैत्रशुक्लादौ ।

अर्धास्तमिते भानौ यवनपुरे भौमदिवसाख्ये ॥

मासीकृते समासे द्विष्टे सप्ताहतेष्टयमपदैः ।

लब्धैर्युतो धिमासैस्त्रिंशद्युक्तस्तिथियुतो धस्यः ॥

रुद्र * समनुशरो नो लब्धो नो गुणखसप्तभिद्युगलः ।

रोमकसिद्धांतो यं नातिचिरं पौलिशे ष्येवं ॥

The astronomers of Ujjayinī place Varāha Mihira in the beginning of the fifth century. It is not unlikely that they have mistaken the Śaka Kāla for that of the Vikrama Samvat, or fallen into the same error as Albīrūnī.

Albīrūnī states that 526 years had passed up to his own date, A.D. 1031, from the date of the composition of the Pancha Siddhāntikā of Varāha Mihira;² which event must, therefore, be placed in A.D. 505. But in this he is evidently in error. Varāha Mihira adopted the epoch of the Romaka Siddhānta, for finding the number of civil or natural days (Ahargaṇa) ;

¹ Colebrooke's Misc. Ess., vol. ii. p. 482.

² Journal Asiatique, tome iv. 1844, p. 285.

and Albîrûnî or his informants have assumed this to be the date of Varâha's Pancha Siddhântikâ, which adopts the epoch of the Romaka Siddhânta.

Varâha Mihira, as we have seen, on the authority of Âmarâja, died in A.D. 587, *i.e.* a century and eleven years after the birth of Âryabhata.

The so-called Khaṇḍa Kāṭaka of Albîrûnî is evidently Brahmagupta's Khaṇḍa Khādya; and Arcand is a corruption of Karaṇa.

From various considerations, the middle of the sixth century has been allotted to Varâha by Colebrooke, and by the learned American translator and commentator of the Sûrya Siddhânta. The passage I have quoted from Bhaṭṭotpala confirms these conjectures.

This calculation, it proceeds to tell us further, is that of the Romaka Siddhânta; and, judging by similar calculations and other Siddhântas, it appears to me highly probable that the Romaka Siddhânta was composed in Śaka 427, or A.D. 505. Varâha Mihira founded his Pancha Siddhântikâ Karaṇa on the Romaka Siddhânta and four others. It is clear, therefore, that Varâha could not have lived before A.D. 505. In all likelihood, his birth was twenty or thirty years subsequent to this date; which would make Varâha Mihira about fifty or sixty years old at the time of his death in A.D. 587. In an essay on Kâlidâsa,¹ I have attempted to show that the nine gems of Indian celebrity flourished at the Court of Harsha-Vikramāditya, at Ujjayinî, in the sixth century of the Christian era. As we have now established the date of Varâha Mihira beyond a doubt, my hypothesis that Mâtrigupta is identical with the celebrated Kâlidâsa gains further support.

The authors of the Pauliṣa, Romaka, Vâsishtâ, Saura, and Paitâmaha Siddhântas being noticed by Varâha Mihira, it follows that they flourished before A.D. 505. Brahmagupta affirms that Śriṣheṇa, the author of the Romaka Siddhânta, bases his calculations on those of Lâṭa, Vasishṭha, Vijayanandin, and Âryabhata, and that Vishṇuchandra, following the same guides, wrote the Vâsishtâ Siddhânta. As we have the date

¹ Journal Bombay Branch Royal Asiatic Society, 1862, vol. vi.

of A.D. 508 for the Romaka Siddhānta, it is evident that Lāṭa, Vijayanandin, and Vasishṭha flourished before that time. I presume that the Romaka Siddhānta was composed in accordance with the work of some Roman or Greek author; just as the Pauliṣa Siddhānta was composed from the work of Paulus Alexandrinus. Is not Lāṭāchārya also a foreign author? Bhaṭṭa Utpala notices also a strange author, of the name of Sphujidhvaja or Asphujidhvaja, as a Yavaneṣvara, who composed a new Śāstra before the Śaka era. His works appear, from the following passage,¹ to have been consulted by Bhaṭṭa Utpala, who remarks that Varāha Mihira consulted the works of other Yavana authors not available to himself. I believe the word Sphujidhvaja is a corruption of the Greek name Speusippus. Diogenes Laertius mentions two authors of this name, one of whom was a physician called Herophileus Alexandrinus, and may, possibly, be the astronomer whose works were translated and studied in India.

Varāha Mihira's knowledge of Greek technical astronomical terms and doctrines has been fully treated of by Weber and others. The verse in which he gives the Greek terms for the Sanskrit names of the signs of the Zodiac, has hitherto been presented to us, except by Mr. Whish, in a corrupt form;² as the following will show that the last puzzling word is the veritable Greek *Ἰχθύες*, or *Pisces* :—

क्रियतावुरुजुतुमकुलीरलेयपार्थोनजूककोर्थाखाः ।

तौचिक आकोकिरो हद्रोगश्चेत्यसिः क्रमशः ॥

I have failed, as yet, to discover the Pauliṣa and Romaka Siddhāntas. I have two old copies of a Romaka Siddhānta; but it is, evidently, a modern production, taken from some Arabian author, and having nothing in common with the citations and references to the older Romaka Siddhānta preserved in the works of Varāhamihira, Brahmagupta, and Bhaṭṭotpala.

¹ यवनेश्वरेणास्फुजिध्वजेनान्यत् शास्त्रं कृतं शककालस्य प्राक् ज्ञायते
अनुयवनाचार्यैः पूर्वैः कृतमिति तदस्फुजिध्वजोऽप्याह ।

² See Journal As. Soc. Bengal, 1845, p. 810.

III. BRAHMAGUPTA

has given his own date in the *Brahmasphuṭa Siddhānta*. I gave this extract in my *Essay on Kālidāsa*, three or four years ago; but it has escaped the attention of one of our ablest and most accurate scholars.¹

श्रीचापवंशतिलके श्रीव्याघ्रमुखे नृपे शकनृपालात् ॥ पंचाशत्संयुतैर्वर्षश-
तैः पंचभिरतीतैः ॥ १ ॥ ब्राह्मःस्फुटसिद्धांतः सज्जनगणितगोलवित्प्रीति
॥ चिंशद्वर्षेण कृतो जिष्णुसुतब्रह्मगुप्तेन ॥ २ ॥ अध्याय २४ आर्या ७ - ८

“In the reign of Śrī Vyāghramukha, of the Śrī Chāpa dynasty, five hundred and fifty years after the Śaka King (*i.e.* Śālivāhana, or A.D. 628) having passed, Brahmagupta, the son of Jishnu, at the age of thirty, composed the *Brahmagupta Siddhānta*, for the gratification of mathematicians and astronomers” (chap. 24. *Āryās* 7-8).

IV. BHĀṬTA UTPALA'S

age has been quoted from his work by Colebrooke and others :

फाल्गुनस्य द्वितीयायामसितायां गुरोर्दिने ।
वस्वष्टाष्टमिते शाके कृतेयं विवृतिर्मया ॥

V. BHĀSKARA ĀCHĀRYA

has stated, in his *Siddhānta Śiromaṇi*, the date of the composition of his work as follows :—

रसगुणपूर्णमहीसमराब्दनृपसमये भवन्ममोत्पत्तिः ॥
रसगुणवर्षेण मया सिद्धांतशिरोमणी रचितः ।

This date has been singularly confirmed by an inscription which I discovered, some years ago, in the neighbourhood of the railway station of Chalisgam, about seventy miles beyond Nassik. This inscription gives also the names of several of Bhāskarāchārya's descendants, who taught his works in a college endowed in the neighbourhood of Chalisgam, at the foot of the hills which contain the Peetulkhora caves. (See Appendix B.)

¹ Professor Max Müller, Preface to the *Rigveda*, iv. pp. xiv. f.

Remarks on the inscription referred to in p. 410, and given at length in Appendix B.

In this inscription we have the names of the following kings of the Yadu dynasty: Bhillama, Jaitrapāla, and Singhana. Under this dynasty is the following genealogy of subordinate chiefs of the solar race: Kṛṣṇarāja, his son Indrarāja, his son Govana, and his son Sonhadeva. This last makes a grant of certain privileges, in the shape of perquisites, or first-gifts, to a college established by Changadeva, (within six miles of the railway station at Chāliśgām, and at the foot of the Pītalkhorā caves), now entirely deserted and in ruins, in the year 1128 Śaka-kāla, *i.e.*, A.D. 1206, on the occasion of a lunar eclipse.

Changadeva was the son of Lakshmīdhara, who was patronized by Jaitrapāla, as the chief of his Pandits. Lakshmīdhara's father was the celebrated Bhāskarāchārya. His father was Kaviṣvara Māheśvarāchārya; and his father was Manoratha; his father, Prabhākara; his father, Govinda Sarvajna; his father, Bhāskara Bhaṭṭa, to whom Bhoja gave the title of Vidyapati. His father was Trivikrama. This learned family, we are further told, belonged to the *gotra* of Śaṇḍilya.

The names of Bhillama, Jaitrapāla, and Singhana occur in two copper-plate grants, Nos. 9 and 10 of Mr. Wathen's series (*Journal of the Royal Asiatic Soc.* v. pp. 178, 183). In these grants we have also the names of the successors of Singhana, *i.e.*, Kṛṣṇa, Jaitrapāla (Singhana's son), his younger brother Mahādeva, who succeeded him, and Rāmachandra, the son of Kṛṣṇa, the dates of whose grants are Śaka 1212 and 1194. The donor, Sonhadeva, in our inscription, dated Śaka 1128, is a contemporary and subordinate of Singhana, whose third lineal descendant was Rāmachandra, in whose reign the grants of Śaka 1212 and 1194 are dated.

These dates, therefore, are perfectly compatible with, and confirmatory of, the accuracy of that of the inscription.

Bhāskarāchārya, the author of the *Siddhānta Śiromaṇi*, gives the date of his birth as follows:

रसगुणपूर्णमहीसमश्कनृपसमये ऽभवन्ममोत्पत्तिः ।

रसगुणवर्षेण मया सिद्धन्तशिरोमणी रचितः ॥

“In the year 1036 of the Śaka king, I was born ;
And at the age of 36, I composed the Siddhānta Śiromaṇi.”

This date is quite in accordance with that of the inscription.

The following lines, in praise of Bhāskarāchārya's accomplishments, are sometimes to be found added to MSS. of the *Līlāvati* :

अष्टौ व्याकरणानि षट्च भिषजां व्याचष्टयः संहिताः षट्त्कीन् गणितानि पञ्च चतुरो वेदानधीते च यः ॥ रत्नानां चित्तयं द्वयं च बुबुधे मीमांसयोरन्तरं सत् ब्रह्मैव जगद् गाधमहिमा सोऽस्याः कविर्भास्करः ॥

An important fact to be noticed is, the bestowal of the title of Vidyāpati on Bhāskara Bhaṭṭa, an ancestor of Bhāskarāchārya, by Bhoja.

This Bhoja is, undoubtedly, the monarch of Dhārā, whom it is the fashion to speak of as distinguished for his patronage of learning.

In the Rāja Mrgaṅka Karaṇa, attributed to Bhoja, a copy of which was brought to me, by my Pandits, from Jessulmere, whither I sent them in search of Jaina MSS. two years ago, its author recommends 964 to be subtracted from the Śaka era to find the Ahargaṇa, i.e. “the sum of days,” in civil reckoning.

Bhoja, therefore, it follows, flourished in $964 + 78 = 1042$ A.D. At the end of the work he is called Raṇa Ranga Malla, a title also to be found in the Pātanjala Yoga Sūtra Vṛtti.

My pandits have succeeded in getting a very imperfect copy of the Tilaka Manjarī of Dhanapāla, who is said by Merutunga, the author of the Prabandha Chintāmaṇi, to be the author of that work, and to have been a favourite of Bhoja. Merutunga adds that from Vikrama Samvat 1076, or A.D. 1019, Bhîmarāja reigned. He was succeeded by Karṇa in 1028. At the time the Chālukya Bhîma reigned in Gujerat, Bhoja says Merutunga ruled in Mālava. According to this Jaina hierarch, Munja was imprisoned by Tailapa, the Chālukya, who commenced his reign in Śaka 895, or A.D. 973, according to the copper-plate grants of Mr. Wathen. Dhanapāla was a Brāhmaṇa, but, evidently, a Jaina by faith. He composed the Jina Stavāna, or Gāthās in Māgadhi, in praise of Jina,

of which a complete copy was brought me from Jessulmere. The Jainas are loud in the praises of Dhanapāla.

Mr. Bentley speculated that Bhāskarāchārya flourished after Akbar the Great. Our inscription furnishes a new proof that the unfavourable opinion of Hindu veracity which led to this conclusion was utterly unfounded.

APPENDIX A.

“We will now proceed to inquire how far the doctrines of our treatise correspond with what has elsewhere been handed down as taught by Āryabhaṭṭa. The peculiar division of the Great Age (*mahāyuga*) and constitution of the Æon (*kalpa*), described by Brahmagupta (see Colebrooke, as above) as Āryabhaṭṭa's, are here given. The treatise begins the Æon with sunrise at Lankā, a tenet which distinguished the school of Āryabhaṭṭa from that of Puliṣa (see Colebrooke, as above; also Essays, ii. 427, et al.) It affirms the revolution of the earth on its axis, and the non-reality of the apparent daily motion of the stars, comparing this to the effect of riding in a chariot when fixed objects seem to be moving in a direction contrary to that in which the chariot is proceeding (see the reference to this point in Mr. Hall's paper). It declares the moon, planets, and stars to be naturally dark, and only illuminated upon the side which is turned toward the sun (see Colebrooke, Hind. Alg., note G; Essays, ii. 467). The variability of dimensions of the epicycles of the planets is recognized, although the agreement between this treatise and the Sūrya Siddhānta herein is not so close as Colebrooke (As. Res. xii. 236; Essays, ii. 401) seems to have understood it to be: perhaps Colebrooke's reference here belongs rather to the other Ārya Siddhānta. The passage repeated by Colebrooke (Hind. Alg., note I; Essays, ii. 473) from Bhaṭṭa-utpala on Varāha-mihira is almost precisely represented by the first verse of our third *pāda*: its evidence, however, is of little account, as it relates to a matter so general that it might occur in nearly equivalent terms in almost any treatise; Colebrooke is mistaken in attributing it to any necessary connection with the doctrine of the precession: the position of the equinoxes would be described by a Hindu astronomer as in the first of Aries and of Libra, whatever his theory respecting the important fact of their movement along the ecliptic. The doctrine respecting the precision attributed to Āryabhaṭṭa by

Muniṣvara and others (see Colebrooke, As. Res. xii. 213; Essays, ii. 378, et al.), namely, that the equinoctial points librate 578,159 times in an *Æon* (*kalpa*) through an Arc of 48°, appears from Bentley (Hind. Ast. p. 140, etc.) to belong to the more extended treatise, and not to the *Laghu Ārya Siddhānta*. In connection with the latter, Bentley makes no mention of the precession, nor have we as yet succeeded in discovering anything about it in our treatise, although we would not venture to say with entire confidence that it is not there. It seems, then, altogether probable that Colebrooke's suggestion (as above) is well-founded, to the effect that the libration of the equinoxes may be taught in the *Āryāshtāṣṭa*, and not in the *Daśagītikā*, although we cannot regard as of force the particular reason he assigns for it, since the equinoxes are by no means likely to have been treated as nodes by the early astronomers. A scholiast upon the *Vārāhi Sanhitā* ascribes to Āryabhaṭṭa (Colebrooke, As. Res. xii. 244; Essays, ii. 410) the determination of Jupiter's revolutions in a Great Age (*mahāyuga*) as 364,224; this is the number given in our treatise, and in Bentley's *Laghu Ārya Siddhānta*; that found in his *Ārya Siddhānta* is 364,219,682."—Journal of the American Oriental Society, vol. vi. pp. 562-3.

APPENDIX B.

१ नमो गणाधिपतये सिद्धि—सुधाकरभूमि

स्थ—दूत्र संरक्षणानि गगनेचरवास्तोतः उद्भटबुद्धिर्भट्टे सांख्ये संख्यः
स्वतंत्रधीस्तत्रे । वेदे नवयविद्यो नल्पः शिल्पादिषु कलासु ॥ १ ॥ स्वहं-
दो थ हंसि शास्त्रे वैशेषिके विशेषज्ञः । यः श्रीप्रभाकरसमः प्राभाकर-
दर्शने कविः काव्ये ॥ २ ॥ ब्रह्मगुणगणितप्रभृतिसंघचित्तये त्रिनेत्रसमः ।
विबुधाभिवंदितपदो जयति श्रीभास्कराचार्यः ॥ ३ ॥ श्रीमदबुधेश्वर-
स्वस्थस्तु समस्तवस्तुसहिताय । विश्वं यत्र चातुं जातो विष्णुः स्वयंचस्तु ॥
४ ॥ गर्जज्वरकुंजरोत्कटघटासंघट्टकंठीरवो लाटोरस्कपाटपाटन-
पटुः कर्णाटहृत्कटकः । श्रीमान्भिल्लमभूपतिः समभवद्भूपालचूडामणिः
त्रस्तार्तीध्रपुरंध्रिकांत सुखहृच्छ्रीजैत्रपालो भवत् ॥ ५ ॥ लक्ष्मीकांतलवः
प्रतारितभवः श्रीजैत्रपालोज्ज्वलः संग्रामांगणसंचितातिविभवः शास्ता
भुवः सिंघणः । पृथ्वीशो मथुराधिपो रणमुखे काशीपतिः पातितो येना-
सावपि यस्तु भृत्यबटुना हम्मीरवीरो जितः ॥ ६ ॥ अवततार पुरा पुरुषो-

तमो यदुकुले जगतीहितहेतवे । जयति सोऽयमिमां सकलामिलामव-
ति मामसिद्धमहीपतिः ॥ ७ ॥ अथ भृत्यान्वयवर्णनं ॥ श्रीमद्भास्करवं-
शाय भव्यं भूयात्स भूपतिः । निकुंभो यत्र संभूतो रामो यस्यान्वयेऽभवत्
॥ ८ ॥ तत्रासीन्नृपतिर्जितचित्तिपतिर्ध्यातैकलक्ष्मीपतिर्देवब्राह्मणवंदने त-
तमतिः श्रीकृष्णराजाह्वयः । शौर्यौदार्यविवेकविक्रमगुणैस्तुल्यो न ये-
नापरः प्रीत्या पाण्डवपुंगवार्जितपदं तद्वर्मराजिति यत् ॥ ९ ॥ प्राप्तां-
गप्रभवस्ततस्ततमतिः प्राप्तप्रतापोन्नतिर्वीरो वैरिवधूविधूनिताशिरा यः
श्रीन्द्रराजाह्वयः । तस्यासीत्तनयः सतां सविनयः सामंतसीमंतिनी-
वैधव्यव्रतसद्गुरुर्गुरुगुणः सत्पुण्यपण्यापणः ॥ १० ॥ चतुरसुरगारुडो रे-
वंत इव गोवनः । सौन्दर्यदर्पः कन्दर्पो यं दृष्ट्वांगतां गतः ॥ ११ ॥ श्रीगो-
वनाद्रलसिंधोरुद्भूतमूर्तिस्तपुष्पकीर्त्तिः । जितारिचक्रः क्षितिपाल-
शक्रः श्रीसोऽहोदेवः सुतवासुदेवः ॥ १२ ॥ शरणागतवज्रपंजरः परना-
रीषु सदा सहोदरः । व्रतसत्यपथे युधिष्ठिरः सततं वैरिवधूभयञ्जरः ॥
१३ ॥ स षोडशशतग्रामदेशं दुर्गपुरान्वितं । सोऽहोदेवे दिवं याति शास्त्रि-
तस्यानुसंभवः ॥ १४ ॥ त्यागे सूर्यसुतोपमोऽर्जुनसमः शौर्ये निकुंभान्वये
विख्यातः क्षितिपालभालतिलकः श्रीगोवनस्यात्मजः । श्रीमत्सिंघणदे-
ववैरिकरटी कंठीरवो यत्करो नन्द्यान्नंदसुन्दने ततमतिर्हेमाडिदेवश्चिरं
॥ १५ ॥ शांडिल्यवंशे कविचक्रवर्ती त्रिविक्रमोऽभूत्तनयोऽस्य जातः । यो
भोजराजेन कृताभिधानो विद्यापतिर्भास्करभट्टनामा ॥ १६ ॥ तस्यान्नो-
विंदसर्वज्ञो जातो गोविंदसन्निभः । प्रभाकरः सुतस्तस्यात् प्राभाकर
इवापरः ॥ १७ ॥ तस्यान्वनोरथो जातः सतां पूर्णमनोरथः । श्रीमान् म-
हेश्वराचार्यस्ततो जनि कवीश्वरः ॥ १८ ॥ तत्सूनुः कविवृन्दवन्दितपदः स-
द्वेदविद्यालताकंदः कंसरिपुप्रसादितपदः सर्वज्ञ (विप्रासदः) । यच्छिष्यैः
सह कोऽपि नो विवदितुं दबो विवादी क्वचित् । श्रीमान् भास्करकोविदः
समभवत् सत्कीर्त्तिपुण्यान्वितः ॥ १९ ॥ लक्ष्मीधराख्योऽखिलसूरिमुख्यो
वेदार्थवित्तार्किकचक्रवर्ती । क्रतुक्रियाकाण्डविचारसारो विशारदो
भास्करनन्दनोऽभूत् ॥ २० ॥ सर्वशास्त्रार्थदबोऽयमिति मत्वा पुरादतः ।
जैत्रपालेन यो नीतः कृतश्च विबुधायणीः ॥ २१ ॥ तस्यात्सुतः सिंघणचक्र-
वर्ती देवज्ञवयोऽजनि चंगदेवः । श्रीभास्कराचार्यनिबद्धशास्त्रविस्तार-

हेतोः कुरुते मठं यः ॥ २२ ॥ भास्कररचितग्रंथाः सिद्धांतशिरोमणिप्र-
मुखाः । तद्वंशस्तताश्चान्ये व्याख्येया मन्मटे नियतम् ॥ २३ ॥ श्रीसोन्हदे-
वेन मठाय दत्तं हेमादि (ना किंचिदिहापरिच्य) भूम्यादि सर्वं परिपाल-
नीयं भविष्यभूपैर्बहुपुण्यवृथै ॥ २४ ॥ स्वस्ति श्रीशके ११२८ प्रभवसंव-
त्सरे श्रीश्रावणे मासे पौर्णमास्यां चंद्रग्रहणसमये श्रीसोन्हदेवेन सर्व-
जनसन्निधौ हस्तोदकपूर्वकं निजगुह्यरचितमठायाग्रस्थानं दत्तम् ॥ त-
द्वया

इयां पाटणी जे कणे उघटे तेहाचा जो सिंदू जो राउला होता योहका
पासीं तो मढा दिन्हला ब्राह्मणजेंदिकहे ब्रह्मोत्तरतं ब्राह्मणीदिन्हले ॥
ग्राहकापासिं दामाचा वीसोवा असु पाठी गिधवग्राहकापासि ॥ पंचपो-
फलीग्राहकापासि पहिवहिले आधणे आदाणा चीली मठा दिन्हला
जेतिघाणे वाहति तेतियां प्रतिपलि पली तेला । जेमविजेने मढीचे नमाय
नवावेमापा उगठा अर्ध अर्ध मापाचे हारिभूपाचे स्तूक तथा भूमिः चतु-
राघाटविशुद्ध ३०६ ग्राम — बाले कामतामध्यच था कल पंडिता-
कालतु — मीचउरा धामोजीचीसोढीआ ॥

TRANSLATION.

Obeisance to the god of wisdom (Gaṇâdhipati)—four or five syllables lost—perfection—four syllables lost—moon and earth—about twenty-five syllables lost. Stha—two syllables lost—dû—one syllable lost—tra—preservations—the planets and stars¹—three syllables not well made out.

Glory to Bhâskarâchârya, eminently skilled in Bhâtta,² estimable in Sâṅkhya, original in the Tantra, deeply conversant in the Vedas, great in the mechanical arts, independent in poetical metre, intimate with the Vaiṣeṣhika Śâstra, like Prabhâkara³ in the Prâbhâkara system, a Kavi in poetry, like the three-eyed god (Śâmba) in the three subtle sciences, such as mathematics,⁴ whose feet are bowed to by the learned.

Peace to the prosperous Yadu dynasty, with everything appertaining to it; (a dynasty) in which, for the preservation of the world, the independent Viṣṇu assumed being.

¹ Gaganachara.

² The Mīmāṃsâ as propounded by Bhâtta Kumârila.

³ In the Mīmāṃsâ Śâstra. Prabhâkara and Murâri Miṣra were the founders of two other schools, besides Kumârila Bhâtta.

⁴ The three sciences (Skandhas) are Gaṇita, Horâ, and Sanhitâ.

In it the illustrious King Bhīlāma flourished, who was a lion attacking the furious masses of noisy Gurjara King-elephants, who was skilful in bursting the powerful breasts of the Lātas, a thorn in the heart of the Kārṇātas, and a crown-jewel among kings; Jaitrapāla flourished, who was the destroyer of the happiness of the Āndhra females with their husbands.

A portion of the Lord of Lakshmi, who escaped (or saved himself), from the world, descended from Jaitrapāla, (and) who gained the utmost power on the field of battle, a controller of the earth, —Singhaṇa; who in the van of battle threw down the lord of Mathurā, the king of Benares; a young child of whose servant defeated the warrior Hammira. Formerly Purushottama (Vishṇu) for the benefit of the world became personified in the Yadu family. He (Purushottama) conquers all the world and protects me. Now the description of the subordinates. May blessings attend the illustrious solar race, in which the king Nikumbha was born, whose descendant was Rāma. Of this race was the king Kṛṣṇarāja, a conqueror of kings, devoted solely to the Lord of Lakshmi; whose mind is expanded in revering gods and Brāhmaṇas, who has no equal in the qualities of bravery, liberality, discrimination, and prowess; and who by love (gained) the title of Dharmarāja, possessed by the best of the Pāṇḍavas. From him (Kṛṣṇarāja) Indrarāja obtained his bodily descent, who was of large intellect exalted by prowess, a hero who filled the heads of the wives of his enemies with terror. His son, discreet among the virtuous, and a high-priest to give the vow of widowhood to the wives of feudatories, whose qualities are exalted, a store-house of merit, clever on horseback like Revanta, was Govana; on seeing whom, Cupid, who is proud of his beauty, abandoned his bodily form.

From Govana, the ocean of jewels, issued Sonhadeva, the praise of whose merit is wide-spread, who conquered the circle of enemies, an Indra among kings, who praises Vasudeva, a castle¹ of adamant to those who sought his protection, who looked upon others' wives as his sisters, a Yudhishṭhira . . . in vows and in the path of truth, and ever a fearful fever to the wives of his enemies.

His younger brother, Hemādideva, rules a country of 116 villages,² with forts and towns, since Sonhadeva went to heaven;³ in liberality like the son of the Sun (Karna), in bravery like Arjuna, celebrated in the race of Nikumbha, the mark on the forehead of kings (*i.e.* chief among kings?), the son of Govana, whose hand is a

¹ Cage, in the original.

² Or 1600 villages.

³ The following adjectives are equally applicable to the brothers Sonhadeva and Hemādideva.

lion to the elephant enemies of Singhaṇa, whose mind is expanded in the good son of Nanda (Kṛṣṇa), may he be happy for a long time.

In the Śaṇḍilya family was Trivikrama, best of poets. His son was Bhāskara-bhaṭṭa, to whom Bhojarāja gave the title of Vidyāpati. From him was Govinda-sarvajña, like Govinda. From him was a son Prabhākara, as if he was another sun. From him was Manoratha, a fulfiller of the wishes of the virtuous; from him was the great poet Maheṣvarāchārya, whose feet are embraced by assemblages of poets, a bulb of the excellent creeper of the science of the Vedas, who obtained the favour of the feet of the enemy of Kansa (Kṛṣṇa), who has a seat among (or who has conquered) the Brāhmaṇas with universal knowledge, with whose disciples there is nowhere any person to dispute. Full of good fame and merit was Bhāskara. The learned Bhāskara's son was Lakṣmīdhara, the first among the learned; acquainted with the meaning of the Vedas, the first among metaphysicians, and skilful in the knowledge of sacrificial ceremonies. Jaitrapāla, having recognized him as well-versed in the meanings of all the Śāstras, took him from this pura (town) and made him the chief of Pandits. His (Lakṣmīdhara's) son was Changadeva, the best of the astronomers and astrologers at the court of Singhaṇa Chakravartin. He (Changadeva) constructs the college (Maṭha) for the spread of the treatises composed by Bhāskarāchārya. The works composed by Bhāskarāchārya, the chief of which is the Siddhānta Siromaṇi, and the works of his ancestors and descendants, ought to be duly studied in my college. Sonhadeva granted ground, with gold, etc., to the college; others have also made some grants (?). Future kings ought to protect this, for the increase of merit. The syllable *ṣa* between two syllables follows *swasti*. In the year 1128 Śaka in the year Prabhava, in the Śrāvaṇa month, full moon, on the occasion of a lunar eclipse, Sonhadeva, in the presence of the people, having thrown water into the hands, granted¹ to the college of his preceptors as follows. (The succeeding portion is mostly written in a form of old Marathī, corresponding to the Khāndeṣī. This is more difficult to make out than Sanskrit; but the purport appears to be:) certain rates were levied on the oil-mills, sugar manufactories, on the total revenue collected (?) and on the corn, for the support of the college. (Again in Sanskrit:) in the same way, ground distinguished by the four boundaries 306 (?). Villages (again Khāndeṣī)—two syllables lost—some letters have not been made out . . . Pandits . . . chauras of ground . . . Dhāmoji's ground (?).

¹ A syllable lost: the word means a place, but here is evidently intended to mean the first gifts, Agradāna.